

ADVANCED-BASED ARTIFICIAL INTELLIGENCE CAPABILITIES  
EMPOWERMENT OF THE UNITED STATES  
NATIONAL SECURITY

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MASTER OF MILITARY ART AND SCIENCE  
General Studies

by

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## ABSTRACT

ADVANCED-BASED ARTIFICIAL INTELLIGENCE CAPABILITIES  
EMPOWMENT OF THE UNITED STATES NATIONAL SECURITY, by Shannon L.  
Gorman, 82 pages.

The twenty-first-century technological race includes many components; however, the technology of advanced-based artificial intelligence (AI) may be the most astonishing. The United States' adversaries, in particular China, are making a point to be the world's superpower in this technological advancement by 2030. The National Geospatial-Intelligence Agency (NGA) has a model of AI initiatives, data-centric technologies (such as advanced analytics) automation, deep learning, machine learning and human-machine teaming initiatives that other Department of Defense (DOD) components can emulate to reduce unnecessary repetitiveness and useless spending of national money and resources. This study explores the components of AI-based initiatives for successful establishment across the governmental apparatus to advance US national interests. Additionally, it compares the United States and China regarding AI, private sector innovation and ethical issues pertaining to AI; and lastly, 2018 NGA and Office of the Director of National Intelligence (ODNI) AI-based initiatives that will impact future decision-makers.

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## ACRONYMS

ABI	Activity-based Intelligence
AIM	Augmenting Intelligence using Machines
AI	Artificial Intelligence
BCG	Boston Consulting Group
DARPA	Defense Advanced Research Projects Agency
DL	Deep Learning
DOD	Department of Defense
GEOINT	Geospatial Intelligence
IARPA	Intelligence Advanced Research Project Activity
IC	Intelligence Community
ML	Machine Learning
NGA	National Geospatial-Intelligence Agency
ODNI	Office of the Director of National Intelligence
SOM	Structured Observation Management
USG	United States Government

## CHAPTER 1

### INTRODUCTION

If we fail to adapt . . . at the speed of relevance, then our military forces, our Air Force, will lose the very technical and tactical advantages we've enjoyed since World War II.

— Secretary of Defense James N. Mattis, quoted in Vivienne Machi, “Mattis: More Engagement Needed with Industry, Allies”

#### Introduction

The National Geospatial-Intelligence Agency (NGA) is the principal Department of Defense (DOD) intelligence agency that possesses and processes “Geospatial” information. The agency is aggressively pursuing innovative solutions regarding artificial intelligence (AI)-based enhanced capabilities, automation, and human-machine teaming augmentation. NGA will utilize these advancements to “automate routine GEOINT tasks and corporate business processes and invest in technology-transfer opportunities from commercial or nontraditional sources as appropriate.”<sup>1</sup> The agency has the proper organizational cultural vision, goals, and mindset, to pursue creative public-private sector partnerships in innovation while adapting to change in an ever increasingly abstruse and technological world. The DOD sister-service components can emulate NGA’s model and further their advanced-based initiatives by contributing data and utilizing the agency’s epistemological organization to remain viable. In a time, where there is significant peer rivalry across the competitive continuum of technological advancement from China and Russia that is challenging the United States National Security interests, there needs an adequate model and framework for governmental entities to utilize AI-based

technological advancements to empower senior policy-makers and the warfighter in sound timely decision-making.

### Assumptions

One of the assumptions made in this research is that the Republic of China advanced AI-based initiatives will continue to progress, outpace, and dominate the globe in the near-term. China has had a two to three-year jump on its near-peer and peer competitors across the AI-based competitive spectrum. Due to the state-owned structure of the Republic of China, it is easier to implement mandated initiatives.

Another assumption is that NGA is an exemplary agency that has the structure, data, and framework to be the model for other DOD components advanced AI-based initiatives regarding automation, machine intelligence, deep learning (DL), and human-machine teaming.

Organizations across the governmental spectrum can intelligently implement AI-based initiatives in its apparatus. There are ample governmental organizations that are starting to apply AI-based strategies. Common themes for proper application are applicable for organizations to model and then customize fittingly and sufficiently in its organization for success.

### NGA Utilizing Advanced Methods to Meet National Security Interest in 2030

According to the *National Security Strategy 2017* and the *National Defense Strategy 2018*, the national security interests, competitive advantage, and prosperity are to ensure the nation's power projection continues to propagate in the decades to come in

an oppositional, competitive volatile operational environment from peer and near-peer adversaries. *National Defense Strategy* highlights are as follows:

Defend the homeland from attack;

Sustain Joint Force military advantages, both globally and in key regions;

Deter adversaries from aggression against our vital interests;

Enable US interagency counterparts to advance US influence and interests;

Maintain favorable regional balances of power in the Indo-Pacific, Europe, the Middle East, and the Western Hemisphere;

Defend allies from military aggression and bolstering partners against coercion, and equitably sharing responsibilities for the common defense;

Dissuade, prevent, or deter state adversaries and non-state actors from acquiring, proliferating, or using weapons of mass destruction;

Prevent terrorists from directing or supporting external operations against the United States homeland and our citizens, allies, and partners overseas;

Ensure common domains remain open and free;

Continuously deliver performance with affordability and speed as we change Departmental mindset, culture, and management systems; and

Establish an unmatched twenty-first century National Security Innovation Base that effectively supports Department operations and sustains security and solvency.<sup>2</sup>

Revolution in military affairs is described as “the assembly of a complex mix of tactical, organizational, doctrinal, and technological innovations in order to implement a new conceptual approach to warfare or to a specialized sub-branch of warfare.”<sup>3</sup> The proper integration and synchronizing of advanced technology can promote the achievement of national interests of the United States, whether the world is currently in a revolution in military affairs in the twenty-first-century warfare.

In order to achieve the strategic, operational, and tactical objectives based on national interests, the intelligence community needs to work more coherently and intelligently with our allied and multinational partners to achieve and maintain superiority in a multi-domain environment, such as the electromagnetic spectrum, information, air, land, sea, space, and cyberspace domains. Further, we need to look at the unclear concurrent battlefield from a multi-dimensional perspective. To achieve the nation's interests, the United States Government (USG) need to employ all capabilities available to project influence and national power on the adversaries during the next decade.

The National Geospatial-Intelligence Agency is one of seventeen intelligence components across the intelligence community. NGA “delivers world-class geospatial intelligence (GEOINT) that provides a decisive advantage to policy-makers, warfighters, intelligence professionals, and first responders. NGA is the lead federal agency for GEOINT and manages a global consortium of more than 400 commercial and government relationships.”<sup>4</sup>

NGA's expertise of geospatial intelligence known as “GEOINT [which] is the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the Earth. GEOINT consists of imagery, imagery intelligence and geospatial information.”<sup>5</sup>

NGA's Strategy 2025 describes the agency's overall mission is to “provide GEOINT for our nation's security.” The agency is able to complete its mission and remain viable by being committed to areas of data integration and relentless innovation.<sup>6</sup>

Assisting its customers across the full spectrum in the range of military operations, as well as, providing senior policy-makers with pertinent information, GEOINT brings significant attributions in time and space. NGA employs the full force of GEOINT capabilities through working with government and allied partners, industry, and academia. The nation can achieve its objectives by establishing opportunities across the strategic, operational, and tactical application levels that provide actionable intelligence to leadership, which allow them to make informed, sound decisions at every level of the decision-making spectrum with greatly compressed timelines.

Due to emerging technologies and threats by our various adversaries, the nation must adapt and adjust accordingly. Adversaries at all levels have developed sophistication in various realms, such as, in the electromagnetic spectrum and cyberspace realm, firepower and range capacities, accuracy and precision progress, and informational warfare headways, to name a few. To respond accordingly, the USG national interests must adapt and adjust by providing information to the customers in a more timely fashion. So how does the nation move from the current operating demands to future operating demands to deter or defeat the enemy? The focus should be on the element of time. Time is the element in which we can best defeat the adversary in the various competitive domains during any future engagements. That is, providing customers with sound data and information, to be utilized at the appropriate level to allow customers to execute their mission requirements successfully.

National Technical Means and commercial platforms provide data and information to customers at the senior military and policy-makers level to assist in formulating a national strategy. Likewise, various information is provided to the elements

at the tactical level, which support their level of operations. NGA will need to provide the customer, who works in a time-constrained, ambiguous and chaotic environment, with timely data and information. Further, in order for the customer to maintain a position of relative and decisive advantage, both senior leaders and the warfighter must maneuver significantly quicker (speed of decision-making, the speed of action, operational tempo and momentum, the agility of action, quality and competency of an interdependent joint force) than the adversary. How will the nation accomplish this? The proper incorporation of robust automation can accomplish this task as well as AI-enabled capability integrated into the daily practices of the GEOINT processes.

The DOD has established the Joint Artificial Intelligence Center. The purpose being the “overarching goal of accelerating the delivery of AI-enabled capabilities, scaling the Department-wide impact of AI, and synchronizing DoD AI activities to expand Joint Force advantages.”<sup>7</sup> Overall, the purpose of this agency inaugurates new collaboration across the Joint DOD Community and ensures proper “execution in AI that includes the tools, shared data, reusable technologies, processes, and expertise to enable rapid delivery and Department-wide scaling of AI-enabled capabilities.”<sup>8</sup>

To meet DOD advanced-enabled capability needs, NGA’s commercial components established a focus on “emphasizing innovation in the face of a rapidly advancing technological landscape. The strategy focuses on partnerships, information assurance and the integration of commercial GEOINT with automation and artificial intelligence.”<sup>9</sup> The key to this strategy is the assimilation of partnerships interrelated in governmental and non-governmental areas, as well as, ensuring the quality and accuracy of information provided by the entities. The establishment of these areas will safeguard

the guarantee that “strategy meets the advancing operating environment and reflects the priority of sustaining American leadership through research, technology, and innovation outlined in the National Security Strategy.”<sup>10</sup>

Consequently, it is imperative NGA’s calculus ensures the future of incorporating the vitality of AI-enhanced initiatives that will improve customer success; in addition, maintain the customer’s strategic and tactical competitive advantage in a multi-domain fluid environment. However, the amount of data that will be available for the NGA team to analyze will be insurmountable. According to the previous Director of NGA, “6 million imagery analysts [are needed] to keep up with that kind of [data] flow” from both classified government satellites and unclassified commercial satellite systems.<sup>11</sup>

It is imperative to appreciate the problematic context and related issues concerning big data. “Today’s worldwide geospatial data production is measured in exabytes—a single exabyte equals one million terabytes. For context, digitizing every book within the Library of Congress would produce about 10 terabytes. The sheer volume of geospatial data—much of it relevant to NGA’s national security mission—highlights how large a big data problem it poses.”<sup>12</sup> The amount of GEOINT data an intelligence agency would work with would be voluminous. To deal with this problem-set, NGA has initiatives that establish offices and hire the best and brightest talent in the Silicon Valley area to assist the agency with the issue.<sup>13</sup>

There is still the element of deception that NGA will need to prepare for by letting the AI systems conduct analytics of imagery for the agency. Case in point, according to Valerie Browning, Director of the Defense Sciences Office at the Defense Advanced Research Projects Agency (DARPA), “It’s important that we understand the limitations

of where AI is today,” she said on a panel discussing the relationship between technology and human analysis. “There are numerous examples of where the current state of the technology can be very easily fooled and unfortunately, we don’t really quite understand the mechanisms. We have some hints.”<sup>14</sup>

This thesis will focus its scope of research on United States DOD initiatives, with an in-depth focus on NGA’s AI-enhanced capabilities and initiatives; as well as, NGA *Strategy 2025*. Additionally, compare and analyze China’s aggressive approach to be the world leader in AI by 2030. Next, analyzing the leaders in the AI industry, such as Google’s DeepMind AI Alpha variants initiative. Also, this thesis will look at the implications of utilizing AI enhancements and the ethical considerations involved. Finally, the relevant body of work is limited to approximately the last thirty years.

### Definitions

The terms utilized in this thesis research paper are defined and explained in the section below. Specific definitions are provided to elucidate the researcher’s intended meaning in utilizing the terms below.

#### Important Definitions:

Artificial Intelligence (AI)—The Intelligence Community (IC) defines AI as “the branch of computer science focused on programming machines to perform tasks that replicate or augment aspects of human cognition,” a term coined in the 1950s. At that time, scientists began to harness nascent computer capabilities to perform advanced information manipulations much more rapidly. In particular, it was realized that computers could be used not only to perform calculations on numbers, but also to perform inference on other types of information such as symbols, data, and text. This popularized the idea of a “thinking machine” that could, if filled with all the right knowledge and rules for access and retrieval, simulate a human response. Technologies and research areas generally considered to be sub-domains to AI: Automated Planning and Scheduling • Computer Vision • Decision Support, Predictive Analytics, and Analytic Discovery • Distributed

Artificial Intelligence/Agent-based Systems • Human Language Technologies • Identity Intelligence • ML • Process Modeling • Robotics/Autonomous Systems.<sup>15</sup>

Automation—Computational systems designed to perform repetitive tasks.<sup>16</sup>

Foundation GEOINT—GEOINT content describing the basic parameters of the geographic and cultural features of geospatially referenced activities on the Earth. It includes aeronautical, controlled imagery, elevation, geodetic, geographic boundary, geographic name, human geography, maritime, and topographic feature data.<sup>17</sup>

Future GEOINT Environment—An end-to-end environment (system of systems) which brings knowledge, analysis, and collection together simultaneously to discover what we cannot know any other way; synonymous with persistent GEOINT environment.<sup>18</sup>

Geospatial Information—Information which identifies the geographic location and characteristics of natural or constructed features and boundaries on the Earth, including statistical data; information derived from, among other things, remote sensing, mapping, and surveying technologies; and mapping, charting, geodetic data, and related products.<sup>19</sup>

Geospatial Intelligence (GEOINT)—The exploitation and analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the earth[sic]. GEOINT consists of imagery, imagery intelligence, and geospatial information.<sup>20</sup>

Machine Learning (ML)—The field of study interested in building computational systems that can improve their own performance of some task.<sup>21</sup>

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<sup>1</sup> Director, National Geospatial-Intelligence Agency (NGA), *NGA Strategy 2025* (Springfield, VA: National Geospatial-Intelligence Agency, 2018), 5, accessed 13 March 2019, <https://www.nga.mil/Documents/>.

<sup>2</sup> Department of Logistics and Resource Operations, “F104: Determine, Document, and Resource Organizational Authorizations” (PowerPoint Presentation, Force Management Course, US Army Command and General Staff College, Fort Leavenworth, KS, 2018), slide 4.

<sup>3</sup> MacGregor Knox and Williamson Murray, ed., *The Dynamics of Military Revolutions, 1300-2050* (Cambridge, NY: Cambridge University Press, 2009), 12.

<sup>4</sup> Office of the Director of National Intelligence (DNI), “How the IC Works/Our Organizations/National Geospatial-Intelligence Agency,” INTEL.gov, accessed 13 March 2019, <https://www.intelligence.gov/how-the-ic-works/our-organizations/414-nga>.

<sup>5</sup> National Geospatial-Intelligence Agency (NGA), “Mission,” accessed 14 March 2019, <https://www.nga.mil/ProductsServices/Pages/default.aspx>.

<sup>6</sup> Director, NGA, *NGA Strategy 2025*, 2.

<sup>7</sup> Susan B. Cassidy, “Covington Artificial Intelligence Update: Department of Defense Establishes Joint Artificial Intelligence Center,” *National Law Review*, 16 July 2018, accessed 13 March 2019, <https://www.natlawreview.com/article/covington-artificial-intelligence-update-department-defense-establishes-joint>.

<sup>8</sup> Ibid.

<sup>9</sup> National Geospatial-Intelligence Agency (NGA), “Releases Updated Commercial GEOINT Strategy,” National Geospatial-Intelligence Agency News Release, 2 August 2018, accessed 17 March 2019, <https://www.nga.mil/MediaRoom/PressReleases/Pages/CommercialGEOINTstrategy.aspx>.

<sup>10</sup> Ibid.

<sup>11</sup> Carten Cordell, “NGA Embraces the Promise of AI, But Not Without the Human to Match,” *FedScoop*, 28 September 2018, accessed 27 April 2019, <https://www.fedscoop.com/nga-embraces-promise-ai-not-without-humans-match/>.

<sup>12</sup> Frank Konkel, “NGA Launches Bold Recruitment Plan to Hire Silicon Valley’s Best,” *Nextgov*, 8 December 2017, accessed 27 April 2019, <https://www.nextgov.com/analytics-data/2017/12/nga-launches-bold-recruitment-plan-hire-silicon-valleys-best/144410/>.

<sup>13</sup> Ibid.

<sup>14</sup> Cordell, “NGA Embraces the Promise of AI, But Not Without the Human to Match.”

<sup>15</sup> Office of the Director of National Intelligence, *The AIM Initiative: A Strategy for Augmenting Intelligence Using Machines* (Washington, DC: Government Printing Office, 2019), 13, accessed 10 May 2019, <https://www.dni.gov/files/ODNI/documents/AIM-Strategy.pdf>.

<sup>16</sup> Ibid., 14.

<sup>17</sup> National Geospatial-Intelligence Agency (NGA), *NGA GEOINT CONOPS 2022* (Springfield, VA: National Geospatial-Intelligence Agency, 2018), 19.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid.

<sup>20</sup> Ibid.

<sup>21</sup> Office of the Director of National Intelligence, *The AIM Initiative*, 15.

## CHAPTER 2

### LITERATURE REVIEW

Their investments threaten to erode U.S. military advantage, destabilize the free and open international order, and challenge our values and traditions with respect to human rights and individual liberties.

— Department of Defense,  
*Summary of the 2018 Department of Defense Artificial Intelligence Strategy*

This thesis will be limited to only the utilization and examination of unclassified material. The intended purpose will allow this research to be approved for public release and distribution is unlimited. The author intends to allow as many readers at the unclassified level to enhance partnerships, promote collaboration, and educate others regarding the vital area of advanced AI-based initiatives and promote the US national security interests.

This research necessitates the author's examination of various sources of literature review to comprehend what capabilities are required to implement adequate advanced AI-based initiatives appropriately across the governmental spectrum to promote the United States' national interests. Chapter 2's literature review comprises of several focus areas to outline the examination of this volume of knowledge. The sources utilized for the literature review is distributed into various components discussed in the following paragraphs.

*The US 2017 National Security Strategy* provides strategic guidance and nests downward to all subordinate components. The DOD incorporates the *National Security Strategy* to produce the 2018 *National Defense Strategy* for all governmental defense departments. The big take away from the *National Defense Strategy* for this body of

research is that the national leadership's guidance is to "Establish an unmatched twenty-first century National Security Innovation Base that effectively supports Department operations and sustains security and solvency."<sup>1</sup> This allows clear guidance to the government apparatus that technological-based advancements and innovation implementation are essential for the success of the US national security.

The second component utilized in the review of literature pertains to unclassified NGA information, such as the agency's press releases. The body of information includes NGA *Strategy 2025*, the Broad Agency Announcement (BAA) for Boosting Innovative GEOINT (BIG) Topic Area 10, and the *Commercial GEOINT Strategy –2018*. The utilization and examination of this research material will provide the context of how NGA is strategically implementing innovation, advanced technological-based initiatives such as AI-enhancements, ML, and human-machine teaming augmentation to meet the US' national security interests.

The third component utilized in the review of literature is the examination of the 2018 Boston Consulting Group study titled, "Mind the (AI) Gap: Leadership Makes the Difference." This study focuses on analyzing why the People's Republic of China is arriving at more success than other peer rival nation-states across the competition continuum. The review of this case study will bring into context why China is progressing faster in AI-based initiatives than other rivals. Additionally, a literature review of China's AI-based initiatives, such as the 2017 New Generation Artificial Intelligence Development Plan, which promotes and empowers the Chinese manager's approach regarding AI-based implementation.

The fourth part utilized in the review of literature is the examination of various articles relating to the US national security interests, ethical considerations, and big technology. Further, the examination of the literature will provide clarity regarding how the three components are interconnected. The scrutiny of the literature will analyze why Google did not renew the Pentagon contract regarding the AI-based Project Maven initiative. This provides a proper foundational comprehension of how this type of action of public-private cooperation ultimately impacts the other components of the USG regarding similar AI-based initiatives. This review and examination of research will put into context the concerning issues pertaining to the United States and like-minded Western democracies, which will be subject to technological limitations based on considerations such as civil liberties, ethical considerations, and the philosophy of Just War Theory.

The fifth component utilized in the review of literature is the analysis regarding Google's DeepMinds AI Program. The examination of the research intends to provide information pertaining to Google's DeepMinds AI Program, which substantially impacted China's leadership and other nations' mentality to pursue AI technological advantage. In addition, an examination of the *Nature* case study regarding "Mastering the Game of Go Without Human Knowledge," which details how DeepMind utilized advancements in AI algorithms to further each AlphaGo variant.

The sixth component utilized in the review of literature is the analysis of Macy Bayern's *TechRepublic* article, regarding "The 3 Most Overlooked Limitations of AI in Business." The purpose of the review in the research is to assist governmental entities in their understanding regarding the limitations of AI-based implementation. Additionally,

this examination provides an understanding of the importance and basis for AI-based advancements; pertaining to data structure and the consideration the consequences of the proper data structure of an organization.

The seventh component utilized in the review of literature is the analysis of AI-based initiatives across the US governmental spectrum. The examination will look at the components from the government, including the US Air Force, as well as IARPA and DARPA. Next, an analytic review of NGA's AI leadership speaking at the Federal Executive Forum regarding technological advances in ML and AI in government, which assists in understanding the successes and challenges of AI-based implementation for DOD components. Additionally, an analysis of the commercial vendor, Citygate GIS processes to overcome challenges pertaining to AI-based initiatives.

Finally, the last component of the literature review is to examine AI-human-machine teaming augmentation. The research's examination will review a *YouTube Ted Talk* discussing this future augmented trinity relationship titled, "The Incredible Inventions of Intuitive AI." The concluding analysis will entail a research experiment, named the HIVE, conducted by utilizing the three components of AI-human-machine teaming augmentation.

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<sup>1</sup> Department of Logistics and Resource Operations, "F104: Determine, Document, and Resource Organizational Authorizations" (PowerPoint Presentation, Force Management Course, US Army Command and General Staff College, Fort Leavenworth, KS, 2018), slide 4.

## CHAPTER 3

### RESEARCH METHODOLOGY

Continued American leadership in AI is of paramount importance to maintaining the economic and national security of the United States and to shaping the global evolution of AI in a manner consistent with our Nation's values, policies, and priorities.

— President of the United States, Donald J. Trump,  
*Executive Order on Maintaining American Leadership in Artificial Intelligence*

The research methodology utilized in this thesis begins by analyzing the 2017 *National Security Strategy* and how the Trump Administration update of the national strategy makes an emphasis ensuring the US maintains its competitive advantage in the technological realm. Next, the research will look at the strategic level of the DOD AI initiatives down to the operation and tactical levels and how AI is currently incorporated.

The primary question of this research analyzes whether advanced AI initiatives at NGA is a sufficient base model for other components of the DOD to shadow and ensure there is no unneeded repetitiveness across governmental components. The examination of this study will necessitate a review of the private sector's Deepmind Project AI Program to be examined to detail how rapid advancements of AI initiatives are progressing, almost exclusively since 2015.

Additionally, a comparison of the Chinese and USG AI governmental policies and actions is incorporated into this research. The communist regime of China has had a considerable head start in pursuing AI advancements compared to its competitors. The examination will scrutinize why China is winning the AI race and how this jump start impacts US strategic interests, as well as what is needed to ensure the United States of America retains its competitive technological advantage across the globe.

The DOD was blindsided by the Google Corporation when the organization pulled out of the Pentagon's Unmanned Aerial Vehicle AI initiative, named the Maven Project. Many reasons for this were apparently due to ethical reasons from the employees and ultimately the organization's senior leadership concerns. As the USG enters into new contracts, governmental leadership needs to be cognizant of ethical issues regarding AI implementation across DOD components that will impact future initiatives.

Next, the utilization of NGA announcement of the updated commercial GEOINT strategy, released on 2 August 2018, detailed to see where the intelligence agency stands with its initiative to incorporate the AI technology. Further, research of NGA's new 2025 strategy to determine if NGA's role model of AI advanced analytics is an accurate and precise conclusion.

Next, there is thesis research regarding the new Intelligence Community initiative recently released by the Office of the Director of National Intelligence Augmenting Intelligence using Machines to incorporate the AI-based technology across the intelligence community.

Finally, detailed research of the utilization by academia and the private sector in regards to advanced AI analytics will be completed to assist in answering the primary and secondary research questions.

This paper's research is more reflective than scientific, which leads to the employment of a qualitative methodology in nature, relatively different than a quantitative research methodology. The research in this thesis relies on a deductive collection of information and data, review of historical commercial sector technological progress, an examination of governmental, commercial partnerships and interaction, to

build a better understanding. Further, this research relies on information gathered by analyzing NGA strategy and initiatives, as well as governmental organizations AI initiatives. The thesis' research and primary content analysis are accomplished by examining unclassified documents generated by NGA press releases, as well as service component information, for instance, US Army Training and Doctrine Command information. The information evaluated will assist in creating a foundational understanding to determine whether NGA is a reliable actor to follow in setting up other governmental AI initiatives. This thesis secondary content analysis will be derived from sources, such as YouTube Ted talks, books, scholarly studies and articles, Federal Radio information, magazine and newspaper articles for current and reliable information.

## CHAPTER 4

### ANALYSIS

To sustain our advantage, GEOINT must support autonomous military operations, human-machine teaming, humanitarian crisis, complex sense-making, and strategic policy actions.

— Director, National Geospatial-Intelligence Agency,  
*NGA Strategy 2025*

The primary purpose of the thesis' examination is to explore the research question: should the various governmental agencies and DOD sister-service components, which lag in AI innovation and adaptation, profitably use NGA's AI-initiatives as a lead model, partner with NGA in AI development, and contribute their data to unified AI efforts utilizing the Agency's epistemological and organizational advantages to assist them to remain apace? The subordinate research questions pertaining to this thesis are as follows:

1. What is China's strategic AI Initiative?
2. What are Google's AI Initiatives?
3. How have AI-advancements evolved and how the capabilities are utilized throughout the DOD and other government forums?

Chapter 4 of this thesis is an analysis of the needed components it will take to successfully implement enhanced AI initiatives within the architecture of a governmental agency and explain those various restrictions that will limit efficacious employment. Five areas will contribute to the analysis of answering the primary and subsequent research questions in this thesis paper.

The first component to be analyzed is NGA's leadership, particularly recently departed Mr. Robert Cardillo's philosophy and vision of advanced technological innovations and initiatives such as machine learning, AI-enhancements, and human-machine interaction. Additionally, the research will analyze NGA's leadership proponent philosophy of collaboration with the private sector and the promotion of developing public-private sector partnerships to bolster effectiveness across the enterprise. Next, this thesis will analyze NGA's issue regarding the exponential propagation of data by small satellites, also known as smallsats, as well as advanced intelligence analytics, such as activity-based intelligence's impact on the agency's analysts and how the organization plans on dealing with the vast information problem.

Secondly, China is notably the forerunner as a nation which is aggressively incorporating AI advanced technologies within every aspect of its societal, military, and governmental frameworks. The second component of the research in chapter 4 will analyze the Chinese President's declaration of technological dominance by the year 2030 and the magnitudes of initiatives China is pursuing to advance their positional and national interests globally. Moreover, examination of the 2018 Boston Consulting Group's (BCG) study titled, "Mind the (AI) Gap: Leadership Makes the Difference," to assist in determining as to why China is achieving greater success than other near-peer and peer competitor nation states and how the communist regime's success will impact the US national interests.

Thirdly, the next component in the research to be analyzed is how western democracies and constitutional republic governments will be subject to technological advancement limitations based on considerations of civil liberties, ethical considerations,

and the philosophy of Just War Theory. Further, analysis of how the US Government is finally taking action in regards to the direction of AI-based enhancements. Additionally, study to determine how China's strategy and state-owned companies are utilizing their influence in weak or failed states that will ultimately hinder the US and democratic allied nation's security interests across the globe. China is utilizing technological advancements to promote facial recognition, social credit scores to push its state-controlled authoritarian ethics, values, and morality; hence, the USG needs an appropriate strategy to counter China's advanced AI strategies and initiatives. Lastly, how the organization, Google LLC, blindsided the DOD by withdrawing from the Pentagon's Project Maven initiative, as well as how this type of action of public-private cooperation extraction ultimately impacts the other components of the USG regarding similar initiatives.

Fourth, this paper's research will look at Google's DeepMinds AI Program as a case study, which impacted China's leadership and other nation states' mindset to get on board to pursue this technological advantage.

Next, chapter 4 of this research will analyze the limitations of artificial intelligence-based initiatives. Further, the section will consider the consequences of the proper data structure of an organization. This provides an understanding foundation for AI-based advancements pertaining to the data structure.

Additionally, this paper's research will provide an examination of AI-based initiatives across the US governmental spectrum. The analysis will look at the components from the government including the US Air Force as well as the Intelligence Advanced Research Project Activity (IARPA), DARPA, and NGA. This research will provide an understanding of the type of AI-based initiatives that are utilized in the

government sector. Additionally, it will examine the commercial vendor, Citygate GIS processes to overcome challenges to AI-based advances that are utilized in the governmental sector and how the private sector is assisting them to overcome initiative issues.

Lastly, this thesis will explore academic research utilization of artificial intelligence-based collaboration with human and robotic mechanics. This examination demonstrates how industry and academia are experimenting and utilizing AI-based advancements that will impact the human-machine teaming efforts.

### Artificial Intelligence-based Capabilities

There are many differentiating opinions of what is AI. Corporations are pushing smart-enabled devices such as Apple HomePod, Apple Siri, Google Home, Amazon Alexa, and the Amazon Echo as AI-advanced devices. However, for the context of this body of knowledge, the author will utilize the IC's definition of AI.

According to the ODNI's Augmenting Intelligence using Machines (AIM) Initiative, which is the IC's strategic focus for the augmentation of intelligence utilizing machines. The community's definition of AI is

“the branch of computer science focused on programming machines to perform tasks that replicate or augment aspects of human cognition,” a term coined in the 1950s. At that time, scientists began to harness nascent computer capabilities to perform advanced information manipulations much more rapidly. In particular, it was realized that computers could be used not only to perform calculations on numbers, but also to perform inference on other types of information such as symbols, data, and text. This popularized the idea of a ‘thinking machine’ that could, if filled with all the right knowledge and rules for access and retrieval, simulate a human response.<sup>1</sup>

The examination of the author's research pertains predominantly on AI-based capabilities, ML, and human-machine augmentation teaming. The ODNI and the IC

include “Technologies and research areas generally considered to be sub-domains to AI,” such as automated planning and scheduling, computer vision, decision support, predictive analytics and analytic discovery, distributed AI/agent-based systems, human language technologies, identity intelligence, ML, process modeling, as well as robotics/autonomous systems.<sup>2</sup> The future success of ensuring the US maintains its overmatch in the competitive and conflict continuums, as well as promote the NSS interests, is to adequately and succinctly incorporate these advanced-based technologies appropriately across the governmental spectrum.

The National Geospatial-Intelligence Agency  
to Harness Data-Centric Technology

This section intends to provide context regarding information pertaining to NGA’s philosophy and vision of utilizing advanced-based technological innovations and initiatives such as AI-based enhancements, utilization of ML, and human-machine interaction. This provides a basis to properly understand future agency initiatives and collaboration with the private sector to bolster effectiveness across the enterprise. Additionally, this section provides a basis to properly understand the problematic concerns regarding how NGA plans on dealing with the vast data problem in the near future.

Various components of the private sector and government agencies at all levels are enthusiastic about the prospects of utilizing AI-based enhancements, as well as other closely related technological advancements. Advances of these technologies in the private sector are proliferating and will eventually affect society, military, and the government at various levels. Major Christopher Telley’s item in the Land Warfare

Paper, titled “The influence Machine: Automated Information Operations as a Strategic Defeat Mechanism,” highlights an established AI expert, Andrew Ng, who explains “[j]ust as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don’t think AI will transform in the next several years.”<sup>3</sup> Leaders within the intelligence community are implementing many bold initiatives about their agency.

The National Geospatial-Intelligence Agency leadership would like to utilize ML to more effectively and efficiently analyze the vast increase amount of imagery data to enable NGA analysts to accomplish more pertinent advanced geospatial-intelligence analytics. That is, “Instead of analysts staring at millions of images of coastlines and beachfronts, computers could digitally pore over images, calculating baselines for elevation and other features of the landscape.” NGA’s automation and AI-enhanced initiatives have greater determination and expectations for the agency to achieve “NGA’s goal, which is to establish a ‘pattern of life’ for the surfaces of the Earth and be able to detect when patterns change, rather than looking for specific people or objects.”<sup>4</sup>

NGA leadership has the mindset that the utilization and integration of human and machine interaction will propel innovation. The agency is establishing public-private sector relationships with companies, including Concurrent Technologies Corporation, HRL Laboratories, Raytheon, and Soar Technology, Inc., which are focusing on the initiative of AI-enhancements and automation.<sup>5</sup> A senior analyst at the agency indicated, “This research provides NGA with great opportunities to explore how humans and machines can team together to sift, sort, and process in a data rich environment.”<sup>6</sup>

Each of the aforementioned four public-private partnered companies will specialize in a specific area regarding automation and AI. The various areas of research are as follows:

1. Advance an interdependent human-machine network concept designed to enable task automation and management;
2. Will identify correlations between analysts' interactions and automatically share relevant data across like-user groups;
3. Autonomously provide workflow recommendations and suggested courses of action to help analysts become aware of unconscious bias when making key judgments; and finally,
4. Provide automated mining of streamed data to alert analysts to anomalous activity that could be of interest.<sup>7</sup>

These initiatives are part of a broader three-year enterprise established in 2016 by NGA. The broader initiative by NGA established a working relationship, with both academia and the private sector, to provide feedback by gauging the impact of the value of its products and services to NGA's various customers. NGA's campaign is named the Boosting Innovative GEOINT Broad Agency Announcement. The three main areas of the Boosting Innovative GEOINT Broad Agency Announcement deal with optimizing "value" for the customer, AI-enhancements, and automation, and lastly "Area 3 is classified and titled 'Synthetic Aperture Radar (SAR) Image Formation.'"<sup>8</sup>

NGA has a public-private partnership contract with Commonwealth Computer Research, Inc, which utilized "machine learning and neural networks to identify GEOINT user communities and characteristics of GEOINT data that contribute most to the success

of each user community.”<sup>9</sup> The objective is to determine what is of importance and value to those that utilize NGA’s services and assist customer’s knowledge gaps to “steer users to specific GEOINT data that has the highest likelihood of providing value to the user.”<sup>10</sup>

NGA is seeking additional and more robust collaboration in the arenas of data to further its successes with the aforementioned initiatives.<sup>11</sup> Essentially, many agencies and private sector companies understand that future success will come down to a proper understanding of the volume and propagation of data. The data will need to be characterized in a coherent and structured framework in which the analytical system, whether autonomous or AI-enhanced, can process, comprehend, and exploit for accurate and precise useable analysis. NGA additionally solicits ideas from areas of academia and the private sector for its Boosting Innovative GEOINT Broad Agency Announcement Topic Area 10, Amendment 10, regarding SOM Automation, which is a focus area of data structure.<sup>12</sup>

The superior flexibility and enhanced innovations of the free market enterprise and academia, allows NGA to utilize their creative capacities to ensure foundation GEOINT data is adequately characterized and structured in an understandable format. In September 2018, NGA awarded seven new contracts regarding foundation GEOINT data and advanced geospatial analytics.<sup>13</sup>

NGA is focusing on enhancing and bolstering the agency’s data, information, analytics, products, and its services by establishing various areas of research on the “Characterization of Geospatial Data,” by utilizing contracted academia and private sector’s machine learning, DL capabilities, structured spatiotemporal inference, and

automation incorporation. A portion of seven contracts components deal with the following areas to improve foundation GEOINT data:

1. “panchromatic electro-optical imagery for land use characterization and agricultural crop assessment” to bolster NGA’s crop analytics;
2. Processing of spectral datasets into an understandable categorized structure and into a big-data database by utilizing ML;
3. Site activity monitoring large temporal spans and methods that identify temporal variations, trends and spatial correlation; and finally,
4. Provide automated geospatial product generation including, “images and point clouds collected using any sensor,” and the “discovery and classification of foundation data,” thereby improvements of geolocation accuracy, as well as validation of terrain surface models.<sup>14</sup>

These advanced initiatives are utilizing cooperation and collaboration between NGA, the private sector and, academia, in hopes that the initiative will bolster NGA’s foundation GEOINT data in a more accurate and timely manner; as well as, “measuring the value of GEOINT content delivered to diverse customers in a cloud environment.”<sup>15</sup>

Case in point, an October 2018 NGA press release, announced the Release 7 of the ArcticDEM Project, which NGA, the private sector, and academia collaborated on to develop 3-D digital elevation models of the Arctic with a resolution of 2-meters. The 2-meter resolution is five times the original release.<sup>16</sup> This is a powerful example of the productivity and capability of incorporating three enterprises of public-private-academic sector partnerships.

NGA continuously announces various welcoming White Papers for its Boosting Innovative GEOINT efforts.<sup>17</sup> The agency is seeking ideas for Boosting Innovative GEOINT Broad Agency Announcement Topic Area 1 pertaining to “value.” NGA continues to seek the positive impact regarding how working and partnering with the private sector and academia can propel the agency’s utility. Not only in production but actual worth of value to the agency’s various customers. Further, the agency is promoting and encouraging “White Papers from collaborations of entities (industry and industry, industry and university, university and university, etc.) because research in multidisciplinary Topic Areas may require forming teams with strengths in multiple science and engineering fields.”<sup>18</sup>

NGA’s robust initiatives are providing opportunities and challenges for the agency with regards to what analysts are asked to do and the ever-increasing amounts of data impacting the agency. Former NGA Director Cardillo’s perspective, AI and automation will only empower the analyst and not replace them, which various analysts had raised concerns about.<sup>19</sup> However, these new methodologies will allow NGA’s analysts to do even more advanced analytical work. Cardillo explained, “automation ‘isn’t to get rid of you—it’s there to elevate you. . . . It’s about giving you a higher-level role to do the harder things.”<sup>20</sup> NGA leadership’s ultimate goal and vision is to simplify the time that it takes NGA analysts to do repetitive responsibilities. Thus, the push is to enhance practitioners to be unencumbered to complete advanced projects, as well as analytics such as pattern of life and ABI examination, which require much more intricacy of the tradecraft.

Activity-based Intelligence is an intelligence discipline that emerged during the Iraq and Afghanistan campaigns against insurgents and terrorists. Unlike the military footprint signatures, insurgents and terrorists have different smaller signatures. Their signatures would include other types of less traditional footprint data. Further, ABI expert Gregory F. Treverton explains, “ABI disrupts that linear collection, exploitation, dissemination cycle of intelligence. It is focused on combining data--any data--where it is found.”<sup>21</sup> The important aspects of ABI analysis will be NGA utilizing the components of automation, algorithms, and AI-advancements simultaneously that will utilize significantly greater quantities of data to assist in fostering faster, as well as more accurate and precise practitioner analytics.

Next, the vast amount of data will present NGA with great opportunities and challenges. Data will be produced from various platforms and algorithms, ranging from commercial smallsats to the utilization of ML. This will be accomplished by establishing a standard or baseline from which algorithms can automatically analyze the substantial increase of imagery instead of analysts continuing with mundane exploitation.

Ultimately, the utilization of these advances of AI-enhanced capabilities will assist NGA’s goals to “establish a ‘pattern of life’ for the surfaces of the Earth to be able to detect when [the] pattern changes, rather than looking for specific people or objects.”<sup>22</sup>

Consequently, the empowerment of AI capabilities and technological advances will assist decision-makers across the strategic, operational, and tactical spectrum. Sound timely decisions can be fostered with more exactitude. By harnessing AI-advancements, ML, DL, automation, human-machine collaboration, the “NGA will evolve GEOINT from providing authoritative observations of recent activities to delivering models and

modeling capabilities that satisfy customer needs, such as strategic warning, mission forecasting, and humanitarian preparations.”<sup>23</sup> Further, these technological capabilities will assist NGA practitioners to recognize, prepare, and organize for pattern shifts regarding human migration, humanitarian concerns, and environmental complications, catastrophic weather crises such as tornadoes, hurricanes, floods, mudslides, and wildfires.

### Artificial Intelligence Global Initiatives

The intent of this research segment is to provide context regarding the Chinese President’s declaration of China AI-based supremacy and technological dominance by the year 2030 and the enormities of initiatives China is pursuing to advance their competitive position and national interests, globally. Moreover, an examination of the 2018 BCG study titled, “Mind the (AI) Gap: Leadership Makes the Difference,” that assists in determining why the communist regime of China is arriving at greater success than other near-peer and peer competitor nation states and how the communist regime’s success in the competition continuum will impact the US national interests.

Looking at AI-enhancements from a macro global perspective, nations have understood the significance to pursue research and development in this arena of advancements. China has taken the lead and to date has dominated the race of AI advancements, with the United States a distant second place.<sup>24</sup> There are significant factors that explain why China is leading.

First, in 2017, China’s President, Xi Jinping, conveyed the nation’s strategic establishment of their desire to be the technological dominant rising power in the world, when China communicated its nations’ New Generation AI Development Plan.<sup>25</sup> China’s

national strategic goals include a desire to be a global “science and technology superpower” by 2030. These areas include aerospace, fifth generation wireless technological advancements, offensive and defensive cyber technology, and quantum information sciences (e.g., quantum communications and quantum computing), emergent technologies such as nanotechnology and biotechnology, and leveraging AI, the internet, and big data. Jinping’s regime’s desires to be the premier world leader in AI by 2030 by investing and supporting research and development of next-generation AI advanced technologies, such as “brain-inspired neural network architectures and quantum-accelerated machine learning.” China further realizes “that innovation is a critical determinant of national power and competitiveness.”<sup>26</sup>

Second, expansions in AI-based enhancements are happening at such a rapid rate, and nations struggle with the “ability to structure governance and growth frameworks around” various industries.<sup>27</sup> The reason for success in peer-to-peer competition in AI dominance and growth has to do with factors such as innovation cycles and national level structural improvements, according to the BCG. Chinese success is due to a shorter innovation cycle than their near-peers. Next, the Boston Consulting Group found that the national level involvement plays a significant role for growth in AI, by investing in “data infrastructure, in research hubs and networks, and higher education for IT and data-related fields.”<sup>28</sup>

So why is China dominating compared to its various near-peer competitor’s regarding AI-enhanced competition? The Boston Consulting Group has found several reasons for China’s AI success and dominance documented in their December 2018 study

titled “Mind the (AI) Gap: Leadership Makes the Difference.” The BCG study highlights three areas of China’s success in the AI race for success.

First, the study found that of seven countries, including 2700 managers, a very high percentage of the companies in China are active participants (AI piloting or AI adopting) in the field of AI, compared to the other six countries, surveyed in BCG’s December 2018 study. China’s overall participants totaled a significant 85 percent, whereas the US totaled 51 percent, and France and Germany were next at 49 percent. The survey explains that China’s domination in this area is due to the national strategic plan introduced in 2017, which empowered Chinese companies to “adopt AI into some existing processes” or assists companies to generate “pilot initiatives.”<sup>29</sup>

The second significant takeaway of the BCG study is that China’s 2017 New Generation Artificial Intelligence Development Plan empowered and impacted Chinese managers approach regarding AI-based innovation. Consequently, Chinese initiatives are across and dominate all industries, whereas, the United States and the other countries are strong in “one or two particular industries.”<sup>30</sup>

Lastly, the BCG study indicates that there are four significant factors that empower AI success pertaining to adaption and piloting initiatives. Success in adaption and piloting initiatives are dependent on technical infrastructure, available skills, execution of speed and responsiveness, as well as support from upper management. According to this study, the US has an edge regarding its start-up companies due to the “small engineering and R & D teams comprised of highly skilled and talented technical professionals and can move much faster than their larger competitors.” Thus, the United States’ success is in the start-up of companies that have “tax incentives in new

technologies,” investments in AI activity in the digital realm, which business participants are conveying a 90 percent success rate.<sup>31</sup>

### National Security, Ethics, and Big Tech Ties to State-Controlled Authoritarian Regimes

This section intends to provide context regarding how the US and Western democracies will be subject to technological advancement limitations based on considerations such as civil liberties, ethical considerations, and the philosophy of Just War Theory. Moreover, an examination of how the US Government is finally taking action in regards to the direction of AI-based enhancements. Furthermore, analysis to determine how China’s strategy and state-owned companies are utilizing their influence in weak or failed states that will ultimately hinder the US and democratic allied nation’s security interests across the globe.

Additionally, this section intends to examine why Google halted its relationship with the DOD regarding the Pentagon’s Project Maven AI-initiative. This analysis provides a proper understanding of how this type of relational public-private cooperation ultimately affects the other components of the USG regarding similar AI-based initiatives.

It is apparent that the national strategy regarding China’s 2017 New Generation Artificial Intelligence Development Plan, has been considerably successful, and it has taken the Western world by surprise. According to the *National Defense Strategy 2018*, “The central challenge to US prosperity and security is the reemergence of long-term, strategic competition by what the National Security Strategy classifies as revisionist powers. It is increasingly clear that China and Russia want to shape a world consistent

with their authoritarian model—gaining veto authority over other nations’ economic, diplomatic, and security decisions.”<sup>32</sup> Further, the *National Defense Strategy* goes on to convey that China utilizes “predatory economics to coerce” other countries nearby in the Indo-Pacific region and seeks “regional hegemony in the near-term and displacement of the United States to achieve global preeminence in the future.”<sup>33</sup> However, China’s strategic and military ambition is not limiting it to its Indo-Pacific region, but it is aggressively pursuing its AI initiatives in other global geographical areas as well.

Case in point, in March of 2018, the Chinese state-controlled artificial-intelligence company, CloudWalk Technology, entered into a deal with the Republic of Zimbabwe’s government.<sup>34</sup> The Republic of Zimbabwe has approximately sixteen million people and has been an unstable nation; for example, the recent *coup d’état* led by the country’s army in November 2017.<sup>35</sup> A result of unstable nations permits China to strategize, develop, and implement plans to “take advantage of the weak legal systems and low privacy standards of developing nations.” The benefit and advantage of these types of agreements between China and other countries, allows China’s state-owned CloudWalk Company, to expand its facial data and thereby improving its AI algorithms; whereas, the Zimbabwean authoritarian regime, gains superfluous empowerment by “an advanced facial-recognition system that it can use to identify, track, and monitor citizens.” An ethical consideration here, is it moral to monitor citizens via facial recognition; more importantly, is it ethical to surveil citizens and give them a social score based on behavioral patterns regarding citizens “social and economic performance[?]”<sup>36</sup>

The vision of China’s plan for the Social Credit System to monitor its 1.3 billion citizens was announced in June of 2014, by the State Council of China.<sup>37</sup> Since then,

China started implementing digital algorithm recordings, and this allowed the generation of a credit score for its citizens, which will determine entitlements or potential blacklists of services. Services included that may impact the Chinese citizenry are components such as insurance premiums, access to essential social services, banking loan rates and loan amounts, traveling abroad out of China, school admission and university scholarships, [access] to boats, planes, and high-speed trains, access to social media and internet services, and eligibility for work, particularly governmental jobs.<sup>38</sup>

China's authoritarian President, Xi Jinping, further conveyed his push for "social governance" and his state-owned government's vision of the utilization that "Algorithms would use a range of data to calculate a citizen's rating, which would then be used to determine all manner of activities, such as who [receives] loans, or faster treatment at government offices or access to luxury hotels."<sup>39</sup>

The communist party is pushing their ethics, values, and morality by controlling their peoples' every move through establishing and enforcing the social-credit system, which "is to 'allow the trustworthy to roam everywhere under heaven while making it hard for the discredit to take a single step.'"<sup>40</sup> Establishing a defined algorithm that determines whether a citizen is compliant with "government-mandated social behaviors" and then can impose government "sanctions and penalties," hence is an ethical topic of coercion or conformity that needs to be addressed by humanitarian organizations, western countries, and like-minded liberal governments.<sup>41</sup>

It is of interest to the United States' National Security, as well as, our various allies' national interests, to pursue an aggressive counter AI-enhanced strategies posture and incorporate methodologies of competitiveness contrary to China's social governance

of control. Those who believe in liberty, freedom, and the democratic or republican form of governance must be vigilant and act against repressive authoritarian regimes. For if the United States and the West delay “dire consequences will follow for global democracy.”<sup>42</sup> A former Ronald Reagan Administration Assistant, Under Secretary of Defense for Policy Planning, Mr. Michael Phillsbury, conveys that much of the Chinese philosophy and strategy to replace America’s superpower status is built upon the ideology that “Chinese states prized deception above all as they jockeyed for supremacy.”<sup>43</sup> Additionally, Phillsbury explained that a former Chinese Dictator and Mao’s successor, Mae Zedong, conveyed “hide your brilliance and bide your time.”<sup>44</sup> The United States and the Western allies need to be vigilant against these tactics in the era of technological evolution and AI-advancements.

In order for a nation to be successful, it needs to work and collaborate with those of AI enhanced technical means and understanding. The United States Department of Defense has the Algorithmic Warfare Cross-Functional Team, to work on a project named Project Maven.<sup>45</sup> The goal of the DOD initiative is to incorporate big data, AI, and machine learning and to service the “Project Maven to Deploy Computer Algorithms to War Zone by Year’s End.” The Pentagon’s project would assist the United States’ allies to maintain its competitive advantage over the “capable adversaries and competitors” by accomplishing more precise actions in a more timely manner, which should assist in limiting collateral damage.<sup>46</sup>

According to the DOD News, Defense Media Activity, in July 2017, Project Maven utilizes computer vision, which is “an aspect of machine learning and deep learning—that autonomously extracts objects of interest from moving or still imagery.”<sup>47</sup>

Further, the addition of “Biologically inspired neural networks” will assist in the project’s goal to free up time and allow analysts to complete additional tasks for effective efficiency. Additionally, the Maven Project integrates analysts, software engineers, algorithm developers, and a data-labeling company to properly label data, and “prepare it for machine learning.” Lastly, the design and development of an AI and human operators interface will be established on government platforms; and thereby the AI will “compliment the human operator” during its deployment to the war zone.<sup>48</sup>

However, in June of 2018, there was a Pentagon setback when Google announced it would not renew a contract regarding the Maven Project.<sup>49</sup> Google had approximately 4,000 employees sign a petition or “resigned in protest” due to the Pentagon Google Cloud business contract.<sup>50</sup> The employees’ concerns were in regards to the use of AI technology by “Google’s work” as well as the utilization of AI “software to improve the sorting and analysis of imagery from drones, and some drones rely on such analysis to identify human targets for lethal missile shots.”<sup>51</sup> The employees and AI researchers were protesting and concerned “that the contract was the first step toward using the nascent technology in advanced weapons.”<sup>52</sup> Subsequently, Google conveyed that its newly established AI principles preclude “the use of A.I. in weaponry.”<sup>53</sup> Thus, the organization made a cognizant withdrawal from assisting the United States from pursuing its competitive advance in the realm of AI advancements, which impacts the US national security interests.<sup>54</sup>

Consequently, Google’s AI principles and ethical considerations impact, influence, and was the final determining factor for the tech giant’s withdrawal from working with the Pentagon’s AI Maven initiative; however, the company has determined

its fine to work conscientiously with Beijing's research center.<sup>55</sup> Google's principles do not restrict it from working with the Chinese Government, which actually "convert consumer technologies to military applications" and incidentally help to potentially thrust Chinese dominance in a variety of technological progressions, including global AI-advancements.<sup>56</sup>

Google, Silicon Valley, and other big tech organizations have significant influence and promote the technological direction regarding AI-advanced capabilities. These companies are advancing AI-enhancements that potentially will transform society and the world. AI advancements are an "optimization technology, meaning it carries out defined tasks as efficiently as possible" in countless industries, which the big tech companies hold the "intellectual property" to advance the methodologies.<sup>57</sup> DOD would like to work and collaborate with these companies; however, these enterprises "have opaque chains of ownership often tied to Chinese or Russian interests," which is problematic to DOD.<sup>58</sup>

The reason that these organizations, particularly establishments such as Google, have interrelated interests ultimately emanates down to money and where the technology giants can put their venture. Nevertheless, there have been recent global governmental concerns and humanitarian backlash, particularly the United States and other western democracies, against the giant tech organizations.<sup>59</sup>

Case in point, in 2018, Google received significant attention from both the United States Government and the European Union partners. In December 2018, the United States Congress called Google's CEO, Sundar Pichai, to testify regarding a variety of

issues such as political bias, privacy, and congressional interest of Google's Project Dragonfly, and their "concerns over it launching a censored search product in China."<sup>60</sup>

Additionally, the European Union passed the General Data Protection Regulation, which restricts the use of "consumer data for research." As a result, Google is pursuing investments in countries that do not have this type of governmental oversight towards its companies' initiatives and sadly, "where illiberal values dominate."<sup>61</sup>

The significance of Google's Project Dragonfly is what it comprises of and how it will further empower the Chinese's Government and the Communist Party. In August of 2018, a Google employee leaked the project's details, which were subsequently reported by the news organization, the Intercept. The Intercept's reporting explained that Google's Dragonfly Project would assist the Chinese Government's ability to block and blacklist various websites from the Chinese citizens; block various word searches that a free republic or democracy would possess, such as, "student protests" or "human rights," more importantly, the Dragonfly initiative will link phone numbers and the searches of a user for the expressed purpose of government exploitation, "meaning that [their] searches could be tracked and traced."<sup>62</sup>

Conversely, Google decided not to work with the Pentagon's AI Maven Project. However, it is working on initiatives, such as the Dragonfly Project, the technology that assists in the linkage of personnel to their search engine searches, which will ultimately assist the Chinese Government to exercise greater control of their citizenry.<sup>63</sup> As a result of the backlash of Google's employees pertaining to the AI initiative with the Pentagon, during the summer of 2018, Google published seven principles for its use of AI:

1. Be socially beneficial;

2. Avoid creating or reinforcing unfair bias;
3. Be built and tested for safety;
4. Be accountable to people;
5. Incorporate privacy design principles;
6. Uphold high standards of scientific excellence;
7. Be made available for uses that accord with these principles.<sup>64</sup>

Interestingly, Google conveyed that “they won’t pursue weapons or tech that are likely to cause harm, and that they’ll avoid surveillance that violates internationally accepted norms and human rights.”<sup>65</sup> Google’s AI initiatives (the Maven Project and the Dragon Fly Project) and its seven principles seem to conflict with each other. As such, Google’s employees and humanitarian organizations, for example, Amnesty International, are establishing initiatives, [such] as the “global day of action against” these inconsistencies.<sup>66</sup>

However, it is likely that Google and the DOD will find partnerships in future initiatives with regards to the “military in other domains.” More significantly, the DOD and the companies in Silicon Valley all gain from the “substantial cross-pollination of investment and research and development,” as in the case of “CIA’s venture capital fund In-Q-Tel.”<sup>67</sup> In-Q-Tel is a non-profit organization that focuses on research and development, which is “useful to the CIA mission of intelligence gathering.”<sup>68</sup> This type of interrelated cooperation between government and the private sector has brought technological advancements such as Google Maps and is developing potential capabilities like “scanners to create 3-D printed objects.”<sup>69</sup>

There are implications of the USG working with industry that is essential to national security. Even though China may be the aggressor in the AI-advanced initiatives, other powerful authoritarian governments realize its potential power. As Russian President, Vladimir Putin, conveyed the power that produces AI mastery shall “become the ruler of the world.”<sup>70</sup>

Consequently, Western nations need to ensure there is a proper balance between national security technological advancements in AI with ethical standards when super-intelligence algorithms are considered, analyzed, developed, and eventually established for use. Mr. Henry A. Kissinger, former National Security Advisor and Secretary of State for the United States, was not too impressed with AI. However, in 2015, Mr. Kissinger was introduced to the information pertaining to computer algorithms, which were not “preprogrammed,” but rather that the algorithms were able to acquire understanding, by playing “games against itself, learning from its mistakes and refining its algorithms accordingly.”<sup>71</sup> Shortly thereafter, AI-advanced algorithms AlphaGo would go onto beat the human Go players “decisively.”<sup>72</sup>

Due to his astonishment of the AI achievements, Kissinger went on to write a lengthy piece in the *Atlantic*, in June 2018, titled “How the Enlightenment Ends,” where the former National-Security Advisor believes that AI is of national security concerns; additionally, AI needs to be a “major national project” analyzing AI’s “full scope,” possible implications of AI implementation, and analyzing the “process of ultimate learning.” Furthermore, Kissinger expressed concerns that the President and Congress should establish “a presidential commission of eminent thinkers to help develop a national vision.” Ultimately, Kissinger’s concerns that we as a society consider the

possible ramifications of the AI-superintelligence revolution; moreover, societally, have we considered the magnitudes of the “culmination may be a world relying on machines powered by data and algorithms and ungoverned by ethical or philosophical norms.”

Thus, Mr. Kissinger highlights the importance of AI-superintelligence as a United States national security concern, but the ethical components are essential throughout the process of implementation. Lastly, from his perspective, the technological revolution “should be given a high national priority, above all, from the point of view of relating AI to humanistic traditions.”<sup>73</sup>

The United States of America’s national security interests are at stake due to authoritarian regimes like China and Russia, which have state-owned organizations giving the governments greater control and power. These nations governmental structure allows them more flexibility and ability to be more intrusive globally. With big technology companies, for example, Google, assisting them should be a significant warning of concern regarding America’s national security, as well as its like-minded allies.

China is pushing aggressively to be the world leader not only in AI supremacy but other cutting-edge based advancements such as the fifth generation communications improvements, known as 5G, which will have ramifications to bolster the communist’s interests of dominance and surveillance globally. Additionally, other invasive regimes, such as Russia, try to improve its competitive advantage by utilizing military invasions, false information campaigns, propaganda techniques, technology encroachments, and social media to continuously push the boundaries of war in countries such as Georgia,

Crimea, and Ukraine. Russia is utilizing the previously stated technologies to destroy their enemy in ways that have not been observed before.

The two examples, of China and Russia's desire for global ascendancy and intrusiveness to enhance their positions of advantage within the competitive continuum, which will remain a significant threat to America's national security interests. Lastly, the USG needs to analyze the ramifications of big technology organizations support to totalitarian regimes and the promotion of their desires other than America's national security interests; as well as, its impact on America's and its allies objectives to preserve ethics, freedom, liberty and the rule of law. The proper development of a strategy and utilization of AI-based advancements can assist in maintaining those aspirations.

#### Google's DeepMind Artificial Intelligence Research and Development Initiative

This section of the research intends to provide information pertaining to Google's DeepMinds AI Program as a case study, which significantly impacted China's leadership and other nation states' mindset to pursue this technological advantage. Moreover, the examination of why the Google organization blindsided the DOD by withdrawing from the Pentagon's Project Maven initiative. This provides a proper foundational understanding of how this type of action of public-private cooperation ultimately impacts the other components of the United States' Government regarding similar AI-based initiatives.

Artificial intelligence experts' ultimate goal is to create or design "an algorithm that learns, tabula rasa, superhuman proficiency in challenging domains."<sup>74</sup> According to *Merriam-Webster*, "tabula rasa" means "the mind in its hypothetical primary blank or

empty state before receiving outside impressions.”<sup>75</sup> *Tubula rasa* is a sixteenth-century concept and gained prominence due to British philosopher, John Locke, who promoted and advocated for the concept in the “*Essay Concerning Human Understanding* in 1690 that the term gained widespread popularity in our language.”<sup>76</sup> Moreover, today’s AI promoters like to endorse the idea of *tabula rasa*; however, even though recent results in AI progressions have seen phenomenal advancements, the algorithm(s) did not exactly start at a “blank state.”<sup>77</sup> According to a December 2018 PBS and NOVA Next’s article, AI-based capabilities and actual true intelligence, “Programmers are still feeding it one crucial morsel of human knowledge: the rules of the game it is about to play. ‘It does have far less to go on than anything has before,’ . . . ‘but the most fundamental thing is, it’s still given rules. Those are explicit. ’”<sup>78</sup> Thus, technology is moving incredibly fast, and with every new day and with various AI projects, there seem to be significant advances since the prior year. Following is a look at initiatives in recent years and what noteworthy advancements were achieved.

Scientists and researchers have utilized AI platforms to challenge individual gaming champions for years. One of the most monumental accomplishments of AI advancements happened in 1997 when International Business Machines (also known as IBM) designed and developed a supercomputer, named Deep Blue, which subsequently “beat the world chess champion Garry Kasparov.”<sup>79</sup>

Fast-forward, a score of years later, the story of computer programs AlphaGo Lee, AlphaGo Fan, AlphaGo Master, AlphaGo Zero, and AlphaZero, which exemplifies the astonishing advancements, and potential of the implementation of technology and AI. These algorithmic computer programs utilize the complicated game of “Go,” which was

invented 3000 years ago in China, a “two-player strategy game,” which is still very popular in East Asia.<sup>80</sup> The game of Go is difficult and challenging conceptually due to the number of possible strategic movements during each of the opponent’s moves.

Google’s DeepMind AI Project, developed a computer program named AlphaGo, which integrates machine learning processes into a computer program that plays the game Go.<sup>81</sup>

First, DeepMind’s programmers utilized an AlphaGo variant named AlphaGo Fan to challenge Mr. Fan Hui, a Go master and European Champion of the game Go. In October of 2015, this AlphaGo variant, AlphaGo Fan, was the first computer “program to achieve superhuman performance in Go.”<sup>82</sup> Subsequently, in March of 2016, the computer program went up against another one of the world’s greatest players of the game and beat “South Korean Go master Lee Se-dol—was viewed as an important test of how far research into artificial intelligence has come in its quest to create machines smarter than humans.”<sup>83</sup> This time the DeepMind programmers utilized an AlphaGo variant, named AlphaGo Lee, to challenge and defeat Lee Se-dol. The chief executive and founder of Google’s AI Team of DeepMind, Mr. Demis Hassabis, conveyed that AlphaGo’s victory over Lee Se-dol was a “historic moment.” Moreover, the computer program’s “central advantage of AlphaGo was that ‘it will never get tired, and it will not get intimidated either.’”<sup>84</sup>

Between 2015 and 2016 the two AlphaGo’s variants, Fan and Lee, were programmed similarly by the DeepMind programmers. In an October 2017 article, published by *Nature*, the DeepMind Team explained in detail how the AlphaGo variants were designed, which is as follows:

AlphaGo Fan used two deep neural networks: a policy network that outputs move probabilities and a value network that outputs a position evaluation. The policy network was trained initially by supervised learning to accurately predict human expert moves, and was subsequently refined by policy-gradient reinforcement learning. The value network was trained to predict the winner of games played by the policy network against itself. Once trained, these networks were combined with a Monte Carlo tree search (MCTS) to provide a look ahead search, using the policy network to narrow down the search to high-probability moves, and using the value network (in conjunction with Monte Carlo rollouts using a fast rollout policy) to evaluate positions in the tree.<sup>85</sup>

Subsequently, the computer program significantly matured in one year. During May 2017, in Wuzhen, China, a Go summit had taken place; however, interestingly the conference was censored to Chinese' citizens.<sup>86</sup> Furthermore, the government had websites blocked to ensure all broadcasts were expurgated to its citizenry. The significance of the event was that the AlphaGo Program would beat the Chinese national, Mr. Ke Jie, the Go master and world champion of the game Go. Ke Jie explained that when he played a previous version the year before, it was "still quite humanlike." However, he went on to convey that due to the astonishing strategic moves that AlphaGo made, "this year, it became like a god of Go." Further, other various Go "Players have praised the technology's ability to make unorthodox moves and challenge assumptions core to a game that draws on thousands of years of tradition."<sup>87</sup>

The way the AlphaGo Computer Program had learned to play the game of Go is that the DeepMind AI Project's programmers adjusted the computer program to play against itself and hence learn from these processes.<sup>88</sup> Moreover, the significant development of AlphaGo was due to the programmers' adjustments to improve the "algorithms' efficiency and potential to be generalized across a broader set of problems."<sup>89</sup> The big take away from this event between the AI Computer Program and Go's Champion, Ke Jie, is that "AlphaGo showed yet another way that computers could

be developed to perform better than humans in highly complex tasks, and it offered a glimpse of the promise of new technologies that mimic the way the brain functions.”<sup>90</sup>

Successively, DeepMind’s programmers developed AlphaGo Zero. Four components differentiate Zero against the predecessor AlphaGo variants. According to the October 2017 article published in *Nature*, the four components are:

First and foremost, it is trained solely by self-play reinforcement learning, starting from random play, without any supervision or use of human data. Second, it uses only the black and white stones from the board as input features. Third, it uses a single neural network, rather than separate policy and value networks. Finally, it uses a simpler tree search that relies upon this single neural network to evaluate positions and sample moves, without performing any Monte Carlo rollouts. To achieve these results, we introduce a new reinforcement learning algorithm that incorporates lookahead search inside the training loop, resulting in rapid improvement and precise and stable learning. Further technical differences in the search algorithm, training procedure and network architecture are described in Methods.<sup>91</sup>

DeepMind’s programmers have matched AlphaGo Zero against the earlier versions of AlphaGo variations, “which were trained from human data using handcrafted futures, by a large margin.”<sup>92</sup> When matched against the variant, AlphaGo Master, which is similar to the Lee and Fan variants and additionally beat the world best players in January of 2017 60-0, the Zero variant of AlphaGo would beat the Master variant eighty-nine games to eleven games. Consequently, DeepMind’s research concluded “that a pure reinforcement learning approach is fully feasible” and what is needed is only a couple of more hours to train for the game properly; additionally, this “achieves much better asymptotic performance, compared to training on human expert data.”<sup>93</sup>

The significant difference between its predecessors, the AlphaGo variants, is that AlphaZero can play chess, shogi, as well as Go, simultaneously.<sup>94</sup> These are impressive advancements of scientists, researchers, programmers, and innovators to reach the

objective of AI computer superintelligence. However, there is much innovational improvement that needs to be accomplished in regards to the amount of energy consumed to conduct these AI computational tests: “This intensive regimen also used 5,000 of Google’s proprietary machine-learning processor units, or TPUs, which by some estimates consume around 200 watts per chip. No matter how you slice it, AlphaZero requires way more energy than a human brain, which runs on about 20 watts.”<sup>95</sup>

However, the progress of Google’s DeepMind AI-initiatives and achievements cannot be denied. These DeepMind initiatives are achieving “A long-standing goal of artificial intelligence is an algorithm that learns, tabula rasa, superhuman proficiency in challenging domains.”<sup>96</sup>

### Limitations of Artificial Intelligence

This section of the research intends to scrutinize the limitations of artificial intelligence-based initiatives within an institute. Moreover, this examination provides an understanding basis for AI-based advancements; pertaining to data structure and considers the consequences of the proper data structure of an organization.

In order for the full spectrum of IA-enabled capabilities to be fully realized, it is prudent to see where the private sector and academia are within the spectrum of AI-based capabilities and AI-based limitations. According to Macy Bayern at Techrepublic, there are three limitations pertaining to AI-based initiative implementation. The three areas of consideration are (1) data, (2) bias, and (3) lack of process knowledge by employees.<sup>97</sup> Of the three areas, this research focuses on data.

Consequently, the big takeaway is that the data needs to be organized suitably in order to implement AI-based initiatives appropriately. Thus, the United States Congress

needs to legislate and ensure that all GEOINT partners, from NGA to various DOD, allied partners, and commercial partners develop and utilize a recognized standard of the organization and proper storage of data and information. This order of storage should start immediately to ensure that AI-based advancements, DL, and ML can be utilized rapidly to assist leaders in their decision-making processes.

Therefore, in order for the DOD to utilize AI-based advancements properly the data structure needs to be controlled and categorized in a format AI algorithms can comprehend. Case in point, if we analyze the English language and the Spanish language, the languages are structured differently. Consequently, an AI algorithm would be unable to understand the noise of unstructured data if the algorithms were only designed to understand the Spanish language, but not the English language. The AI algorithms need to be programmed with knowledge of items and nicely classified in a common language for it to work efficiently and effectively. These are the tasks that organizations need to consider in order to incorporate AI-advancements properly.

#### Artificial Intelligence-based Initiatives in Government

The intent of this section of the research is to provide an examination of AI-based initiatives across the US governmental spectrum. The analysis will look at the components from the government, including the US Air Force, as well as IARPA, DARPA, as well as NGA. Additionally, an examination of the commercial vendor, Citygate GIS processes to overcome challenges to AI-based initiatives. Moreover, this examination will provide an understanding of the type of AI-based initiatives that are

being utilized in the governmental sector and how the private sector is assisting them to overcome problematic issues.

The AI initiatives are proving to be extremely beneficial. In Phil Goldstein's article titled, "Air Force, NGA Embrace AI in Different Ways," explains that the United States' Air Force is unitizing AI enhancements to improve the DOD component's operations. In a collaborative initiative with the Defense Innovation Unit, the Air Force is looking to save cost and time on its equipment's maintenance. The Defense Innovation Unit's mission is "identifying highly relevant technology companies and matching them to Defense Department customers through collaborative, agile business processes." By providing data on a specific platform, the Air Force "cut unscheduled maintenance time for aircraft by 30 percent, boosting the fleet's maintenance reliability rate."<sup>98</sup>

The AI-advanced initiatives are also ensuring security against various malicious attacks. In December of 2018, IARPA announced a draft Broad Agency Announcement regarding its TrojAI Program to combat attacks on AI systems by various Trojans.

IARPA-BAA [Broad Agency Announcement]-19-03 synopsis for solicitation number is explained as follows:

Using current machine learning methods, an artificial intelligence (AI) is trained on data, learns relationships in that data, and then is deployed to the world to operate on new data. For example, an AI can be trained on images of traffic signs, learn what stop signs and speed limit signs look like, and then be deployed as part of an autonomous car. The problem is that an adversary that can disrupt the training pipeline can insert Trojan behaviors into the AI. For example, an AI learning to distinguish traffic signs can be given just a few additional examples of stop signs with yellow squares on them, each labeled "speed limit sign." If the AI were deployed in a self-driving car, an adversary could cause the car to run through the stop sign just by putting a sticky note on it (see figure below). The goal of the TrojAI program is to combat such Trojan attacks by inspecting AIs for Trojans.<sup>99</sup>

Thus, the overall goal of the TrojAI program is to protect AI systems from adversary's attempts to place malicious malware within the platform. The desire of IARPA would be "a system that can process about 1,000 AIs per day."<sup>100</sup>

An additional AI-based initiative that DOD is working on is from DARPA. The Defense Advanced Research Projects Agency's purpose for DOD is being responsible for the improvement of evolving technologies. DARPA's AI initiative is called Knowledge-directed Artificial Intelligence Reasoning Over Schemas, or KAIROS, which will utilize "something called schema-based AI to better comprehend events around the world, specifically helping uncover complex events found in multimedia information and bring them to the attention of system users."<sup>101</sup>

NGA has models of collaborative challenges similar for both DARPA and IARPA initiatives that offer "financial incentives to compel and inspire investment/innovation, promote diversity, and drive solutions in automation and GEOINT Assurance." NGA is implementing collaborative challenge approach, as well as ensuring appropriate SOM for geospatial data, and incorporating new ideas such as the SpaceNet "Open data initiative with IQT Lab CosmiQ Works to foster innovation in automation of imagery analytic tasks. It brings a collaborative approach from machine learning analysis to commercial imagery and training data in order to develop algorithms to extract information." The utilization of the aforementioned GEOINT advanced-AI strategy processes will incorporate a unity of effort, build confidence and trust, promote innovation, enhance relevance, encourage anticipatory intelligence, and ensure the USG will outpace the nation's near-peer and peer adversaries and maintain its competitive advantage in the future battlespace.<sup>102</sup>

Nevertheless, on 27 October 2018, on the Federal Executive Forum regarding technological advances in ML and AI in Government, broadcasted on Federal News Radio, WFED 1500am, in Washington DC, government principals from various agencies deliberated about the new technological advancements and their development for organizational implementation for AI initiatives. The leadership at NGA that promote AI-based initiatives clarify that NGA GEOINT problem set is extensively more challenging and complex than initiatives such as Google’s DeepMind AlphaGo project; albeit impressive that the latest AlphaGo variant can beat copious players simultaneously.<sup>103</sup> “NGA is an open-ended issue. Further, NGA has to master a deluge of data which it sifts through and master the data as quickly as possible with increased accuracy, quantity, [and] persistence of results.” Roberts explains that organizational leadership pursuing AI initiatives should ensure that there needs to be clarity of objectives operationally.<sup>104</sup>

In addition, NGA’s leadership clarified that there are three focus areas to ensure there is a proper understanding thereof. Those participants in AI initiatives need to focus on the comprehension of technology and advanced methods, ensure that data is structured adequately from partnerships (both indirect and direct), and finally get a proper understanding of the organization’s domain.<sup>105</sup>

NGA’s leadership expounds that the agency’s global mission set regarding the safety of navigation, which impacts both aircraft and vessels globally. NGA has to be accurate continuously. Thus, leverage what is emerging and then apply it to NGA’s problem set and ensure there is accurate data for all those making intelligence decisions and ensure adequate and accurate delivery.<sup>106</sup>

In order to successfully implement proper AI-based initiatives, the data needs to be adequately structured. Consequently, data is the problem. AI-based initiatives need to properly understand the data to complete their algorithms' intended purpose. The process of conflation is the solution that can assist organizations to accurately and precisely categorize divergent datasets.

Citygate GIS has a methodology that is explained as “Conflation is the process of matching features between data sets created at different times and based on different levels of accuracy and precision. Once features have been matched the goal is often to transfer attribute data from one data set to the other.”<sup>107</sup> Citygate GIS has a fully automated conflating system, named ConfleX, which is compatible to work with ArcGIS analyzing large data sets.<sup>108</sup> The process of conflation is able to assist the governmental components or other organizations ready to implement AI-based initiatives to overcome the problematic issues of unstructured or uncategorized data.

The concept of conflation is not new. Through collaboration efforts in 2015, NGA entered into public-private sector partnership with DigitalGlobe in an unclassified initiative named Hootenany to “harness the power of the power of crowdsourced mapping for Geospatial Big Data Analytics.”<sup>109</sup>

Thus, NGA has incorporated the process of conflation into its architecture. NGA's technology and integration initiatives are leveraging advancements and incorporated automation, AI-based capabilities, and augmentation to improve the agency's processes. There are six focus areas including change detection, data utility and generalization, automated feature extraction and automated attribute population, data validation, as well as map finishing. The final focus area of mass data conflation and

metadata tagging is significantly profound because it “conflates all vector and attribute types from multiple datasets into a ‘best of breed’ final dataset.”<sup>110</sup>

### The Future of Human, Machine, and Artificial Intelligence-Based Augmentation

The intent of this section of the thesis is to explore a case study of how research is utilizing artificial intelligence-based collaboration with human as well as robotic machinery. Moreover, this examination provides an understanding basis of how industry and academia are experimenting and utilizing AI-based advancements, which will impact the human-machine teaming efforts in the near future.

According to AI expert, Mr. Maurice Conti, society is moving into a new era when it comes to humanity working.<sup>111</sup> Conti explains historically speaking four major historical areas defined how humans worked. The four eras are considered the Hunter-Gather Age, the Agricultural Age, the Industrial Age, and the Information Age. Further, he explains that humans are “on the cusp of our next great era as a species,” which would be considered as the Augmented Age. There will be an interconnectional relationship between humans, robots, as well as AI-based capabilities to complete tasks and solve complex problems. Humans have abilities in awareness, perception, and decision-making; whereas, robotics are excellent at exercising instructions with perfect precision and repetitiveness; finally, AI is excellent at tracking and monitoring massive amounts data, transactions, and components.<sup>112</sup>

Thus, Conti goes on to explain that our cognitive, physical, and perceptual abilities will be augmented and amplified by the advancements in AI-based abilities by

assisting humans “to imagine and design new stuff, robotic systems are going to help us build and make things that we’ve never been able to make before.”<sup>113</sup>

A 2016 project, named the HIVE, exemplified a cross-disciplinary collaboration experiment in which professionals across the spectrum of computer advancements, robotics, manufacturing, engineering, and design to develop a task working together.<sup>114</sup> “The project involved a 12’ tall bamboo pavilion that was built by attendees of the 3 day event, through a unique human, machine, and robot collaboration. With this multi-disciplinary project, we were exploring a number of future-of-design themes, such as emergent design, wearables, internet of things, and human-robotic interaction.”<sup>115</sup> Thus, the HIVE experiment demonstrated how the future would incorporate the working relationship of humans, robots, and AI-based advancements, which will control and monitor data, activity, and ensure components are accurately and precisely applied.

Thus, AI-based advancements, automation, human-machine teaming will assist organizations by supporting with mundane labor skills to allow humans the freedom to focus on more consequential realms. Further, AI-based processes will be supplementary expedient since the innovation “thinks in ways that humans can’t. Algorithms that can monitor and process massive amounts of data, and make conclusions based on patterns in that data are poised to change every avenue of society.”<sup>116</sup>

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<sup>1</sup> Office of the Director of National Intelligence, *The AIM Initiative*, 13.

<sup>2</sup> Ibid.

<sup>3</sup> Major Christopher Telley, *The Influence Machine: Automated Information Operations as a Strategic Defeat Mechanism*, The Land Warfare Papers, no. 121 (Arlington, VA: The Institute of Land Warfare, Association of the United States Army, October 2018), 1.

<sup>4</sup> Elana L. Gross, “How Artificial Intelligence Is Transforming the Intelligence Community,” Dell Technologies, 1 February 2018, accessed 8 December 2018, <https://www.delltechnologies.com/en-us/perspectives/how-artificial-intelligence-is-transforming-the-intelligence-community/>.

<sup>5</sup> National Geospatial-Intelligence Agency (NGA), “NGA Awards Four Contracts to Enhance Artificial Intelligence and Automation,” National Geospatial-Intelligence Agency News Release, 15 February 2017, accessed 14 March 2019, <https://www.nga.mil/ProductsServices/Pages/NGA-awards-four-contracts-to-enhance-artificial-intelligence-and-automation.aspx>.

<sup>6</sup> Gross, “How Artificial Intelligence Is Transforming the Intelligence Community.”

<sup>7</sup> NGA, “NGA Awards Four Contracts to Enhance Artificial Intelligence and Automation.”

<sup>8</sup> National Geospatial-Intelligence Agency (NGA), “NGA Awards First Contract for Broad Agency Announcement to Boost Innovative GEOINT,” National Geospatial-Intelligence Agency News Release, 13 July 2016, accessed 25 April 2019, <https://www.nga.mil/MediaRoom/PressReleases/Pages/NGA-awards-first-contract-for-Broad-Area-Announcement-to-boost-innovative-GEOINT.aspx>.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Federal Business Opportunities, “Broad Agency Announcement (BAA) for Boosting Innovative GEOINT (BIG) Topic Area 10,” NC DEFTECT, 21 June 2018, accessed 14 March 2019, <https://deftech.nc.gov/opportunities/2018-06-21/broad-agency-announcement-baa-boosting-innovative-geoint-big-topic-area-10>.

<sup>12</sup> Ibid.

<sup>13</sup> National Geospatial-Intelligence Agency (NGA), “NGA Awards Seven Contracts for Advanced Geospatial Analytics,” National Geospatial-Intelligence Agency News Release, 11 September 2018, accessed 10 April 2019, <https://www.nga.mil/MediaRoom/PressReleases/Pages/NGA-awards-seven-contracts-for-Advanced-Geospatial-Analytics-under-the-Boosting-Innovative-GEOINT-Broad-Agency-Announcement.aspx>.

<sup>14</sup> Ibid.

<sup>15</sup> Ibid.

<sup>16</sup> National Geospatial-Intelligence Agency (NGA), “NGA, Partners Complete 2-Meter Resolution Map of Arctic,” National Geospatial-Intelligence Agency News

Release, 5 October 2018, accessed 27 April 2019, <https://www.nga.mil/MediaRoom/PressReleases/Pages/NGA,-partners-complete-2-meter-resolution-map-of-Arctic--.aspx>.

<sup>17</sup> Federal Business Opportunities (FBO), “Broad Agency Announcement (BAA) for Boosting Innovative GEOINT (BIG),” USA.gov, 8 December 2015, accessed 16 March 2019, [https://www.fbo.gov/index?s=opportunity&mode=form&id=315b29bfd424e0b85facd2acd4ee8fb&tab=core&\\_cview=0](https://www.fbo.gov/index?s=opportunity&mode=form&id=315b29bfd424e0b85facd2acd4ee8fb&tab=core&_cview=0).

<sup>18</sup> Ibid.

<sup>19</sup> Jenna McLaughlin, “Artificial Intelligence Will Put Spies Out of Work, Too,” *Foreign Policy*, 9 June 2017, accessed 18 March 2019, <https://foreignpolicy.com/2017/06/09/artificial-intelligence-will-put-spies-out-of-work-too/>.

<sup>20</sup> Ibid.

<sup>21</sup> Patrick Biltgen and Stephen Ryan, *Activity-Based Intelligence Principles and Applications* (Norwood, MA: Artech House, 2016), xx, xxiv.

<sup>22</sup> Gross, “How Artificial Intelligence Is Transforming the Intelligence Community.”

<sup>23</sup> Director NGA, *NGA Strategy 2025*, 5.

<sup>24</sup> Louis Columbus, “How China is Dominating Artificial Intelligence,” *Forbes*, 16 December 2018, accessed 13 March 2019, <https://www.forbes.com/sites/louiscolombus/2018/12/16/how-china-is-dominating-artificial-intelligence/#285d29e42b2f>.

<sup>25</sup> Elsa Kania, “Emerging Technology Could Make China the World’s Next Innovation Superpower,” *The Hill*, 6 November 2017, accessed 13 March 2019, <https://thehill.com/opinion/technology/358802-emerging-technology-could-make-china-the-worlds-next-innovation-superpower>.

<sup>26</sup> Ibid.

<sup>27</sup> Columbus, “How China is Dominating Artificial Intelligence.”

<sup>28</sup> Sylvain Duranton, Jörg Erlebach, and Marc Pauly, *Mind the (AI) Gap Leadership Makes the Difference* (Boston, MA: Boston Consulting Group, December 2018), 3, 10.

<sup>29</sup> Ibid., 2, 5.

<sup>30</sup> Ibid., 6.

<sup>31</sup> Columbus, “How China is Dominating Artificial Intelligence.”

<sup>32</sup> Department of Defense, *Summary of the 2018 National Defense Strategy of The United States of America: Sharpening the American Military's Competitive Edge* (Washington, DC: Government Printing Office, 2018), 4, accessed 13 March 2019, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

<sup>33</sup> Ibid.

<sup>34</sup> Ryan Khurana, "The Rise of Illiberal Intelligence," *National Review*, 10 August 2018, accessed 13 March 2019, <https://www.nationalreview.com/2018/08/china-artificial-intelligence-race/>.

<sup>35</sup> Wikipedia, "Zimbabwe," Wikipedia Foundation, last updated 11 March 2019, accessed 12 March 2019, <https://en.wikipedia.org/wiki/Zimbabwe>.

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## CHAPTER 5

### CONCLUSIONS AND RECOMMENDATIONS

Leveraging artificial intelligence, automation, and augmentation technologies to amplify the effectiveness of our workforce will advance mission capability and enhance the IC's ability to provide needed data interpretation to decision makers.

— Director of National Intelligence,  
*The AIM Initiative, a Strategy for Augmenting Intelligence Using Machines*

#### Conclusions

Artificial intelligence technological advancements present numerous possibilities to empower and provide advantages to nations and non-state actors in the future, even though this innovation is only “one of the new battlegrounds for a technology-based arms race.”<sup>1</sup> NGA is the premier DOD intelligence agency that possesses and processes geospatial information, which assists customers to answer critical intelligence issues, challenges, and questions.

NGA's GEOINT provides products and services to enhance decision-making advantage for senior policy-makers, warfighters, and various governmental and non-governmental customers. As an indirect result of its evolution as the leader in geospatial competence, the agency is also positioned to provide the way forward in artificial intelligence-enhanced capabilities, ML, DL, automation, human-machine teaming, and material infrastructure for all other DOD and non-DOD government agencies, as well as state and local organizations. The agency models leadership by establishing research and development, as well as incorporating appropriate relationships across the spectrum of government, academia, and industry. Ensuring accurate and precise incorporation of advanced technologies of AI will ensure the national security interests and prosperity of

United States are well-advanced and well-preserved, and the “NGA will propel the continued dominance of GEOINT to protect American interests.”<sup>2</sup>

Recent aggressiveness of the DOD’s apparatus regarding its AI-based implementation and strategies—the formation of the Joint Artificial Intelligence Center, the Office of the Director of National Intelligence’s introduction of the framework of the Augmenting Intelligence using Machines initiative, and the 2019 AI executive order by President Donald Trump—all assist enabling the United States of America to remain competitive in the technology advancement race and proliferation of technology against our competitors and adversaries, principally China and Russia. Additionally, these initiatives allow a strategic framework in dealing with the private sector organization, which otherwise might hinder the USG’s competitive technological advantage; as well as guidance to ensure the government will not be reliant on any one major AI big-tech organization, such as Google.

Partnerships need to be promoted and established across the spectrum of the private sector, academic institutions, international community, federal and state and local civil governmental agencies, NGOs, as well as other partners to ensure sound data with standardization, and to enhance discoverability. The cross-disciplinary collaboration efforts between public-private-academic arenas with allied organizations, both domestic and abroad, will promote the aforementioned analytics and advancements amongst the USG’s partners.

Finally, the frameworks allow those who design AI-based initiatives to be well-focused on ethical considerations, protect against existential threats of the United States

and its allies, ensure rigorous preservation of the Constitution of the United States, and safeguarding America's norms, principles, and values.

#### Areas of Additional Research

For additional study, future researchers should focus on ethical considerations pertaining to AI initiatives. Research should be examined by analyzing how authoritarian regimes will utilize high-tech innovations to control their populace, as well as pursue initiatives to strengthen their competitive and strategic advantage globally. The examination should explore the impact of the ease in which these advancements will be established, promoted, and implemented, in nations that are surveillance states and have state-owned businesses.

A second consideration for additional research is to examine the ethical considerations in which various militaries will start to incorporate advanced technology, such as AI-based enhancements, ML, DL, autonomous machinery, as well as human-machine teaming within their organizations. The research should analyze the new technological advances noted above, as well as the human-in-the-loop notion with how military components will start to incorporate and utilize these progressions and examine what impact these technological advances have on the future battlefield.

The US Army Command and General Staff College Officer Course encourage officers to look at war through the prism of ethical apparatuses, such as the ethical triangle and the Just War Theory. There should be further research on how these and other ethical examination methods can test future technological advancements.

Another possibility for future thesis research is to examine the big technology companies' positions regarding these new innovations and what is their working

relationship with the USG. In 2018, Google pulled out of the Project Maven AI initiative with the Pentagon's relating to the company's ethical issues. Subsequently, it was revealed that the Google organization is pursuing other AI initiatives to assist the Communist Chinese regime, which is to advance the totalitarian interests to control their citizenry.

Additionally, the research can explore how American citizens need to be vigilant to ensure they protect their constitutional and civil liberties as big technology evolves and becomes more intrusive in citizens' lives. Lastly, an examination of authoritarian regimes unrestricted freedom to capitalize on new advancements and how they will utilize these technologies to enhance their position globally; whereas Western democracies and Constitutional republics; are subject to limitations such as varying laws, regulations, and political bureaucracy.

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<sup>1</sup> Office of the Director of National Intelligence, *The AIM Initiative*, 11.

<sup>2</sup> Director, NGA, *NGA Strategy 2025*, 6.

## GLOSSARY

Activity-based Intelligence (ABI). An IC analytic method applied to structured data from all sources to discover objects, relationships, or behaviors by resolving significant activity.<sup>1</sup>

Artificial General Intelligence (AGI). Also known as “General AI” or “strong” AI, this is an AI system that can handle any human intellectual task—memory, learning, abstraction, and creativity. There are no AGI systems in existence, although building an AGI has been the goal of the field since it was founded in the 1950s.<sup>2</sup>

Artificial Narrow Intelligence (ANI). Also known as “Narrow AI” or “weak” AI, this is an AI system that is specialized for a single purpose and cannot be generalized. All current applications are ANIs.<sup>3</sup>

Human or Intelligence Augmentation. Use of information technology to augment human intelligence in the performance of some task. Unlike autonomous systems which aim to replace human activity, augmentation is designed with humans as central.<sup>4</sup>

Low-shot Learning. An object recognition, ML classification task where learning must take place despite having only one, or a few, example images for training.<sup>5</sup>

Narrow AI. Nearly all current commercial applications of AI are narrow solutions in that they solve a single problem with a single kind of data. Image classification, face recognition, and human language translation are all examples of narrow AI solutions.<sup>6</sup>

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<sup>1</sup> NGA, *NGA GEOINT CONOPS 2022*, 18.

<sup>2</sup> Office of the Director of National Intelligence, *The AIM Initiative*, 13.

<sup>3</sup> *Ibid.*

<sup>4</sup> *Ibid.*, 15.

<sup>5</sup> *Ibid.*

<sup>6</sup> *Ibid.*, 13.

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