Artificial Intelligence Integration is Creating a Security Dilemma Among Global Powers

by

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Abstract

The US and China are engaged in a science and technology (S&T) rivalry with artificial intelligence (AI) as a primary catalyst. This growing technology rivalry is fast approaching an all-out technology war between the two nations and is the underlying cause behind recent trade conflicts (Lynch, 2019). This is occurring due to China's rapid technological growth, its strategic economic ambitions, and the Communist Party of China's (CPC) Vision of Victory which calls on China to dominate emerging technologies, especially the digital technologies: AI, quantum computing, cloud computing, big data access, block chaining, internet of things (IOT), etc. (Panda, 2019; Mourdoukoutas, 2019). Both the US and China's senior leadership believe AI and digital technologies will be "the engines of the next industrial revolution" and have established national strategies and policies devoted specifically to advancing these technologies and dominating R&D and industry development (He, 2017: 2; Kania, 2017a: 8, 12). The US remains the current leader in overall AI and digital technology research and product / service development. However, China is committed to catching up, and has recently surpassed the US in AI research volume, registered patents, and publications (He, 2017: 2). The Trump Administration considered China's economic prowess, accelerating technological advancements, and growing emphasis on digital technologies with leapfrog potential a major threat to the US S&T and military hegemony and engaged in counterbalancing measures (NSS, 2017: 2). These events and the complexity associated with AI's commercial sector and military integration have created tensions and suspicions among each nation's senior leadership regarding their counterparts' underlying ambitions and motives. These leadership perceptions are promoting a downward spiral of distrust and are contributing to a highly complex new form of security dilemma with global implications (Borzykowski, 2018; Tayal, 2019).

Introduction

The US and China are engaged in a science and technology (S&T) rivalry of which artificial intelligence (AI) is a primary catalyst. This growing technology rivalry is reaching the status of an all-out technology war (Lynch, 2019). The tech war is the underlying cause for the recent trade conflicts between the two nations. The origin of the tech war was brought about by China's accelerated technological growth, strategic economic ambitions, and the Communist Party of China's (CPC) Vision of Victory. This strategic vision calls for China to dominate the advanced emerging technologies, especially the digital technologies (AI, quantum computing, cloud computing, big data access, block chaining, internet of things (IOT), etc.) (Panda, 2019; Mourdoukoutas, 2019). Growing concern over China's rapid technological and economic growth has led the Trump Administration to re-prioritize its National Security Strategy (NSS). The recent 2017 NSS describes China as a competitor and rising challenger that threatens US S&T and military hegemony (NSS, 2017: 2). The NSS called on the US to counterbalance against China's rise and renew its effort to globally lead in S&T and innovation (STI) R&D and in investments directed at the vital emerging technologies with a special concentration on AI and digital technologies. (NSS, 2017: 20; Gavekal, 2018).

The US and China's senior leadership believe AI will be "the engine of the next industrial revolution" and have established national strategies and policies devoted specifically to advancing AI and digital technologies thus guarantying that they are at the forefront of AI R&D and industry development (He, 2017: 2; Kania, 2017a: 8, 12). Senior leadership is defined as each nation's top decision makers at the national level, for example, the US Cabinet or China's Politburo. Both nations have also separated themselves from competitors by developing strong AI related ecosystems comprised of government, industry, and university R&D collaborations with the capability of swiftly transitioning dual use commercial research into military projects (OSTP, 2019a). The US remains the current leader in overall AI research and product / service development. However, China is committed to catching up, and has recently surpassed the US in AI research volume, registered patents, and publications (He, 2017: 2).

China's senior leadership has stated that China will become a "premier global AI innovation center" by 2030. To accomplish this Beijing created the New Generation Artificial Intelligence Development Plan (AIDP), a national strategy dedicated exclusively to AI. Accompanying the AIDP was a variety of additional initiatives, plans, and polices dedicated to supporting AI technology development (Allen, 2019: 5). China's leaders are confident that this plan will help China become a high value producer reinforcing China's commercial success and enabling the People Liberation Army (PLA) to modernize its military and leapfrog[2] past superior US defense forces (Horowitz, Kania, Allen & Scharre, 2018; Allen, 2019: 8).

The Trump Administration, in an effort to counter China's strategic AI ambitions and retain US technological hegemony launched its own AI national strategy, the American AI Initiative. The Administration also directed several existing government offices to establish new agencies, committees, and policies to increase AI R&D and ensure the US remains the global leader in the emerging digital technologies. The Administration also introduced counter measures against china aimed directly at AI and digital technologies. These measures included blacklisting or banning Chinese high-tech companies operating in the US (Motohiro, 2019; Monier, 2019). These events and the complexity associated with AI's commercial sector and military integration have created tensions and suspicions among each nation's senior leadership regarding their counterparts' underlying ambitions and motives. These leadership perceptions are promoting a downward spiral of distrust and are contributing to an AI driven highly complex new form of security dilemma (Borzykowski, 2018; Tayal, 2019).

The research purpose for this manuscript will be to uncover whether the US and China are in the grips of a security dilemma, and if so, to what degree widescale AI integration, throughout the militaries of the US and China, impacts this security dilemma. This research also seeks to understand how AI's enabling and dual use capabilities and its military integration affects each nation's senior leadership perspectives and how these perspectives in turn influence national strategies and policies that further contribute to the security dilemma.

I argue that AI technology proliferation into the militaries of the US and China: increases uncertainty and tensions among the senior leadership of each nation; negatively affects the perception of their counterparts; and leads to national AI strategies, strategic initiatives, and policies that are contributing to a new form of highly complex security dilemma. This new form of security dilemma is also unlike any security dilemma from the past. The rapid evolution, complexity, and highly integrative capabilities that AI and digital technologies encompass increases the difficulty for each nation's senior leadership and policy makers to adequately comprehend, thus increasing uncertainty and distrust which further contributes to a downward spiraling affect which reinforces the security dilemma.

This manuscript will be organized accordingly: Part 1 will explain how this new form of complex security dilemma both resides within and is a product of defensive realism theory. Part 2 will lay out the differences and similarities between each nation's AI ecosystems and describe the factors responsible for their success. Part 3 will describe each nation's national strategic plan for AI, the objectives of those plans, and the primary agencies and offices responsible for meeting those objectives. Part 4 will define what dual use, enabling, and leapfrog technologies are, and why they are relevant to AI military integration. Part 5 will demonstrate why the US and Chinese commercial sectors are crucial for AI military integration. Part 6 will assess how AI military integration is progressing in each nation, the different weapons and support systems being pursued, and how it is changing the face of their military power. Finally, Part 7 will examine why each new advancement in AI technology and its military integration is increasing tensions among their respective senior leadership. It will also explain why AI's technological complexity and leadership perceptions are the driving factors behind the emerging security dilemma.

AI Security Dilemma Implications for the US and China

Defensive realism argues that within the anarchical structure of the international world order states seek to maximize their security by choosing moderate and defensive policies that will preserve their position within the international system rather than in engaging in aggressive measures to maximize their power (Waltz, 1979: 126). States that maximize power and strive for regional or global hegemony have historically provoked a security dilemma and balancing measures from surrounding states. Expansion and aggressive military actions are considered too costly and self-defeating for achieving a state's ultimate goal which is to maximize its security (Snyder, 1991: 11). Therefore, moderate diplomatic, economic, and military strategic initiatives and policies that demonstrate restraint and nonaggressive actions are the best course of action to ensure state security and survival (Taliaferro, 2000: 135-136).

Defensive Realism, S&T Rivalry, and the AI Security Dilemma

The international order has been remarkably beneficial for China's technological and economic rise. China's senior leadership has reached the understanding that any outright pursuit of hegemony, attempts to alter the existing international order, or pursuit of overt power maximizing strategies that indicate aggressive economic or military actions will also initiate self-defeating, counterbalancing measures from the US and its regional neighbors (Mearsheimer, 2015; Elman & Jensen, 2012: 21, 28). The international system rarely rewards an aggressive pursuit of power and in many cases, it comes at the expense of security (Taliaferro, 2000: 129). Therefore, an outright aggressive pursuit of power would be detrimental to China's economic growth which is critical to China's national security interests and the CPC's regime legitimization. China senior leaders believe it is better to adopt a defensive realism security strategy, one that emphasizes self-restraint and gradual or incremental advances, limits leadership expectations, and at least gives the appearance of engaging in security cooperation with other nations (Tang, 2003; Mearsheimer, 2015).

China's most recent 2019 Defense White Paper (DWP) states that despite the US engaging in unilateral national security policies, escalations in defense spending, increased military deployments, and excessive commercial sector competition, Beijing has instead been engaged in cooperative measures such as the "Shanghai Cooperation Council, the China-ASEAN Defense Ministers' Informal Meeting, and the ASEAN Defense Ministers' Meeting Plus (ADMM-Plus)" (Cordesman, 2019: 1). The 2019 DWP stated that China's military modernization efforts have been completely defensive and designed to offset the substantial technological gap in its military and to counter a rising US military presence, regional alliances, and interventions in the Asia-Pacific theater. The DWP re-emphasizes that the Peoples Republic of China (PRC) has never declared war or provoked conflicts with other nations, has recently downsized its military by 4 million personnel, and rejected largescale regional military expansionary efforts. Rather, China has chosen to build its economy and promote global peace and infrastructure development assistance (SCIO, 2019: 8-9). The DWP ignores the rate at which

China's military spending has increased and goes out of its way to justify all defense spending increases and its growing calls for "combat readiness". Beijing claims these endeavors are strictly for peaceful purposes in order to protect China's territories from external (US) influences. The final five pages of the DWP were devoted to demonstrating to the world how China is working to improve regional cooperation efforts (Cordesman, 2019: 2-4; SCIO, 2019: 16-18). These activities have thus far been proven to be a successful campaign for preserving China's international image, its national security, and the CPC's regime survival (Tang, 2003; Mearsheimer, 2015).

As China continues its rapid technological and economic rise and gains more access to financial and material resources, China will inevitably allocate some of those resources towards expanding its military capabilities. Defensive realists expect that Beijing will take measures that will signal to the US and its regional neighbors that China's military expenditures are only intended for defensive national security purposes (Elman & Jensen, 2013: 28). China's senior leadership has indeed done just that, claiming that China is merely seeking to modernize its outdated military and that new weapon systems are for purely defensive purposes and required to protect China and its regional interests from external interference and a growing US presence in the region. The Peoples Liberation Army cites that new weapons systems have been paired with an overall reduction in defense spending and the removal of over 300,000 military personnel **(**Elman & Jensen, 2013: 28; Roblin, 2019**).**

Defensive realism theory recognizes that any rising state like China will attempt over time to gradually shift the balance of power to ensure its security and to benefit its national strategic objectives (Mearsheimer, 2015). China's leadership have engaged in such actions for decades incorporating gradual coercion tactics and incrementalism as part of China's long-term national strategies (Bhatia, 2018: 25).These tactics have recently met resistance from the Trump Administration who perceived their accumulated effect on economic trade and years of intellectual property violations as unfair and detrimental to US and Western interests. The Administration counterbalanced with tariffs, export controls, and the banning or restricting access to China's emerging high-tech companies in 2017. China's leadership immediately retaliated with their own tariffs. Some of the tariffs and export controls were retracted in late 2019 thus reducing tensions between the two nations (Smith, Gerber & Tillet, 2010). Defensive realists don't expect security competition between China and the US to cease given that China's technological, economic, and military power will continue to grow, but that the competition itself does not have to be intense or a guarantee of conflict (Mearsheimer, 2015).

A central premise of defensive realism is the security dilemma. Security dilemmas occur when a state attempts to increase its security, generally through an increase in military power, inadvertently threatens the security of other states which respond in kind (Jervis, 1978: 186; Lobell, 2010: 12). This is arguably the situation China finds itself in regarding the development of dual use technologies. China has made rapid advancements in AI and digital technologies, accelerated the pace of AI integration into a variety of electronic systems, and is making great strides in developing AI's autonomous decision-making capabilities. AI's dual use nature makes AI an excellent tool for military applications and China's AI military R&D programs and weapons systems integration are increasing right along with its commercial sector AI development (Hass & Balin, 2019). This has raised apprehensions among the US's senior leadership that China's AI military integration represents an impending threat to US national security and regional interests. To counter this perceived threat the US has accelerated its own commercial AI development and is actively pursuing AI applications for defense purposes (CRS, 2019a: 9, 21).

These actions have caused the US and China to strengthen their state support for AI technology, increase investments in AI research, establish public and private sector collaborations for AI development, and create entire industries dedicated to dual use AI and digital technologies. Each new generation of ML algorithms intended for military purposes will require less human interaction while increasing weaponry lethality. This spurs the other nation to create the same or fear losing an innovation edge in AI. This tit for tat spiraling cycle creates rising distrust and tensions among the US and China's leadership (Meserole, 2018; Hass & Balin, 2019). Each nation's leaders are already convinced that AI integrated weapons systems will be utilized should a confrontation develop (Williams, 2017; Klare, 2019). All these factors are contributing to a highly complex form of security dilemma and increase the chance for conflict.

Complicating the security dilemma further is the lack of proper protocols that will ensure human agency remains in the decision-making process. There are currently no strategic policies or directives in place that apply boundaries for how AI will be implemented (Williams, 2017; Coker, 2018: 36). Another factor is the disruptive capability of AI and how AI embedded military systems could render existing military weapons less effective or even obsolete over the long run. This could provide a nation with superior AI technology access to clear national security and military advantages (Kania, 2018; Pawlyk, 2018). These advantages have created both apprehension and enthusiasm among the senior leadership of the US and China. Apprehension as to the other nation's capabilities and enthusiasm for the development of their own dual use AI programs. The enthusiasm is accompanied by an acquiescence that AI integration is all but globally inevitable and a nation should pursue AI as a first mover since “speed is of the essence in the digital age” and if a nation fails to do so it runs the risk of falling behind (Kania, 2018; Pawlyk, 2018).

Another complicating factor is that there is no guarantee that AI algorithms will perform as advertised or that AI will be integrated proficiently into existing or new military systems. This will almost certainly be the case in the near term while computer scientists and engineers are “working out the bugs”. But problems could reoccur with the introduction of each new generation of AI embedded weapons platforms. Integrating AI to quickly or with inadequate prototype testing could create systems vulnerabilities and questionable reliability (Horowitz, 2018). These complications intensify misperceptions by leadership, aggravate the already complex US-China security dilemma, and are driving both nations headlong into an AI arms race (Kania, 2018).

Structural Modifiers – Technology & Leadership Perceptions

Structural Modifiers in defensive realism are material factors or capabilities that can alter the balance of power in the international system (Taliaferro, 2000: 137). Defensive realists believe that the anarchical structure of the international system by itself is generally not enough to drive nations to maximize their power (Jervis, 1999: 49-50). Instead, structural modifiers are the key to understanding what causes the onset of conflict between states. Structural modifiers include geography, military capabilities, technology, leadership perspectives, and a nation’s social structure. These can be used separately or in aggregate to best explain a state’s aggression, expansionary tendencies, and its impulse for war (van Evera 1999:7–8; Taliaferro, 2000: 137).

The two structural modifiers most relevant to this paper are technology and leadership perspectives. Technology, in this case AI and the emerging dual use digital technologies, have the capability to revolutionize modern warfare (Kania, 2017a: 8). Technologies such as AI not only enable existing military systems to operate more accurately, efficiently, and with greater lethality, they also provide autonomous command-and-control that will expand a nation's theater of war capabilities (Kewalramani, 2018: 5).

From an offense – defense balance perspective, a technology such as AI with its widescale military integration potential can make conquest easier for a state with aggressive tendencies. This threatens the security of regional states, increases leadership insecurity, and reduces the likelihood that diplomacy and cooperation will be effective tools in conflict resolution. (van Evera, 1999: 122-123). Incorporating AI for military purposes can promote the other regional states and/or a hegemon to inflate threats and justify the aggressive pursuit of AI and similar technologies for security reasons, thus reinforcing the security dilemma (Lobell, 2010: 15; Meserole, 2018).

Any large increase in technologies with military applications can aggravate a security dilemma. Dual use technology development will introduce uncertainty among a nation's leadership regarding the technology's ultimate purpose. Whether a technology like AI will be used for offensive or defensive purposes is often ambiguous, situational, and difficult for leaders to assess (Lynn-Jones, 1995: 667; Glaser & Kaufmann, 1998: 7). Other uncertainties facing a nation's leadership is AI's military integration capability, how powerful the weapon systems will be, and how the weapon systems will be used on the battlefield. No country developing AI technologies is truly sure how powerful AI embedded weapon systems will be in warfare, how thoroughly they will be integrated into existing weapons platforms, or what their battlefield benefit will be versus the cost of implementation (Meserole, 2018). Adding to AI's uncertainty is its enabling capacity. AI does not constitute a single standalone weapon, instead AI and digital technologies are being embedded into a wide variety of weapons platforms and support systems.

AI is also being embedded within command-and-control structures providing decision-makers with a wide range of features such as fully autonomous, real-time, and in field decision-making capability (Kewalramani, 2018: 4-5). AI integration capabilities are likewise rapidly changing, which makes it difficult to adequately test existing system performance before the next generation of algorithms comes out. There is also the matter of how a rival nation or third-party antagonist might use AI in unpredictable ways that strategists and war-planners are unprepared for. Finally, and perhaps the greatest source of uncertainty affecting a nation's leadership perspectives is how AI embedded weapon systems will alter or revolutionize the character of warfare itself. (Meserole, 2018).

Both nations senior leadership are already mired in mistrust and misperceptions regarding their counterparts' intensions and are becoming especially concerned with the intended use of AI and digital technologies. US leaders believe that China has been involved in a series long term trade infraction, intellectual properties theft, and unfair technology transfers all designed to bolster its technologic and economic power. China's leaders perceive the US as interfering in its regional interests, engaging in unwarranted counterbalancing measures, and encouraging neighboring states to do the same (Gavekal, 2018; OSTP, 2018b: 1-2). AI integration into military systems adds another decisive layer into this growing mutual distrust**.** This distrust is made further worse by each nation's government bureaucracies and special interests who have a clear impetus to develop dual use AI and other digital technologies for their own purposes. Many of these groups and their representatives (lobbyists) come from the military, intelligence agencies, or high-tech commercial sectors. Their objectives do not always coincide with national security interests and they can have considerable political influence and have a strong sway in policy direction. These pluralist voices generally complicate policy making and can make it cumbersome to enact. In the case of AI, these special interests make applying regulations or restrictions on dual use AI R&D problematic, and ethical considerations go largely ignored (Kupchan, 1994: 1; DeVore, 2018). Both of these structural modifiers, AI as a complex dual use enabling technology, and leadership perceptions that are riddled with suspicions of their counterparts' intentions are the main contributors to a new form of highly technical and complex security dilemma.

AI Ecosystems

A nations overall AI development is driven by four key aspects: 1) computer systems or devices that utilize integrated circuits (IC) also known as a microchips (chips) that are suitable for running AI related computations, 2) relevant data and lots of it, 3) academic, government, and/or private sector institutions for R&D and algorithm creation, 4) and a strong commercial sector environment for dual use AI development. (Ding, 2018: 4). To meet these needs an appropriate AI ecosystem must exist. An ideal AI ecosystem will consist of access to large data sources, prominent technical research institutions, a knowledge workforce, supportive government policies, and investment incentives and opportunities for private sector companies. Governments will generally assume the role of pursuing basic research in the AI and digital technology fields that do not provide a fast return on investment (ROI). Governments will also be responsible for establishing and developing the AI ecosystem, monitoring its legal requirements, creating ethical standards, and ensuring the ecosystem's outputs are reliable and serve the nation's public and national security interests. The main purpose of an AI ecosystem is to provide a nation with advanced infrastructure and a well-trained workforce which are capable of developing secure and viable AI algorithms and supporting technologies. (Sheppard & Hunter, 2018: 8; Johnson, 2019).

China’s AI Ecosystem

China’s AI ecosystem and the CPC’s management process are arguably more efficient than that of the US. The CPC can direct through the State Council (China’s principal administrative body) how AI research priorities are established, funded, and implemented. All public, private sector, and academic AI ventures are therefore available to the CPC which can in turn order any AI research project or algorithm under development be accessible to the People’s liberation Army (PLA) (CRS, 2019a: 48-49). This accessibility is vital to China’s leaders since the majority of the world’s AI breakthroughs are coming out of commercial businesses. In addition, China’s commercial sector AI ecosystem is strongly supported by China’s whole of government approach and is thriving. Government support has backed venture capital investments which provide capital for entrepreneurial startups and small businesses bolstering an innovative environment (Allen, 2019: 10, 20). In addition, the Chinese government through the Ministry of Science and Technology (MOST) encourages and coordinates major research partnerships between its government research institutes and state-owned enterprises (SOEs) and China’s emerging innovative private sector companies to stimulate China’s overall AI development (Kewalramani, 2018).

China’s large population and its access to big data is a major factor of its AI ecosystem success. Big data is considered the fuel for AI algorithm development and China’s senior leadership has erased restrictions for indigenous data collection. This allows Beijing access and dissemination rights to over 800 million Chinese citizens constituting almost 20% of global data (CRS, 2019: 22). Lax privacy protection laws combined with a population that is largely unconcerned with being monitored, allows China’s government agencies and private sector companies to efficiently coordinate and share data thus providing each access to a vast and growing public database (Kewalramani, 2018). China is also striving to acquire data from other countries. Programs like the Belt and Road Initiative's (BRI) will enable Chinese national internet communication technology (ICT) companies to build telecom networks alongside large infrastructure projects. If successful, this would allow China access to another 30% of the world's data by 2030 (CRS, 2019a: 22; Bradsher, 2020).

China's S&T policy making apparatus is a foundational piece of its AI ecosystem. All major Policy formation are overseen by CPC's Central Committee. The Central Committee is comprised of the CPC's top leaders (205 full-time members and 171 alternates) and considered "party's highest organ of authority". It convenes at least one times per year to oversee policy matters and meets once every five years to elect the 25 strong Politburo, the Politburo's 7-member Standing Committee (PSC), and the General Secretary (President or Party Chairman). It also elects the Central Military Commission (CMC). Once elected the Politburo, PSC, and General Secretary (current Xi Jinping) are considered the supreme Party body and this is where the true power resides for the next five years. The Politburo's decision-making power is absolute and derived from its members which hold the senior most State Council positions within the PRC. Mid-level state positions are generally regulated to Central Committee with lower level state and senior provincial positions allocated to the CPC's 3000-member National Congress (Zhiyue, 2007: 300; Shirk, 2012; J.M., 2013).

Through these state positions the Politburo and the Central Committee guide and direct all of China's policy making, including its S&T policies. Policies specifically related to AI development are explored and implemented by way of the National Science, Technology, and Education Leading Small Group (see Figure 5 page 241). The Small Group is currently headed by two senior Politburo members, its other 14 members are made up of Central Committee members (He, 2017; Liping, 2019). The Politburo and Central Committee also coordinates the activities of the Central Military Commission which provides oversight for defense-related S&T policies and all research conducted through military research institutes and university affiliates. (He, 2017).

The five government ministries within the State Council that are primarily responsible for driving AI policies include 1) The Ministry of Science and Technology (MOST) which acts as the lead agency overseeing China's STI activities and is responsible for most of the S&T R&D funding and includes the growing number of AI-related megaprojects located throughout China. 2) The Ministry of Education (MOE) which coordinates all universities and educational institutions responsible for S&T research. 3) The Chinese Academy of Sciences (CAS) which overseas China's many state-owned research institutes. 4) The National Natural Science Foundation of China (NSFC) which manages basic S&T research funding including all AI-related fields 5) The Chinese Academy of engineering (CAE) which is responsible for providing strategic engineering and infrastructure advice and infrastructure project recommendations to the State Council. (He, 2017; Triolo & Goodrich, 2018).

In addition to the government ministries is the National Development and Reform Commission (NDRC) which conducts long-range planning and assesses investment requirements for the STI sectors. It also established the China AI Industry Development Alliance and provides a government platform to assist in developing China's AI industries and industrial supply chains. The NDRC operates in conjunction with MOST, the Ministry of Industry and Information Technology (MIIT), and the Cyberspace Administration of China (CAC). MIIT produces the majority of industrial and manufacturing policies and places an emphasis on the emerging digital technologies. The CAC creates the legal and regulatory standards for how AI is developed, how

China's big data can and will be accessed, and for the nation's expanding cybersecurity activities (Triolo & Goodrich, 2018). This alliance oversees the development of China's growing AI industry and includes a coalition of over 240 private sector companies (YU, 2017).

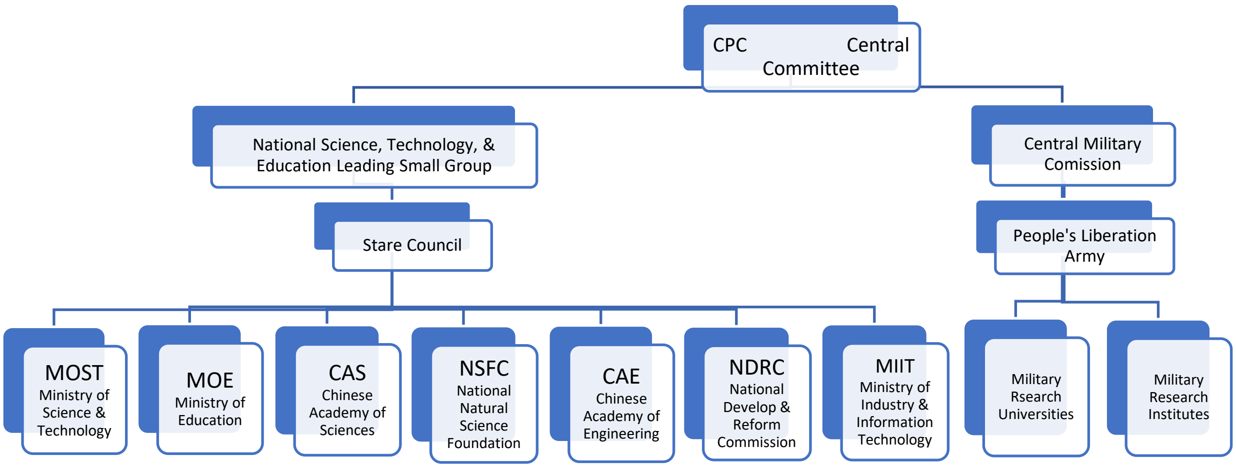

Figure 5. China's AI Ecosystem

*****Source: Wilson Center. How China is Preparing for an AI-powered Future.*

The second major component of China's AI ecosystem is its commercial sector. Private sector companies have become increasingly important to China's technological development and economic growth. They are developing into an excellent source of innovation, far surpassing that of China's SOEs (Allen, 2019). China and the US share some significant similarities in their commercial AI ecosystems. Both have excellent funding structures, unparalleled size, supportive innovative environments. However, they differ in one very important way, the US excels at innovation which entails the conceptualizing new ideas and from those ideas creating original and innovative new products / services (the 0 to 1). China's entrepreneurs on the other hand outrival competitors in implementation or taking an existing technology, prototype, product, or services, and improving upon it (the 1 to n). Once a new technology or product has been demonstrated to be a viable candidate, a plethora of Chinese private sector start-ups and small businesses rush in and begin the process of slightly modify the technology or product in order to differentiate it from its original design or patents. Once it is suitably modified the race is on to be the first to market and to rapidly scale production. The result is a fierce competition for venture capital funding and a contest market dominance (Lee & Sheehan, 2018). China's government is actively encouraging its private sector to expand upon this model, develop their own "indigenous innovation", and compete directly against the US in both capacities (Webster, Creemers, Triolo, Kania, 2017).

China's commercial AI ecosystem gives the CPC the opportunity to monitor and force private sector companies to comply with the PLA and state security services should a dual use product/service be deemed a strategic value. Article 7 of China's National Intelligence Law legally binds private sector companies and their technologies into forced cooperation. In addition to forced compliance, the new AIDP has made civil military integration (CMI) a crucial component of China's AI ecosystem and national security objectives. Companies that actively participate in the CMI are awarded privileged incentives and promises that they will be free from competition by China's large SOE's (Allen, 2019). In addition to working with the CMI, China's large tech companies benefit its AI ecosystem in other ways. They establish large open-source platforms which smaller companies can utilize to create AI applications and AI related products / services without having to incurring large equipment and overhead expenses. These high-tech MNCs also help develop innovative cutting-edge research facilities in both China and all over the world that are unmatched by other government agencies or their research institutes counterparts (Triolo & Goodrich, 2018).

China's AI ecosystem provides some significant advantages. Its primary strength is momentum. China has already secured a leading position in AI technology among the technologically advanced developed nations (CRS, 2019a: 21, 23). China is number one in AI related patents, total publications, and venture capital / private equity investment offerings. China ranks second in the number of total AI-related businesses, and in access to computer scientists and engineers, and it is rapidly closing in both these fields (Allen, 2018). China also produces four times more STEM graduates and three times more computer scientists than any other country, many of which are going into AI technology fields (Allison, 2019). Other key strengths include China's centralized "top down approach" which streamlines S&T policy creation, and the aggressive incentive and investment structure that funds the SOEs and private sector companies (Flagella, 2019). China has 1.4 billion citizens, 80% of which are not concerned with privacy or government surveillance which provides the Chinese government, its SOEs, and private sector companies with an unmatched pool of big data access (Allison, 2019).

China's greatest strength is in its accelerated rate of AI and digital technology implementation and its strong senior leadership support throughout the ecosystem. These advantages have allowed Beijing to establish programs that produced tens of thousands of recent graduates to sort through and clean up large datasets and to write routine algorithms at a relatively low cost. This frees up experienced programmers to develop more cutting-edge algorithms. Strong government support for venture capitalists ensures rapid funding for AI-related startups and small businesses enabling these more innovative companies to bring new or modified concepts or products to market faster and cheaper than western competitors (Allison, 2019).

China’s AI ecosystem has some significant disadvantages as well. Despite China’s large numbers of STEM graduates, China still has problems recruiting top tier AI talent. China’s SOE’s and private sector companies may have access to large scale financial incentives and funding opportunities, but the distribution of resources is inconsistent across the numerous tech sectors, and generally favoring the less innovative SOEs (Fagella, 2019). Other ecosystem concerns include the unpredictable domestic markets and a growing international distrust of doing business with China that Chinese tech companies are subject to China has weak collaborative R&D relationships between its state-owned research institutes and universities and China’s private sector industries. In addition, China’s AI companies, including its national champions, are still far behind in developing AI algorithms and microprocessor chips of the same quality as Western MNC competitors, and there is a significant lack of technical standards and metrics. Finally, China’s SOEs and private sector AI companies lag behind their international competitors in generating original high-quality patents and publications relying largely on modifying or tweaking those already in existence (CISTP, 2018: 106-107; Allen, 2019).

US AI Ecosystem

The US ecosystem is large and complex involving US government agencies, private sector industries, and nonprofit companies. While US government investing in Federal AI R&D activities and Department of Defense (DOD) programs still contributes significantly to AI and digital technology development, over the past few years it’s been the high-tech industry and universities that have been the source of the biggest breakthroughs (NSTC, 2016: 7, 12; NSTC, 2019: 2, 7).

There are several major departments, agencies, and councils within the federal government that are responsible for federal S&T research programs that include AI R&D. Most of these reside within the executive branch and are directed by the Administration. The primary offices of importance include 1). The National Science and Technology Council (NSTC) which responsible for enacting and coordinating US S&T policies and for establishing guidelines for how federal funds will be allocated to STI R&D programs (NSTC, 2016: iii; OSTP, 2019b; NSTC, 2019). 2). The OSTP which advises the Administration's senior leadership on all technical matters dealing with S&T policies, ensures that these policies are founded on sound scientific research, and monitors all federal S&T programs / projects to assure their output actually benefits US interests and are not for political or special interest purposes (NSTC, 2016: iii; OSTP, 2019a). 3). The Subcommittee on Networking and Information Technology Research and Development (NITRD) is responsible for managing the multiple government agencies involved in ICT R&D programs. The NITRD assures that the nation's ICT and networking needs are met and that the US remains on the cutting-edge of advanced technologies (i.e. 5G) so that it retains its global leadership position (NSTC, 2016: iii; NITRD, 2019a).

The entities mainly responsible for AI development are the Select Committee on AI and the Subcommittee on Machine Learning in Artificial Intelligence which were created to advise the Administration on R&D planning priorities and coordinate all AI related activities within the federal government (NSTC, 2016: vii). Residing under the NSTC, these committees were tasked along with NITRD to develop the National Artificial Intelligence R&D Strategic Plan. This Plan was responsible for developing research goals and funding requirements for future government, private sector, and academia AI programs. This plan was initially released in 2016 (updated in 2019) and became the foundation for future US AI policies and AI strategies (NSTC, 2019: iii).

In 2018, the NITRD's Artificial Intelligence R&D Interagency Working Group was established to coordinate many of the functions originally assumed by the NSTC Select Committee on AI and the Subcommittee on Machine Learning in Artificial Intelligence thus reducing department overlap. The working groups primary task was to direct long-term AI R&D funding, maintain legal and ethical standards for the development of AI systems, and promote public – private partnerships (P3s) research collaborations (NITRD, 2019b).

In addition to the federal offices, the Trump Administration released a fact sheet in 2018 called Artificial Intelligence for the American People. This document outlined the White House's AI priorities and explained the proposed evolution of the US AI ecosystem. The fact sheet called on the US to strengthen its AI innovation ecosystem by reinforcing the combined R&D efforts of government, industry, and academia resources, and by implementing additional AI strategic initiatives and policies (OSTP, 2019a). The most significant of these strategies was Executive Order 13859, also referred to as the American AI Initiative. This initiative emphasized four categories designed to accelerate AI technologies: "AI for American Innovation, AI for American Industry, AI for the American Worker, AI with American Values" (White House, 2019a). The executive order laid out the Administration's AI implementation plan and outlined several approaches designed to encourage AI development within the United States. ~~In addition,~~ The plan called for AI research funding prioritization, the reduction of regulatory barriers, government research standards established, and training programs created for workforce transition. In addition, dual use AI technologies would be actively pursued to ensure the US military retains its technological advantages, AI programs developed for government services (i.e. intelligence collection), and international research collaboration strengthened with a strong emphasis on working exclusively with trusted allies (Future of Life Institute, 2019b; OSTP, 2019a).

The commercial sector has grown increasingly important to the US AI ecosystem. Private sector investment has risen significantly over the past decade with the largest industry adoption rates (20% or greater) coming out of AI and digital technologies occurring in the ICT, automotive, financial services, energy, entertainment and media, transportation, and consumer goods sectors (Mckinsey, 2017: 14, 40; Priceconomics, 2018). To help fortify this commercial sector growth, the White House in May 2018 convened the Summit on Artificial Intelligence for American Industry. The summit's purpose was to assess the private sector's role and evaluate S&T policies that would ensure a US's global leadership position in AI and emerging digital technologies (OSTP, 2018a). To meet the summit's objectives, the Select Committee on Artificial Intelligence role was expanded to increase the number of private public partnerships (P3) between federal programs and AI related tech companies and to reinforce ties with universities engaged in AI R&D. The Select Committee would become part of the administrations "whole of government approach" identifying opportunities and advising the Trump Administration on AI R&D planning priorities (OSTP, 2018a; The White House, 2019a).

The US ecosystem enjoys some time-tested strategic advantages. The US has a well-established S&T R&D government – industrial – academic complex which provides the US with state-of-the-art dual use innovation. Despite being originally established for military purposes, defense contractors and research universities engaged in classified research projects have provided numerous inventions with commercial applications, and this trend will continue into the future. When it comes to AI and digital technologies, the US is projected to remain the leader in AI business software, semiconductor production, and in quantum computing for at least the next decade (Davenport, 2019). US tech companies and research universities have their own networks and highly innovative collaborations that encourages innovation including the development of disruptive technologies, something China and other nations have yet to match. The innovative US MNCs involved in AI R&D like Facebook, Amazon, Apple, Netflix, and Google (collectively referred to as FAANG) as well as a plethora of startups have traditionally been the first movers in research and bringing products / services to market in their respective fields (Allison, 2019). Regions like Silicon Valley have built their own incredibly innovative and resilient ecosystems comprised of some of the world's best high-tech companies working hand in hand with top caliber universities, government research institutes, and National Laboratories (Davenport, 2019). The prestige of working in Silicon Valley enables its companies to recruit the top 1/100 of 1% of the world's most highly skilled computer scientists and software engineers (Allison, 2019). Silicon Valley's investments in S&T R&D are strong with AI and emerging digital technologies garnering an increasing share of attention and overall expenditures (Davenport, 2019).

The US does face some disadvantages. The US government and the private sector have some significant difficulties when it comes to sharing their respective datasets. This is due to the US population's preference for privacy over security, its serious distrust of government surveillance projects, and mounting suspicions of what government bureaucracies and large MNCs will do with their private data. In addition, newly proposed privacy laws, antitrust actions, and regulations, if passed, will make accessing big data for algorithm development much more tedious. Recently, some US high tech companies have also developed a serious distrust of working with the DOD or US intelligence agencies which places limits on joint collaborations in promising dual use AI projects (Allison, 2019). Another disadvantage involves the US's inability to keep up with China in producing large numbers STEM graduates especially in the computer science and computer engineering fields. This makes the US reliant on foreign talent for its AI workforce (Rasser, et al., 2019). Finally, while the US is highly innovative, it lags behind China in implementation capabilities. The US lacks the hundreds of thousands of new programmers China can use to cleanup, orient, and manage the massive data sets required to rapidly write the basic code for new algorithm generation. There is also the growing problem of China's ongoing ability to "acquire" US innovation and intellectual property which appears to be happening at an increasingly faster pace. This erodes at the US's innovation and first mover strategic advantage (Allison, 2019).

The US and China ecosystems were compared in terms of their relevant standing in six categories deemed crucial in the development of AI for economic and national security purposes. These categories included: access to top-tier talent; R&D (basic and applied) conducted; product / service development and the speed of implementation; AI adoption levels into government programs (including military), businesses, and throughout society; big data availability and accessibility; and hardware system production (computers and microprocessor chips) (Castro, McLaughlin & Chivot, 2019). The findings illustrated that overall, the US retains the number one position in overall global AI development, finishing first in access to talent, R&D, product/service development, and hardware production. This was due primarily to the US's innovative culture, strong support for startups, dominance in semiconductor and microchip manufacturing, ready access to the world's best AI software developers and computer engineers, and original high-quality publications. China finished second overall, and first in two categories: AI adoption levels, mainly attributed to the CPC's centralized approach and ability to rapidly integrate new technologies, and big data access to over 1.4 billion Chinese citizens. However, China is swiftly closing the gap in federal and private sector funding for R&D and is making a concerted effort to catch up in the other categories as well (Castro, McLaughlin & Chivot, 2019).

What is becoming evident is that the US and China are rushing headlong to develop AI and emerging digital technologies. Each nation has identified that a comprehensive well-funded ecosystem is of vital component of those goals. However, the depth and complexity of each nation's R&D landscapes and the multiple numbers of overlapping sub ecosystems makes management and coordination of activities difficult (NSTC, 2016: 5; CRS, 2019a: 21). Complication matters further is the vast and growing network of interconnected government agencies, research institutes, universities, and private sector companies all engaged in various stages of dual use R&D projects. These complex landscapes are confusing and hard for a nation's senior leadership and policy making advisors to navigate. It also makes policy making and funding subject to inconsistent representation between the different factions as they compete for government resources (Allen, 2018: 11-12; Flagella, 2019). In addition, there is a lack of transparency as to the nature of the dual use AI research lines. This encourages suspicions among the nation's leaders as to how these technologies will be utilized and sparks further distrust and tensions between the two nations and constitutes the prime ingredients of a security dilemma (Hass & Balin, 2019).

US – China AI Strategic Initiatives and Policy Goals

AI strategies generally consist of a group of specific policies enacted to enhance AI development and improve a nation's economic and national security interests. AI strategies are comprised of two groups. The first includes strategies or strategic initiatives that contain both AI specific policies and some type of government funding dedicated for those policies. The second group is comprised of a wide range of strategic initiatives beginning with initiatives which have no coordinated or discernable strategy but do contain at least a set of related AI policies initiatives, and progresses to initiatives made up of AI related policies, guiding documents for strategy implementation, and a recognized commitment for future funding (Dutton, Barron & Boskovic, 2018: 5). Guiding, or strategic AI documents are also vital to AI Strategies, they task agencies; bring to bear resources, assets, and people, and establish processes that will serve the nation's AI implementation goals (NSTC, 2019: 2). China implemented and funded its first AI specific strategic initiative in mid-2017 and the US followed suit in early 2019 (He, 2019).

China AI Strategic Initiatives, Plans, and Policies

One of the biggest indicators of whether an AI strategy will be successfully implemented is a nation's strong senior leadership enthusiasm and support. AI is considered by China and the other technologically advanced developed nations as a strategic technology, one that promises international commercial competitiveness and enhanced defensive capabilities (Webster, Creemers, Triolo & Kania. 2017)". President Xi Jinping announced in October 2018 that China will "achieve world leading levels" in AI technology and reduce its reliance on global imports of key technologies (Allen, 2019: 4). Strategies such as the AIDP, Made in China 2025 (MIC 2025) and their associated policies and documents were to represent the foundation of China's AI strategy and would receive the highest levels of strategic attention. Funding for the implementation of all AI-related initiatives and plans have already exceeded billions of dollars and China is only getting started (CRS, 2019a: 6; Davenport, 2019)

China's AI strategic initiatives can be traced back to February 2006 with the release of the National Medium and Long-Term Plan for the Development of Science and Technology (2006 – 2020). This medium to long-term plan would establish the parameters for R&D investing into frontier technologies, later referred to as emerging technologies (see Figure 6 for timeline). The first of the emerging technologies that China looked into developing included: AI, smart robotics, and virtual reality (He, 2017). In 2011, China followed with the released the 12th Five Year Plan (FYP) (2011 – 2015) which described "scientific development as a primary objective" and targeted high value manufacturing as a strategic emerging industry (SEI). AI integration into what would soon become smart manufacturing systems became a primary driving force behind this new SEI. (Casey & Koleski, 2012: 8, Gu 2012). AI's importance to China's senior leadership and to the State Council was solidified in 2015 with the release of the 13th FYP (2016 – 2020). The 13th FYP described innovation as the central focus of China's new development paradigm and laid out the need for AI related strategic initiatives, policies, and documents (He, 2017). In addition to the overall 13th FYP there were several specific topic FYP's released in the same year that related to AI. These included: the FYP for National Science and Technology Innovation which outlined plans for AI and advanced robotics integration into ICT, advanced (smart) manufacturing, and STI projects; the FYP for Developing National Strategy and Emerging Industries which raised AI development importance to 6th out of 69 in major central government objectives and reprioritized government resources to match the new ranking; and the FYP for Intelligent Smart Manufacturing which outlined the need for a new generation of industrial robotics, a smart manufacturing sector, and the eventual integration of AI into the up-and-coming Internet of Things (IOT) (He, 2017; Hong, Cheung & Sit. 2015: 12-13; Xinhua, 2016).

The 13th FYP also generated two of the most influential strategic initiatives concerning China's development of AI, the 2015 MIC and the Internet Plus. The 2015 MIC 2025 was directed by the State Council and the MIIT and emphasized AI integrated methods for smart manufacturing, semiconductor production, and advanced robotics. The "Internet Plus" Action

Plan led by the State Council, NDRC, MIIT, MOST, and CAC called for accelerating AI and ICT into a variety of industry sectors. When combined, these two major initiatives further demonstrated AI's high importance and strategic value to China's senior leadership and how AI was being prioritized for government funding and support (He, 2017; Triolo & Goodrich, 2018).

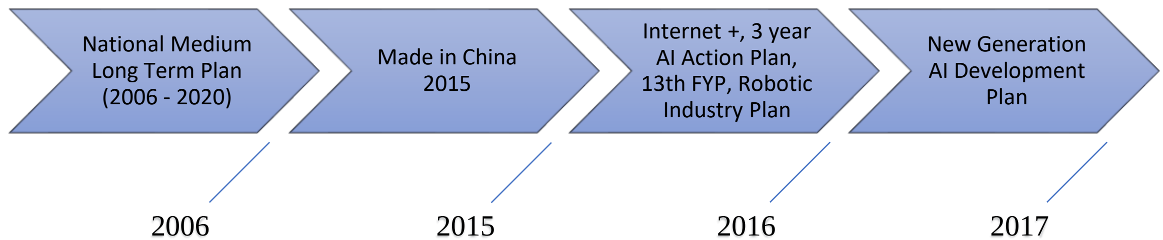

Figure 6. China's AI Strategies and Policies Timeline

Source: *Takshashila Institution. Quest for AI Leadership: Prospects and Challenges.*

In 2017 China released a variety of additional plans that introduced several new technology policies incorporating AI. These included the Robotics Industry Development Plan (2016 – 2020) which was led by MOST and required concrete targets for the development of the robotics industry and for AI integration, a revised implementation plan for "Internet Plus" modified by the NDRC that increased the utilization of AI into commercial sector ICT, the Artificial Intelligence 2.0 AKA the New Generation Artificial Intelligence Plan developed by the State Council and MOST which provided a wide-ranging initiative to increase investments in AI education programs and project development, and the Artificial Intelligence Three Year Action Plan led by NDRC which fostered AI development and integration into nine key engineering fields and a framework for how to grow the AI industry (He, 2017; Triolo & Goodrich, 2018). All of these strategic initiatives and supporting plans increased policy level priorities for AI R&D and industry development. These plans were also accompanied with greater government funding and workforce support, expanded of university curriculums, created new markets, and raised support for private sector collaboration (He, 2017; Ding, 2018).

Building upon these earlier strategic initiatives, China unveiled the AIDP on July 2017, a pivotal strategic plan which designated AI as China's "new engine of economic development" and provided an overarching vision for how Beijing would develop AI technology going out to 2030 (Kewalramani, 2018). The AIDP called for implementing a "three in one" agenda to correct existing problems in China's AI R&D ecosystem. The agenda would consist of developing a wide range of AI products and applications, creating new processes, and establishing a prominent AI industry (Kania, 2017b). The strategic initiative sought to utilize AI technologies to stimulate China's economic development, protect its national security, and improve social construction and cohesion. (Kewalramani, 2018). The goal was to make China an international competitor in targeted AI fields by 2020, attain "world leading" status in AI research by 2025, and become the world's foremost innovation hub and global leader in AI by 2030 (Dutton, 2018).

The AIDP also required expanding China's military – civil fusion, referred to as the CMI, into a broader number of emerging technologies including AI to overcome the US's competitive edge. The Military-Civil Fusion Development Commission was tasked to coordinate efforts to strengthen China's defense industrial base. Its purpose was to integrate AI throughout China's extensive civilian product lines, government intelligence and surveillance programs, and new military platforms (Kania, 2017c). In addition, the CMI was responsible for transitioning ~~commercial~~ private sector AI development into emerging new commercial fields and military weapons systems. China's senior leadership strongly believe that the PLA and China's overall national security would benefit from the improved performance of AI embedded military platforms, the speed and efficiency increase of AI generated command-and-control systems, and advances in cyber security and cyber offensive operations (Kania, 2017b; Kewalramani, 2018).

US AI Strategies and Policies

The Trump Administration considers China's aggressive pursuit of AI's dual use capabilities a direct threat to its economic and national security interests. The initial US policy response to China's AIDP's and CMI were implemented as part of larger counterbalancing measures aimed at years of unfair trade practices and intellectual property theft. The ultimate goal was to slow China's accelerating progress in AI and digital technologies R&D. The primary countermeasure targeted directly at AI involved restricting China's digital technology companies access to US technologies with military and/or intelligence collection applications (Borzykowski, 2018; Tayal, 2019) The Administration also placed limits and restrictions on US foreign direct investments (FDI), applied tariffs on trade with a special attention given to the tech sectors, invested in additional cybersecurity and counterintelligence programs to reduce China's intellectual property theft, and increased prosecution rates for technological and economic espionage (Laskai, Lorand & Sacks, 2018).

In addition to the counter balancing measures, the White House in July 2018 announced that US leadership in AI and emerging digital technologies would become the US's second leading R&D priority and that an additional $2 billion annually for unclassified R&D programs would be provided. Another $2 billion was allocated to the DOD for defense related AI projects over a five-year period (Future of Life Institute, 2019b). Most of this funding went the Defense Advanced Research Projects Agency's (DARPA) ‘'AI Next" campaign. "AI Next" was running 20 dedicated AI programs and over 60 additional programs with varying degree of military AI applications. The campaign's focus was on "transforming computers from specialized tools to problem-solving partners" in defense related matters (DARPA, 2018).

Prior to these activities the Trump Administration had revised the National Security Strategy (NSS) in 2017 to prioritize the safeguarding of US global leadership in STI. This would require new policies geared towards developing and funding emerging technologies research with special attention dedicated to the digital technologies (advanced computing, data sciences, digital encryption, and AI). The new NSS would also recognize the National Security Innovation Base (NSIB) and US commercial sector research and its intellectual property as strategic competitive advantages that must be protected (White House, 2017). The Trump Administration would demonstrate an even stronger commitment to AI in the 2018 National Defense Strategy (NDS) when it announced that investments in AI technologies with military applications were to be increased at the same rate as other prominent emerging technologies. The NDS had assessed the importance of commercial sector's S&T development and determined that a greater number of technological advances are coming out of private sector companies than from government research institutes (DOD, 2018: 3). The NDS also stated that the development of new digital technologies especially AI would be a key to the future of warfare and US national security (Goure, 2018). Therefore, in order to maintain US defense technological superiority, the NDS required that NSIB protections be spread across all government, commercial sectors, and university ecosystems. It also addressed growing changes in industry culture, for example, how Google employees had demanded the cessation of the military's Project Maven, and how federal funding and incentives were to be best allocated across the expanding AI ecosystems (DOD, 2018: 6-8; Hollister, 2018).

In 2019 President Trump signed an Executive Order that would launch the American AI Initiative. This initiative was the US's first foray into a comprehensive AI strategy and was designed to bring the full strength of the US Government's resources to support of AI development. The overall purpose of the initiative was to develop and utilize AI's dual use capabilities and its vast integrative capacity to drive US economic growth, fortify national security, and increase the future prosperity and quality of life for US citizens. (White House, 2019b).

The American AI initiative requires the following five elements to help develop AI technology: 1) Increase and prioritize AI R&D investments. Utilize federal agencies and their funding to strengthen AI R&D ecosystems including government, industry, and research universities. 2) Make more accessible government (federal, state, local) and commercial sector data bases for AI R&D, algorithm development, and industry uses (OSTP, 2019a). Note - access to large data sets are vital for AI enabling it to learn by reiterating and updating information which allows it to experiment and evolve its algorithms. It also accelerates AI research breakthroughs and advances scientific discovery, intelligence collection, national security capabilities, and commercial competitiveness (Hansen, 2017: 3) Establish standards for AI development across the different technology lines and industry sectors. The National Institute of Standards and Technology (NIST) is to be responsible for setting and maintaining technical standards for all US AI interoperable systems. 4) Build an AI workforce program that will help American workers re-educate and adapt to AI related jobs. The American Workforce Policy Advisory Board will sponsor training programs, apprenticeships, and fellowships to train American workers in AI relevant skillsets in computer science, software engineering, and other AI related STEM fields. 5) Maintain an international collaborative environment promoting AI research cooperatives and ensuring that US high tech companies have access to foreign markets. Develop an action plan to protect all US AI and digital technology research and innovation from intellectual property theft, cyberattack, and foreign espionage (OSTP, 2019a). The NSTC Select Committee on Artificial Intelligence was selected to coordinate all agencies and departments currently involved in AI research and program development. Its responsibilities include establishing AI regulations and guidelines and providing federal assistance and grants for AI projects and research (Future of Life Institute, 2019b).

One day after the American AI Initiative was announced the Department of Defense (DOD) released their own Artificial Intelligence Strategy. Also released as an Executive Order, the DOD's AI strategy concentrates on the dual use nature of AI, making sure that the US retains global leadership commercially while vigorously developing AI technologies for national defense purposes. The DOD AI Strategy will work alongside and support the NDS (Cronk, 2019). The strategy comprises the following tasks: 1) The creation of the Joint Artificial Intelligence Center (JAIC) which is responsible for "coordinating the efforts of the Department to develop, mature, and transition artificial intelligence technologies into operational use". 2) Publish guidelines for military AI development and operational functions, rules for the moral and ethical use of AI systems, and legal considerations for the ~~application~~ use of AI embedded weapon systems and support technologies. 3) Establish the National Security Commission on Artificial Intelligence to identify the best methods of advancing AI for defense and national security purposes. 4) Conduct an in-depth evaluation of all military related AI technologies, their applications, and which weapon platforms are capable of benefitting from AI integration to enhance US military competitiveness (CRS, 2019a: 5).

In addition to the introduction of the American AI Initiative and the DOD's Artificial Intelligence Strategy the National AI R&D Strategic Plan was updated by the OSTP in 2019 to identify key AI technologies in need of federal R&D funding. The plan expanded its focus to include: evaluating and providing investments for long-term AI programs; develop legal, ethical, and safety standards; produce benchmarks and metrics for evaluating AI technologies; incentivize P3 collaborations to hasten R&D breakthroughs, conduct studies that would best determine AI related workforce needs and how best to transition workers into those fields, launch a program that makes available large public datasets for AI related training and algorithm development, and establish procedures for the up-and-coming field of human - AI collaboration (NSTC, 2019: 2-4).

Both the US and China realize that strong supporting national strategies and policies are the key to becoming a global leader in AI technologies (Dutton, 2018). China's senior leadership have since determined that they must become a high value (high tech) producers and exporters to sustain economic growth and avoid the middle-class trap. At the same time, growing concerns over regional vulnerabilities and an outdated military has raised alarms among CPC policy making circles that China must modernize its military with advance technologies (Kania, 2017c; McBride & Chatzky, 2019). China's 13th FYP, the MIC 2025, and the AIDP were enacted to accomplish these objectives. Dual use technologies such as AI and digital technologies are considered essential to the next round of "industrial transformation" and the most efficient manner of enhancing PLA weapons capabilities (Kewalramani, 2018: 4-5; Panda, 2019). However, the introduction of China's strategies, plans, and policies, and the successful escalation of AI's dual use capabilities are aggravating regional tensions and have raised suspicions among surrounding nations as to how China will go about securing regional goals. It also represents a challenge to US technological and military hegemony who have been comparably slow in enacting their own national strategies (Kania, 2018; Castro, McLaughlin & Chivot, 2019).

The White House and DOD AI strategies and policies have received scrutiny for being more of a reaction to China's multi-phase and well-funded national strategic initiatives than a proactive strategic measure to dominant global competition. The Trump Administration and the DOD realized in 2019 that if the US intends to retain its technological and military hegemony and effectively counter China's rapid emergence in digital technologies that immediate policy actions were necessary (White House, 2019b; DOD, 2019b). Thus, the US national AI strategy was established to not only enhance AI's dual use R&D and product / service development but to operate alongside previous counterbalancing measures designed to decouple US – China AI and ICT collaborations (Monier, 2019; Tayal, 2019). Not surprisingly, China's senior leaders considered these actions unwarranted attempts to limit China's ability to produce high-value (high-tech) goods and to slow its technological and economic growth which they believe is necessary to avoid the middle-class trap, preserve regional interests, and ensure its national security. China quickly initiated their own policies directing tariffs and technology restrictions aimed at US exports (Borzykowski, 2018; Tayal, 2019).

Each nation's national strategies and policies are hard to define, much less to enact and properly fund. This is due to the maze of all the competing agencies, ministries and bureaucratic offices (Andriole, 2018). Both nations national AI strategies have increased tensions and exacerbated misperceptions between the two nations senior leadership as each engages in new rounds of tit-for-tat policy responses and ignore the claims of their counterparts, that the true purpose of their AI policies, are to ensure national security and to maintain or gradually improve their position in the international order, and not to pursue aggressive regional actions (Allen, 2019: 4; CRS, 2019a: 19-21).

Digital Dual Use leapfrog Technologies

AI is considered an enabling technology that makes existing or recently developed products, services, and processes more efficient, precise, and useful (Lee, 2017). Self-learning algorithms have already reached a sophisticated level of development and are utilized for an increasingly wide range of dual use (commercial and military) purposes. AI and digital technologies are still in their relative infancy providing governments and companies willing to invest in R&D with first mover advantages (Sharikov, 2018: 363). The commercial use of AI is extensive with most of the cutting-edge R&D momentum coming from the private sector. For profit companies are the main providers of an increasing number of machine learning (ML) AI systems that can be utilized throughout multiple business sectors (Barton, et al, 2017). AI's dual use nature combined with its enabling capabilities can also be extremely beneficial to a government's economic and national security interests by increasing program efficiencies and reducing costs. AI technologies can represent a significant security risk in the hands of aggressive states or hostile non-state actors (Pandya, 2019). On the military side, only three countries have thus far seriously engaged in developing AI embedded weapons platform and support systems: The US, China, and Russia, with the US and China dominating global AI military investing (Sharikov, 2018: 363).

Emerging Digital Leapfrog Technologies

Technological leapfrogging occurs when a developing country or a developed country that lacks technological expertise in certain industry sectors bypasses many of the hard-earned and time-consuming research stages required in the technological development process and moves straight into the R&D of new cutting-edge technologies. This is generally accomplished through the following process: the developing country acquires another nation's existing research or newly developed technology, it starts a research line based off the other nations progress or reverse engineers the new technology, it then reproduces the technology with minor modifications or improvements, and finally the newly adopted technology is re-patented as is own new innovation or is used as a launching pad for products in adjacent fields (Bhagavan, 2001). I have combined the definitions of digital leapfrogging and emerging digital technologies to create the term 'emerging digital leapfrog technologies' which I will use through the remainder of this manuscript. I define this term as creation and utilization of computer-based digital technologies including devices, systems, and processes, for which research, product / process development, and commercial / military applications have yet to be realized or are underdeveloped (Rotolo, Hicks & Martin, 2015: 34; Dictionary.com, 2020).

Emerging digital leapfrog technologies include but are not limited to the following: AI, big data access, 5G, quantum computing, cloud networks, block chaining, next generation ICT, augmented reality (AR), virtual agents, and IOT (Moffit, 2018; Newman, 2018). What sets these digital technologies apart from other emerging technologies is that each of these technologies is not only suitable for dual use purposes but how thoroughly they can be integrated into a nation's government, commercial sector, and society as a whole (Deibert, 2016). AI's self-learning capability and enabling capacity is not only a valuable technology in and of itself but is also the foundational operating component of each of the other emerging digital technologies (Fitzgerald, Kruschwitz, Bonnet & Welch, 2013).

The widescale integration and use of these emerging digital technologies is projected to spread exponentially throughout almost all societal frameworks. Once they are widely adopted, starting with the technologically advanced developed nations and progressing throughout the world, their enabling and disruptive nature is set to transform job markets, revolutionize industries (Industry 4.0), stimulate economic growth, enhance government functions, and even alter societal preferences on a vast scale (IMF, 2018). The leapfrogging characteristics of these technologies are excellent allowing any nation's government or commercial sector to rapidly access cutting-edge R&D and advanced production capabilities thus allowing them to bypass the long and costly technological R&D process, providing they have suitable research infrastructure institutions are in place (BCG, 2018).

Leapfrogging - China's Opportunities & Challenges to US Dominance

Among the emerging digital technologies, China's senior leadership consider AI as the most important to their future economic power and their military modernization objectives (Allen, 2019). The AIDP identifies AI as both a leapfrogging opportunity and disruptive technology and explains how China is better suited than the US to embed AI into commercial products and military platforms. It also describes how AI can be more thoroughly integrated throughout the Chinese society and into the PLA and the intelligence security services at a much faster pace due to the CPC's centralized command and control structure (FLIA, 2017: 2-3; Xu, 2019). China's leaders believe that the US's dominance in high-tech conventional weaponry is actually a disadvantage. They cite how the US has grown to accustomed to long-term contractual obligations, complicated procurement processes, and bipartisan political wrangling over defense spending, all of which slow and bottleneck the transitioning to emerging technologies such as AI. Beijing believes that the US is currently underinvesting in AI and dual use digital technologies, especially those with definitive military applications and that it will continue to do so preferring to invest in its current military organizational and force projections requirements (Allen, 2019;

Harper, 2019). China's senior leadership on the other hand, have proclaimed a dedicated commitment to AI. Investment estimates for total government spending across China's AI ecosystem increased from US $12 billion in 2017 to projections that will exceed US $70 billion for 2020 (Andriole, 2018).

China's leaders appear dedicated in their pursuit for leapfrogging opportunities. In 2018, President Xi Jinping announced that China will become a global leader in emerging digital technologies, specifically targeting AI, big data, cloud computing, quantum computing, and smart manufacturing. Plans are currently in place to invest US $400 billion over the next decade in an to attempt to ~~globally~~ upgrade the world in China's latest generation of ICT and 5G systems (Shi-Kupfer & Ohlgerg, 2019: 8, 26). Beijing also wants to surpass the US's lead in quantum computing, quantum cryptography, and quantum communication networks, and is allocating US $50 billion over the same 10-year period for R&D funding and dedicated university and national research centers. This is roughly ten times the amount the US intends to invest in these technologies (Giles, 2019). In addition, China's leadership has plans to significantly increase investments in R&D and industry development for expanding big data storage and retrieval systems, cloud computing networks, block chain technology, and for the development of the IOT (Shi-Kupfer & Ohlgerg, 2019: 8, 19, 30).

In response to China, the US has strengthened its commitment to investing in AI and emerging digital technologies. In the 2019 State of the Union address, President Trump stated that emerging technologies with AI at the forefront will be the driving factors for future commerce and productivity and will transform industry and society. He also proclaimed that "continued American leadership in artificial intelligence is of paramount importance to maintaining the economic and national security of the United States" (OSTP, 2019a). The

American AI Initiative calls on the US government and private sector to maintain its global leadership in AI R&D while becoming early adopters in AI workforce development, erecting global standards, establishing a cooperative international environment with partnering countries, and accelerating technological breakthroughs and innovation (OSTP, 2019a; Parker, 2019). Washington is keenly aware of China's attempts to leapfrog the US in key digital technologies and that its current technological dominance cannot be taken for granted. The Trump Administration has announced that the days of China routinely commercializes US innovation at the expense of its private sector companies are over, any further attempts to "acquire" ICT and other advance digital technologies will be met with additional tariffs and strict government restrictions (Ghosh, 2019; Ghaffary, 2019**).**

The US has already taken a heavy-handed approach against China as part of its earlier counterbalancing measures by banning China's 5G networks and ICT companies like Huawei for potential spying. This ban was also designed to slow China's 5G and new gen ICT rollout providing US and Western MNCs such as Ericsson and Qualcomm the opportunity to catch up. The bans were also put in place to reduce the effectiveness of China's leapfrogging ambitions and demonstrate that the US was prepared to decouple from China over advanced digital technologies (Sputnik, 2018; Monier, 2019; Tayal, 2019). After this first round of countermeasures, the US imposed additional restrictions under the Export Control Reform Act (ECRA) targeting US exports of digital technologies that were deemed vital to US national security. The first of these restrictions applied only to ML neural networks involved in geospatial imagery and point of interest analysis, but an entire series of additional restrictions is expected (Vincent, 2020).

The problem the Trump Administration currently faces is how to maintain the successfully collaborative and innovative environment of the military-industrial-academic complex while trying to protect US STI research and prototype development occurring in the emerging digital technologies from China's growing array of acquisition capabilities. Complicating this problem are the many US commercial companies that are willing to engage in tech transfers or turn a blind eye to China's intellectual property theft and corporate espionage in exchange for market access (Kennedy & Lim, 2018; Ghosh, 2019). To counter this concern, the Trump administration has planned additional policies designed to monitor and control private sector dual use technologies that could end up in China or one of its subsidiaries. The Administration believes that one of the keys to slowing China's technological growth is to slow the flow of US innovation and FDI crossing into China and to limit China's access to US high-tech companies. Export controls are expected to be the primary means of accomplishing this. Export controls will begin by targeting AI, semiconductors, and precision AI development tools, and expand if necessary, into the other emerging digital technologies (Hille & Waters, 2018)

The reason that AI is of such importance to US technological hegemony and such an excellent leapfrogging opportunity for China is because AI can be integrated into virtually every emerging digital technology enabling them to operate more efficiently and, in some cases, intelligently. These advancing digital technologies will then be integrated throughout every fabric of society (Pandya, 2019). In addition, AI is recognized as the technology with the greatest disruptive paradigm shifting potential and is projected to revolutionize commercial products and military weapons systems alike (Bey, 2018). The combined leapfrogging opportunities and disruptive nature AI will have on existing technologies, business models, and military systems produces another layer of complexity that each nation's senior leadership must deal with

(Bloomberg, 2018). The push to develop dual use digital leapfrog technologies, its capacity to make China or any state / non-state actor highly competitive at a fraction of the time and cost, and the lack of transparency regarding a nation's real intention for its ultimate use adds additional distrust to already strained tensions between the US and China (Allen, 2019: 8-9; Kania, 2018).

AI Civilian Applications & International Competitiveness

Accelerating advancements in AI and its widescale integration potential have increased international competition among the technologically developed nations as each strive to become first movers and dominate AI and the digital technology fields (Kania, 2017a). Because of AI's growing commercial research, product development success, and industry growth projections, private sector dual use projects are becoming increasingly important to these nation's national security and military programs. Most of the world's cutting-edge R&D is now happening at private sector research facilities and universities, not in government laboratories as was the case in prior decades (CFR, 2018). Global competition over emerging digital technologies development has intensifying with the US and China's large MNC's in the driver's seat. Each nations' prominent high-tech companies have expanded their R&D budgets in the anticipation of the Golden Age of AI that private sector CEOs believe is soon to occur (Allison, 2019).

The US remains the current leader in overall AI research and investment. There are more US AI businesses engaged in commercial sector R&D algorithm development than in any other country (Knight, 2017; McNutt, 2019). US high tech companies enjoy freedom from government surveillance and are not required to research or develop dual use technologies for military ~~uses~~ applications unless they choose to contract with the government (Mitchell & Diamond, 2018). The main US private sector companies include Facebook, Apple, Amazon, Netflix, and Google.

These MNCs cumulatively are referred to as FAANG. Other prominent AI related US companies include IBM, Microsoft, and Nvidia. AI related investments from these companies total over US $54 billion with the vast majority of the spending dedicated to R&D (Davenport, 2019).

China's private sector companies in contrast are closely monitored by CPC grassroot committees, assigned government officials, and are required to form their own formal party branches at the executive level or cells within their divisions. AI and digital technology startups are 'encouraged' to sell sufficient stock shares to government offices so that a CPC or government representative will have a seat on their Board of Directors (Tai, 2018). Chinese private sector companies are also required to grant government ministries access to existing technologies or those under development that are deemed of interest to the PRC, for example, AI embedded facial recognition or surveillance algorithms (Mitchell & Diamond, 2018).

Despite its forced government compliance, China's commercial sector is rapidly catching up with the US in AI research and marketable products / services. China's major emerging digital technologies companies are referred to as BAT (Baidu, Alibaba, and Tencent) with recent AI startups like iFlytek, SenseTime, and Megvii quickly moving up in global prominence. China refers to these companies as their "National Champions" (Davenport, 2019). Investment data for Chinese tech companies is often difficult to assess but leading sources like the 2017 McKinsey Report estimate that these National Champions have already invested between $20-$30 billion in AI and digital technologies, both in China and internationally, with approximately 90% of those expenditures going to R&D (Sheppard, Lindsey & Hunter, 2018).

Speculation has arisen among peer monitoring agencies that China may have by now surpassed the US in venture capital (VC) and private equity (PE) investments for AI startups. Increases in VC and PE startup investments have traditionally been good indicators of a nation's rise in innovation (Davenport, 2019). China has allocated between US $6 - $9 billion in 2016 and increased the amount to US $9.3 billion in 2018 for PE and VC investment in AI startups and innovative small companies (Sheppard, Lindsey & Hunter, 2018; Davenport, 2019). This has transformed China's AI startup ecosystem once considered comprised of predominantly copycat companies into an entrepreneurial environment capable of producing unicorns (companies with valuations over $1 billion). These highly competitive startups are also vested in developing technologies capable of leapfrogging Western competition (Lee, 2017). Not to be undone, the US still has the largest number of startups receiving funding and incentives and intends to ramp up government programs to entice the VC and PE to invest more in AI (Davenport, 2019; Su, 2019).

China's senior leadership intend become a global leader in commercial digital technologies by 2030. They project the AI industry alone will be worth close to US $150 billion (Kharpal, 2017). Both industry experts and policy analysts agree that China may very well be on its way to accomplishing this. China already dominates the financial technology (fintech) markets with companies like WeChat which provides US $19 billion worth of mobile payment services to over 900 million Chinese. US companies like Apple Pay has yet to reach US $1 billion of service and is used by only 22 million customers (Allison, 2019). Two of China's fastest-growing facial recognition AI unicorns, SenseTime and Megvii's Face++ have combined with Hikvision and Dahua. These last two companies are China's largest global security camera manufacturers and control over 33% of the global security camera market. This collaboration will work directly with the CPC and will receive database access to over 1.4 billion Chinese citizens. This big data access is unmatched worldwide and invaluable to the SenseTime and Face++'s AI algorithm development (Russel, 2018; Allison, 2019). China's startup iFlytek already has user database access to over 700 million Chinese citizens and both-outperforms and has a larger market share than the combined efforts of the US's Apple's Siri, Microsoft's Cortana, Amazon's Alexa, and IBM's Watson in natural language processing (NLP) In 5G, China's Huawei outright controls the entire Chinese market and has attained a 28% share of the global market. Huawei is providing 5G services well in advance of any of its global competitors and is expected to make the first 5G phone available to the public a full year ahead of Apple or Samsung (Allison, 2019).

The US and Chinese MNCs are going head-to-head against one another in the international markets. What is important to note here is that all digital technology development being conducted by these companies are also being evaluated for their dual use military and intelligence collection capabilities. China's senior leadership is using the MOST to support their national champions in the following AI and digital technology sectors to compete head-to-head against US MNCs: Baidu will develop voice recognition and autonomous vehicles; Alibaba will advance e-commerce, cloud commuting, and smart cities; Tencent will be used to transform China's medical industry. The two fast growing startups startups iFlyTek and SenseTime were provided government assistance to develop voice recognition, facial recognition, and computer vision (Kania, 2017a; Lee, 2018). In a more direct comparison to US MNCs, Baidu is competing with Google for global operating systems, Alibaba is challenging Amazon for big data storage and cloud networks for AI algorithm access capabilities, and Tencent and Facebook are facing off on which will dominate the online consumer applications markets (Lee, 2017).

In addition to AI software development, equally important are AI hardware requirements. AI algorithms process massive amounts of differing types of data, this requires very powerful and specialized microprocessor chips referred to as AI accelerator chips. These chips can be custom designed to specific AI tasks such as voice recognition or computer vision for greater efficiency (Nanalyze, 2016). Chips built for specific applications only need to focus on the requirements of those particular applications and can be built on older generation, less expensive, and easier to develop integrated circuitry (IC) technology. This has allowed a wide variety of new chip makers in China to emerge and challenge the dominant US manufactures Intel, AMD, Altera, and Nvidia (Lee, 2019).

AI Influence on Emerging US – China Tech War

The US and China are engaged in a growing technology war and potential high-tech arms race over who will hold the dominant position in the fourth industrial revolution. The impetus for this tech war is China's rapid emergence as a technological power and its strategic goals to dominate key emerging technologies which represents a threat to US technological hegemony (Mourdoukoutas, 2019, Panda, 2019). Both China and the US consider the emerging digital technologies especially vital to their nation's technological futures and economic growth. Each nation' s senior leadership have publicly announced they intend to dominate these technologies internationally and are committed to developing these technologies with dual use leapfrog technologies receiving the greatest support and investment interest (Special Report, 2019; Ward, 2019).

This tech war is being aggravated by the Trump Administration's counterbalancing measures and threats of additional bans and restrictions aimed at China's large ICT companies, and by President XI Xinping's heavy-handed rhetoric regarding the need to modernize and prepare its military for potential conflict. (NSITEAM, 2019: 20, 118; Donnan & Leonard, 2019). High-tech collaborations between the US and China have soured to the point where both countries senior leadership have started to view the development of AI and other digital technologies as a zero-sum game. Each nation has become more internationally competitive and less reliant on one another's high-tech inputs and supply chains. These conditions are spurring a decoupling between the US and China over collaborative AI R&D projects and private sector research partnerships and is increasing and the likelihood that a broad base decoupling involving all the emerging digital technologies is inevitable (NSITEAM, 2019: 118). The Trump administration is looking closely at the US commercial sector and is considering additional policies designed to monitor and control private sector dual use technologies that could possibly end up in China. The administration believes that one of the keys to slowing China's technological growth is to reduce the flow of US innovation and FDI into China and to limit China's access to US high-tech companies and their dual use technologies. Export controls are expected to be the primary means of cutting China's access to these technologies. Future export controls will not only target AI algorithms, but focus equally on semiconductors, advanced microchips, and precision AI development tools (Hille & Waters, 2018).

In response to the threat of a high-tech decoupling, China is working at a fevered pace to develop their indigenous innovation ecosystems and reduce their reliance on Western technologies. China's leadership appears committed to challenging the US innovation advantage (China already dominates in implementation) which they believe is necessary to secure a leadership position in the AI and the other digital technologies industries by 2030. (Kharpal, 2017). To build an innovative environment within China, the Chinese government has generated plans to protect its AI leading companies in both domestic and global markets, provide subsidies and easy access to big data from government sources, and to provide support to venture capitalists for AI startups, all of which will be far in excess of anything the US or Western nations (Allison, 2019).

China for its part still seeks to take advantage of US FDI, tech transfers, and other previously successful means of "acquiring" intellectual property from foreign companies in exchange for its market access (McBride & Chtzky, 2019). China's goal is to reach technological parity with the US in AI and digital technologies with leapfrogging potential in order to reduce the effect of future US counterbalancing measures. The US considers these actions as just another in a long series of coercive practices directed at Western companies and has grown impatient with China's illicit methods of intellectual property acquisition and its dishonest means of doing business. (NSITEAM, 2019: 95, 101). The US is also highly suspicious of how China ultimately intends to use these technologies and will not hesitate to engage in further export controls or other decoupling measures. The technologies currently under export scrutiny include the following digital technologies: AI ML algorithm development, big data analytics, computer vision, voice recognition, and early-stage brain computer interfacing. Non-digital emerging technologies which utilize AI in some manner in their finalized form include robotic systems, smart manufacturing, new materials, and hypersonic missiles. There are more technologies under consideration all of which with dual use characteristics (Mohan & Hao, 2018).

Both the US and China's senior leadership are aware of the problems associated with the tech war. The biggest problem is the onset of a full-scale AI driven arms race. Several US think tanks reports and internal Chinese government reports have raised alarms regarding the threat of that a high-tech decoupling would be followed by an AI arms race and what the global ramification would be to world markets and global supply chains. There is also the concern that if protracted it could escalate into a full-scale arms race. The reports also call for the need for international standards, norms, and treaties all aimed at arms controls (CAICT 2018; Pei, 2019a). However, China's senior leadership remains resolute on the need to dominate the technology and is not only actively developing and utilizing AI embedded autonomous weapons, robotics, and surveillance devices, they have started exporting them to other countries, and are actively pursuing additional international clients (Allen, 2019: 6).

The tech war is recognized as the-underlying cause behind the broader US – China trade war, therefore, it has bigger implications and if left unresolved could have a drawn-out impact on global trade and geopolitics (Lynch, 2019). Attempts at resolving the tech war have been difficult, its depth and breadth are enormous. As AI and the other digital technologies become more integrated throughout each nation's government, military, commercial sectors, and society, it becomes increasingly problematic for their senior leadership to ~~understand~~ comprehend and enact policy accordingly much less avert the tech war from spilling into every quarter of technology. Equally problematic is that most US and Chinese policy makers are hardly aware of its existence and there are few strategies being considered to avoid its escalation. These conditions add another round of complexity and further convolute leadership perceptions regarding the security dilemma each nation is facing (Andriole, 2018; Bey, 2018)

AI Military & Intelligence Collection Applications

AI R&D and military algorithm development is becoming more and more vital to each nation's national security, defense goals, surveillance, and espionage activities. Advances in AI are creating new functional capabilities and reducing the cost of existing military systems throughout a broad range of applications. Chief among these applications are autonomous military hardware systems and robotics / drone systems (Allen & Chan, 2017: 2, 13-14; Allen, 2019: 6, 8). As ML and DL capabilities continue to expand, and weapon systems integration costs decline, AI-embedded robotic and weapon systems will proliferate among the technologically advanced developed nations. This increasing utilization of AI-embedded military hardware systems, combined with autonomous decision-making capabilities, and growing access to an ever-increasing array of sensors and data sets, has already exceeded both human and modern computing proficiencies. This is creating an escalation in each nation's military strength and proficiency and could allow for the reduction of weapons systems and manpower requirements while at the same time maintaining the same level of battlefield readiness (Allen & Chan, 2017: 20-21).

AI-embedded military hardware and robotics are already changing military power projections and redefining the defense landscape, and the US and China are only on the threshold of this potential. New AI embedded weapons platforms and delivery mechanisms have demonstrated that they can outperform existing weaponry in ingenious ways and at a fraction of the cost of conventional systems (NSTC, 2016: 37-38). For example, the development of small autonomous fleets of aerial drones and submarines could represent an effective and significant threat to modern aircraft carriers at a fraction of the cost of conventional systems (Field, 2019). This presents a promising military "leapfrog development" opportunity for nations like China who are willing to invest in AI, and substantial strategic disadvantages for those nations who choose to ignore it. This cost-effective escalation in military proficiency is why both the US and China are ramping up their dual use R&D expenses and AI weapons integration (Kania, 2017a: 37; Allen, 2018: 8).

There are other advantages to integrating AI throughout military platforms as well as a few disadvantages. The main advantages for the US or China are AI's ability to learn and evolve in near real time, the assess greater levels of information and ability to handle complex scenarios, and AI's capacity to operate autonomously under adverse battlefield conditions. Traditional human to computer software interfaces is limited to preprogrammed functions and parameters and can only adapt to conditions within those limitations and according to the original programming (Button, 2017). AI embedded military platforms on the other hand can be integrated across multiple levels, learn rapidly as more battlefield data becomes available, and quickly adapt to a variety of different scenarios (Cole, 2018).

The primary disadvantages are that AI ML's decision-making capabilities are only as good as the data that it receives, in other words, garbage in garbage out. Another disadvantage is ML and the few DL algorithms in production are not yet developed or proficient enough at tasks that require multiple levels of contextual knowledge, for example in target acquisitioning, something generally taken for granted by humans. The problem is not with an AI embedded weapons systems' ability to target potential enemies, but rather figuring out who exactly is an enemy vs. non-combatant and how best to eliminate it. This is especially problematic in modern warfighting environments that generally lack national boundaries, static battlefields, or even identifiable adversaries. A third disadvantage involves user uncertainty, distrust, or fear attributed to problems associated with the prior use of AI. This can make some users hesitate or reluctant to use AI in critical and/or hazardous operations (Button, 2017). The final disadvantage for both researchers and defense contractors are problems associated with reducing the high costs and power requirements of AI integration in outdated legacy infrastructure and equipment (some military hardware dates back to the 1950s) or when a high degree of customization is required for a particular weapons system (Azati, 2019).

China Military & Intelligence Agency Integration

China's plans for AI military integration are more operationally focused. There is more emphasis placed on applied and development research rather than on basic research (Sharikov, 2018: 369). This corresponds with China's strategic advantage in implementation and its ability to "acquire" research through various means **(**Allison, 2019**).** Until recently, China's primary use of AI was in low-tech approaches such as developing unmanned swarm drones to counter the US high-tech naval and air power. With the introduction of strategic initiatives such as the AIDP and MIC 2025 China has started shifting into indigenous development of dual-use, high tech, high value products (He, 2017: 2; Kania, 2017a: 9-11). Under these plans, China intends to alter its manufacturing pursuits to include more sophisticated weapons systems and develop smart weapons platforms like AI embedded directed energy weapons and hypersonic missiles, and a new generation of autonomous robots with war fighting and/or support capabilities (Sharikov, 2018: 370).

China's CMC and its Science and Technology division believe that the technologically advanced developed nations are on the cusp of a S&T revolution. The commission asserts that AI will be the catalyst for this revolution and that China's military modernization will require comprehensive changes to Chinese military weapons systems, force projection models, and military unit training and operational capacity to keep pace. CMC leadership are also convinced that the PLA is uniquely suited for this transformation process since it can leverage China's already expansive AI ecosystems and R&D programs better than nearly every other developed nation (Kania, 2017a: 13) If successfully integrated AI technologies will become a force multiplier for Beijing and allow the PLA to enhance its capabilities by reducing human cognitive decision making time lags, exploiting real time strategic and tactical information, and by untangling and rapidly processing "hidden information interactions" to develop information advantages", thus expanding mission objectives (Kania, 2017a: 18, L3Harris, 2019). The PLA's largest current AI R&D and prototype development projects for military applications include but are not limited to unmanned autonomous vehicles (UAV's) with swarm intelligence, cyber warfare and cyber security, information processing systems, intelligence collection and analysis, training simulations and wargame development (Kania, 2017a: 22, 25-29; Allen, 2018: 5-7)

China's ambitions to modernize its military comprises incorporating AI integration at a massive scale in order to enhance its reconnaissance, battlefield assessment, and strike force capabilities, and to develop more advanced uses of AI enabled "intelligent operations". One field of "intelligent operation" called perception management involves R&D applications for AI enabled cyber warfare, cyber countermeasures, electronic silence, and encrypted quantum communication designed to scramble the enemy's ability to identify and analyze real-time battlefield information and/or allow the enemy to ingest disinformation (Gertz, 2019). The PLA's AI Vision calls for programs "focusing on intelligence supremacy, ubiquitous AppCloud, multi-domain integration, brain-machine fusion, intelligent autonomy, and unmanned combat" Another field of significant interest to the PLA's and one that will work in conjunction with "intelligent operations" is brain – machine interfacing designed to increase cognitive speed and expand analysis capabilities (Gertz, 2018; Gertz, 2019**).**

China's AIDP also includes other applications for AI and the modernization of China's National Defense. One of the more immediate roles will be in AI's ability to render "superior" command decisions. China's senior leadership and PLA strategists expect AI to augment and eventually replace military commanders in specific battlefield scenarios. The CMC intends to integrate AI with digital technologies such as cloud networks, advanced computing capabilities, and big data access for the 'intelligentization' of command decision-making in real time (NSITeam, 2019: 141). The PLA's goal is to utilize AI to shift from its traditional computer-based command automation processes to an AI directed command 'intelligentization' situated throughout China's military command apparatus. These activities will coincide with the PLA's military modernizations plans and some of the basic AI decision making tools that are already in place (NSITeam, 2019: 142; Guo and Si, 2016).

China's Intelligent Command-and-Control Systems Engineering Specialist Committee was tasked to research and determine the most effective battlefield decision-making balance between human commanders and AI decision making support (NSITeam, 2019: 143). Two of the biggest concerns about relying on AI versus human decision-making is the current fallibility (error rate) of China's AI embedded weapons platforms and the uncertainties with how AI interprets mission parameters. CMC leaders believe these issues will be resolved with the introduction of new generations of ML algorithms (Osoba & Welser, 2017: 12, 21; NSITeam, 2019: 146).

Beijing considers the CMI originally created in 2014 to fuse China's commercial sector with its defense economy another vital strategic initiative for its military modernization objectives. The goal of the CMI was to leverage the more innovative private sector's research and product development to gain commercial dominance in the key emerging dual use technologies (Laskai, 2018; Sheppard & Hunter, 2018: 20). Over time, the CMI would assign a high-level priority to AI and digital technologies because of their adaptive and highly integrative capacity. These technologies are to be the catalysts needed to enhance and modernize the PLA on a massive scale (Kania, 2017a: 9, 19).

The CMI's strategy has been effective, commercially developed technologies and technologies accessed through foreign tech transfers are made readily accessible to the PLA (Hille & Waters, 2018). This provides China's CMI advantages over the US military – industrial – academic complex by affording it unlimited access to commercial product lines and foreign tech transfers, increased speed of implementation, and more direct government support in both funding and incentives (Laskai, 2018). To coordinate CMI efforts, the Central Commission for Integrated Military and Civilian Development was created. The commission's purpose was to ensure that ongoing collaboration occurred between government research institutes, research universities, state owned enterprises, private sector companies, and the PLA's own industrial facilities was maintained according to CPC interests (Kania, 2017a; Laskai, 2018).

Despite the strong leadership support for the CMI there have been some major drawbacks. China's state-owned defense sector is bloated, secretive, and entrenched in a bureaucratic top-down management style. This centralized administrative style contrasts sharply with the flat organizational structures of innovative private sector companies and makes working with startups especially difficult. There is also a general lack of trust between China's large defense SOE's and private sector companies and disagreements over how research lines should be prioritized. This has resulted in defense SOE's taking active measures to exclude the private sector from their programs (Laskai, 2018). In addition to these CMI concerns, China's ambitions to dominate the emerging digital technologies has had its own unique set of challenges. CPC overreach into the management and affairs of private sector companies and an overconcentration of state sponsored funding directed towards inefficient SOE's has restricted innovation. China is to heavily reliant on foreign technologies for AI development in key sectors like hardware (microprocessor chip production), and recent technology bans by the US has restricted access to vital components even further. China's recent strategic initiatives, aggressive industrial policies, and cybersecurity laws have also increased apprehensions among international competitors. This has expanded into a outright distrust of some of China's digital services over possible surveillance and spying concerns and has validated the US's counterbalancing efforts against China to a growing number of the Western nations (Shi-Kupfer & Ohlberg, 2019: 10).

Recognizing the growing threat of US countermeasures represent, China is escalating its attempts to catch up with the US in AI and digital technology development, but this is coming at the expense of quality control levels the developed world has grown accustomed to. There is also growing skepticism over whether China will be truly self-reliant in producing advanced digital technologies. The CPC is struggling with how to properly balance private sector funding versus its large SOEs and how to remain in tight control of its commercial sector AI development while not stifling innovation. Finally, Chinese analysts are warning that Beijing's drive to dominate AI could lead to an "AI bubble" brought about by overinvestment and the rapid development of the industry before global markets are ready (Shi-Kupfer & Ohlberg, 2019: 19-20**;** Gerbert & Spira, 2019). China's senior leadership do not consider any of these obstacles insurmountable nor do they believe they need to overcome all of them to become a leader in AI technology. Beijing has confidence that its momentum and its centralized whole of nation approach will allow China to rise above these challenges faster than the other technologically advanced development nations which are facing similar complications and trials (Kania, 2017a; Shi-Kupfer & Ohlberg, 2019: 10)

US Military & Intelligence Agency Integration

The US approach to military integration digital technologies can be summed up in the following 2018 NDS statement "the surest way to prevent war is to be prepared to win one" (Vrolyk, 2019). The DOD acknowledges that the greatest obstacle to US national security and retaining military hegemony is the "reemergence of long-term strategic competition" with revisionist states like China (DOD, 2018: 2). The NDS calls for a revised strategic approach to US military preparedness and a renewed long-term commitment to build the most lethal defense force possible. The integration of emerging digital technologies especially AI into the US military will be instrumental in meeting these objectives and to help prepare US warfighters for the conflicts of the future. Washington believes that future battlefield engagements will no longer occur solely on the sea, air, and land but will also be fought in outer space as well as cyberspace (DOD, 2018: 3-4). The remaining sections of this manuscript will concentrate more specifically on AI.

Both the US and China realize that the nation that can best embed and integrate AI weaponry into their military platforms will have clear battlefield advantages for decades to come. China's senior leadership intend to use these advantages to develop leapfrog technologies that will surpass US conventional forces and to strengthen its authoritarian control over its population. The Trump administration and DOD are determined to not allow China to outperform or dominate the US in any of these the digital technology fields. Secretary of Defense Mark Esper has stated that the US and China are in a race to develop advanced weapons technologies and AI's enabling dual use capabilities are the key to those weapons systems (Gertz, 2019).

DOD analysts concur that AI represents a strategic advantage to US military systems that if properly integrated will provide a sustained competitive edge that could last for decades. However, if the US fails keep pace with China's accelerating dual use AI R&D, weapon systems development, and AI integration plans, its current technological superiority could vanish resulting in the loss of US asymmetrical military advantages and subject US defense forces to contending with leapfrogging technologies (Lye, 2019; CRS, 2019a: 34, 36). The Trump Administration's American AI Initiative and the DOD's AI Strategy were both enacted to prevent China and other countries from surpassing the US in advanced digital technologies. These national strategies also signal to the world that the US fully intends to remain the leader in dual use technological development and will make full use of AI's disruptive potentials (Cooper, 2018). Examples of AI related projects that the DOD is actively pursuing include cyberspace and cyberwarfare operations, semi-autonomous and unmanned autonomous vehicles, lethal autonomous weapon systems (LAWS), and Multi-Domain Command-And-Control (MDC2) (CRS, 2019a: 11-15).

The DOD is also interested in the PLA's use of "intelligence supremacy" and believes that it too must utilize AI to help reduce battlefield uncertainty and achieve information superiority in order remain competitive and to increase the speed and accuracy of real-time combat decision-making. Simply put "winning the decision space is winning the battle space" and there are DOD studies that have already demonstrated AI's capability to make "near instantaneous responses" that can result in "perfectly coordinated action" (Allen & Husain, 2017: 31-33). There are circles within the DOD that have reservations regarding the use of AI. These reservations are not necessarily concerned with the AI's capabilities or with its accuracy but on the human capacity to assess the information in a time sensitive matter (mere moments). They argue for example, that if future battlefield environments consist of the interactions of thousands of miniatures extremely fast AI embedded weapon systems (drones) it could accelerate battlefield conditions beyond a human's cognitive capability and render human responses to slow (Allen & Husain, 2017: 30; CRS, 2019a: 36-37). The PLA intends to offset this problem by taking the human element "out of the loop" in these situations relying solely on AI directed command decision-making, something US commanders and military analysts are averse to (Kania, 2018).

Cyberspace is another arena that warrants the DOD's attention. AI is in the early stages of being utilized for military and intelligence collection cyber operations on a massive scale.

Large supercomputers running AI algorithms are being developed to target and disrupt strategic military command-and-control centers, and military / civilian infrastructure. In addition to large-scale disruptions, algorithms designed for cyber hacking have been introduced that actively search out and exploit an adversary's critical software systems (Sharikov, 2018: 368). The US Cyber Command has announced that it will start phasing out much of its reliance on human intelligence for much of its cyberspace activities, claiming that human monitoring is becoming too slow. Instead, ML will be utilized to cipher through and analyze the massive volumes of data the Cyber Command is responsible for. ML algorithms will then look for anomalies that develop within government networks, modify or remove pervasive program alterations, and/or isolate the small elements of code that hackers routinely introduce into programs to alter to evade cybersecurity measures (CRS, 2019a: 10).

AI technologies are evolving to the point where they are considered a DOD strategic priority, one that has the capacity to transform how the US military operates. The DOD created JAIC in 2018 to address this potential and to oversee all DOD AI related mission profiles which currently includes over 590 projects (Sharikov, 2018: 369; Freedberg, 2018). DOD AI related R&D projects are generally conducted within the individual armed services, at DARPA, or at the Intelligence Advanced Research Projects Agency (IARPA). Any project exceeding $15 million per year will be coordinated out of the JAIC. JAIC also oversees the Algorithmic Warfare Cross Functional Team (Project Maven) which was categorized as JAIC's first National Mission Initiative (CRS, 2019a: 7). The DOD and JAIC are no longer satisfied with just developing new AI embedded weapons technologies but believes the command must anticipate how competitors (state and non-state actors) could use these new technologies against the US in a war fighting environment (DOD, 2018: 7).

The DOD recognizes that many of the most prominent developments in emerging digital technologies are coming out of the private sector. Because of this shift in the innovation landscape the DOD also created the Defense Innovation Unit (DIUx) which “contracts with commercial companies to solve national security problems” Valley (Laskai, 2018; DIU, 2020). Headquartered in Silicon Valley, DUIx functions include identifying potential dual use technologies under private sector development and when appropriate awarding government contracts for the rapid integration of those technologies into military programs. The creation of the DUIx was in part a response to China’s CMI strategy and concerns that the CPC could use China’s growing private sector innovation combined with the sheer size of its industrial infrastructure to scale up AI development at an unprecedented pace (Bey, 2018).

In addition to DOD contracts, US defense contractors can use the DIUx “other transaction” (OT) agreements to expedite their contract awards. This addresses the troublesome protracted procurement process which is one of the biggest concerns that private sectors companies have with contracting with the government. DIUx OT agreements will allow bidding and contract awards to occur at an accelerated pace and with terms similar to those in the commercial sector (Cassidy, Plitsch & Evans, 2018). This is important to both AI start-ups looking to establish partnerships with the US military and for established companies like BAE Systems who have already initiated plans to apply ML and DL algorithms throughout their entire line of products, services, and support systems. The goal of these companies is to not simply develop AI to military hardware integration for greater functionality alone, but also assist the warfighter to be able to learn and/or process battlefield information more quickly and with greater efficiency. It will also be used to train personnel to operate in complex environments in a much safer and more cost-effective manner through the use of a near infinite number of modeled scenarios (Cole, 2018).

One final issue regarding AI military integration involves its long-term use and the eventual reliance on rapidly advancing ML and DL systems. These systems could in time all but render human agency and its relatively slow decision making obsolete. Should DL algorithms develop fully functional self-learning capabilities, such programs would not only be able to out compete humans, they could resist any attempt to stop, alter, or prevent the competition of their mission objectives (Muehlhauser & Helm, 201: 6-8). This generates a significant "AI control problem" for military applications and will require AI be correctly designed with reliable control safeguards (capability and motivational controls). These safeguards will need to be applied in the design phase or command elements run the risk of their AI potentially rewriting mission parameters, refusing programmers access to code, disregarding or modifying new orders, or re-prioritizing and pursuing other objectives (Yudkowsky, 2008: 12, 18, 20).

Every technologically advanced developed nation's modern defense force is already inundated with a countless automated and redundant computer systems. With the introduction of AI, the complexity of these systems will only increase (NSITeam, 2018: 128). As economies of scale increase, ML and DL costs drop, and data becomes more readily accessible, AI algorithms will become more common place in military systems. What is problematic here is that in the not too distant future there will soon be to many AI embedded smart platforms, operating too rapidly, with each system interwoven into numerous other systems (referred to as network centric warfare) for human commanders in monitor, assess, and account for in a time sensitive manner (Horowitz & Mahoney, 2018; Knight, 2019). The introduction of each new AI embedded weapons system is already increasing the complexity and producing an overabundance of information that decision makers are forced to contend with. This is creating a warfighting environment that is growing too complex and fast paced for human decision makers to comprehend much less operate within. In addition, some strategic and tactical recommendations provided by current ML algorithms are so inconceivably 'weird' and the logic so difficult to understand that the programs are being discarded by decision makers despite the AI's advantages, i.e. its ability to assess almost every possible scenario or outcome in near real time. These situations either negate the benefits of the AI if it is ignored or will require that military leaders operate in high degrees of uncertainty and/or rely on faith that the system is sound (Friedman, 2019).

Even though AI technologies are beginning to outperform humans among certain functions, there is one caveat. In high stress or conflict scenarios, humans possess something referred to as experienced based intuition. This allows experienced decision makers to approach problems from multiple perspectives and make intuitive decisions quickly in conditions of uncertainty and ambiguity. AI must rely on accurate inputs (data feeds) that are properly accessed for accurate analysis. This creates an exploitable vulnerability in warfighting scenarios where an adversary could manipulate inputs in subtle ways producing disastrously inaccurate ML results, something an alert and suspicious human combatant would be keen to pick up on. This introduces further complexity and uncertainty for battlefield commanders who are being required to surrender increasing amounts of command-and-control authority to AI (NSITeam, 2018: 129, 131). Regardless of the complexities and vulnerabilities, it appears that the future of military confrontations will require AI algorithms. Military leaders at the National Security Commission on Artificial Intelligence are convinced that future battles will involve one nation's ML and DL algorithms vs. another nation's algorithms" and the country with the most proficient algorithms will possess a significant advantage. The tradition chain of command is going to be altered, to what extent is not yet known, but current command and control practices will simply not be able to keep pace with faster and more efficient AI technologies (Vergun, 2019).

Each advancement in AI technologies, integration of AI into a military weapon platform, and improvement in autonomous decision-making capabilities raises new fears and additional uncertainties in the senior leadership and policy making advisors of the US and China. It is also reinforcing the escalation of a new form of highly complex security dilemma. Despite the mounting concerns of a security dilemma each nation is rushing forward enacting new national AI strategies and policies, increasing investments in AI research and industry development, and incentivizing more P3 collaborations (Kania, 2017c). The US and China have approached a crossroad. On the one hand are the benefits of faster and more efficient dual use ML and DL algorithms and more lethal AI weapons systems culminating into a drive to accelerate AI integration throughout their commercial and military sectors. On the other hand is the growing suspicion and distrust each nation's senior leaders have for their counterparts and the greater the hold the security dilemma has on the two nations regardless of their claims that they are only seeking to maximize their security (Gavekal, 2018; Hass & Balin, 2019).

Should a regional confrontation breakout between US and Chinese forces due to escalating trade wars, threat over a Taiwan secession, or accidental naval encounters in the South China Sea, each nation's senior leadership is convinced that AI integrated weapons system will be utilized (Hass & Balin, 2019). Equally problematic has been the lack of international protocols designed to set boundaries for how AI is implemented in a nation's military or used in a conflict scenario. In addition, few policy directives have been put in place by either nation that would ensure that human agency will remain in the tactical decision-making loop to check for errors or look for invasive cyber manipulations. This lack of oversight adds another layer tension and uncertainty that a future confrontation could occur without leadership even becoming aware as to the cause or able to respond in a timely manner (Allen & Hussain, 2017; Kania, 2017c: 37).

As AI embedded weapon platforms evolve and become more integrated throughout the militaries of the US and China it will change the nature of how each nation conducts warfare. The scope or volume of AI integration has already risen for the two nations, and the pace of integration is expected to soon follow suit (Pandya, 2019b**)**. What is unclear is whether either the US Administration or China's Politburo will provide conscientious and responsible strategic policies for AI military integration or whether both will choose instead to focus on AI polices that are dedicated solely to advancing military platforms. The development and integration of new AI technologies for defense purposes is not the only factor, how these two nations will use their AI embedded weapon systems may be of greater importance. Each nation's leadership have yet to decide on the appropriate operational strategies, tactics, and doctrines considered acceptable in the fast paced and rapidly changing battlefield environment where AI command and control algorithms will be 'calling the shots' (NSITeam, 2018: 97-98). There is also the matter of new legal and ethical restrictions regarding what types of weapons systems AI and other digital technologies will be allowed to integrate into (i.e. no autonomous gas drones), and public opinion will also have to be accounted for, at least in the US. Failure to address these issues will allow AI military weapons development and integration to continue without constraints further intensifying leadership uncertainties, suspicions, and distrusts (Kania, 2017a: 37-38).

Leadership Perceptions and Misperceptions of AI Integration

Leadership perception were earlier recognized as one of this study's primary structural modifiers and a critical component contributing US-China hostilities and growing threat of a security dilemma. Distrust, suspicions, and uncertainties are not the only leadership concerns. As each nation seeks to use dual use AI technologies to achieve military and economic advantages over one another, they run the risk of inaccurately misperceiving or mis-interrupting each other's actions as a threat where no true intention of threat actually exists. If these misinterpretations are followed by other nations overreacting, a cycle of response counter-response can result in the downward spiral effect of a security (Jervis, 1978: 175; NSITeam, 2018: 133-134).

This scenario is to some extent already occurring. Leadership misperceptions regarding the use of AI technologies have been considered in part responsible for intensifying the S&T rivalry. One of the prime reasons for this growing tech rivalry began with China's development of dual use and leapfrog technologies which was followed up by US counterbalancing measures and the escalation of its own dual use AI development to preserve its technological hegemony (Mourdoukoutas, 2019). As the rivalry has intensified and the threat of effective AI military integration became a reality for each nation, digital technologies became the central focus and a lightning rod for rising tensions. Each new digital technology with dual use capabilities invoked a new round of misperception and fear. Senior leaders from both nations no longer perceived their counterparts' motives as simply trying to maximize their security or preserving their positions within the international order. Instead, leadership perceptions shifted to outright cynicism and growing doubts over their counterparts true underlying motives (Borzykowski, 2018; Tayal, 2019; Panda, 2019).

Each nation's senior leadership's misperceptions can be granulated further by the lack of understanding as to which of the dual use digital leapfrog technologies will be integrated into the

PLA weapons systems and even more importantly, how exactly these AI embedded weapon systems will be used against their counterpart (Straub, 2018; Hass & Balin, 2018). Concerns are arising among policy makers and military analysts regarding how powerful and effective these AI embedded weapon systems will be in warfighting scenarios, how difficult they will be to counter against, which nation's defense forces are best prepared to integrate AI throughout their militaries, and who will be the other actors (governments, terrorists, insurrectionist, organized crime, etc.) that could develop and use these weapons systems against other nations and for what purpose. It should be noted that no country developing AI technologies is yet certain of how powerful AI embedded weapon systems will be used if employed on a massive scale (Meserole, 2019).

Another factor influencing leadership misperceptions is AI's growth rates. AI technologies are only in the early adopter phase but there are already indicators that ML and DL algorithm development is proceeding at a near exponential clip. This growth will be further accelerated by the introduction of quantum computing and large-scale cloud networks which will allow for faster computations and greater access to 'big data' (Nanalyze, 2017; UBS, 2017)**.** This accelerated pace will make predicting which AI technologies should be prioritized for development and production extremely difficult and forecasting long-term AI integration near impossible. AI's vast integrative capacity and the speed at which AI can be embedded into military platforms adds another layer of uncertainty that each nation's senior leadership will have to contend with and will make good technology policies making all the more challenging. The accelerated growth rates will compel each nation's leaders to strive to keep up with rapidly advancing AI technologies to remain commercially competitive and preserve their national security (Jervis, 1978: 175; Meserole, 2019**).**

An additional factor that can alter senior leadership misperceptions revolves around AI's inherent 'fuzziness". Fuzziness describes the impreciseness of leadership perceptions. The functional capacity of technologies such as AI are generally defined by a weighted value or assessed on a sliding scale instead of in absolutes. AI's military integration capabilities will therefore be perceived of in degrees of utility from 0% (completely useless) to 100% (completely of value) (Wong & Guo, 2017). The difficulty for a nation's leadership and their analysts is in assessing all the numerous components of AI's widescale integration on a weighted or sliding scale. Referred to as the "AI abstraction problem", AI's integration and the technology itself becomes to ambiguous and incoherent for leadership to accurately comprehend and this makes policy making difficult and subject to errors. This becomes even more complicated when AI is accompanied with the other digital technologies. Adding to the "AI abstraction problem" is how the process of developing AI technologies, properly integrating AI throughout a nations military, and enact appropriate supporting policies are also dependent on contributing factors. These factors include successful collaborations in research, funding and incentives availability (government and private sector), restrictions to recruiting top talent, cybersecurity protections vs. ~~counter~~ cyberwarfare and espionage threats, and others. In essence, fuzziness and "the abstraction problem" complicates AI integration programs and convolutes how leaders perceive a program's success. This can lead to leadership distrust regarding the validity of their nation's AI integration programs and a lack of confidence in measuring the success of integration among their potential rivals (Atherton, 2019).

Looking deeper into factors influencing leadership misperceptions is the matter of how AI technologies are produced. The majority of major research breakthroughs and new algorithm development over the past years have been coming out of the commercial sector and subject to global supply chains. This adds a whole new degree of complexity and risk to AI development. Consider that after decades of trade, the US and China have grown accustomed to developing components for one another and in many cases utilizing the same supply chains (Meserole, 2019). Recently this has changed, US decoupling measures against China in the digital technology sectors has already resulted in broken contracts, mutual loss of profits, and cessation of productive collaborative research efforts. This has contributed to a growing distrust between the two nations over trade that has affected international supply chains to the point where it threatens to spread ~~a~~ downward spiral of response – counter response actions throughout global technology markets (Monier, 2019; Tayal, 2019).

Further complicating leadership perceptions is how dual use AI and other digital technologies are being integrated or designed into almost every electronic device available to the technologically advanced, developed nations. This will create additional levels of uncertainty and raises anxiety for each nation’s leadership since they will need to contend with the possibility that almost any AI algorithm or AI embedded device produced for commercial purposes could be used for military or intelligence collection purposes against them. Compounding this problem, in today’s world of illicit intellectual property “acquisition” and commercial espionage, designers and developers of AI technology are too naively focused on creating functional algorithms for what they believe are benign commercial purposes. Their attention is not on protecting national security, encrypting their research, or how the dual use characteristics of their algorithms will be “acquired” and used against their own country by any number of potentially hostile actors. (Pandya, 2019a).

Perhaps the greatest problem facing each nation’s leadership is the perception that their country will fall behind the other technologically developed nations in AI technologies and not be able to catch up should they not develop their own AI programs in earnest (keeping up with the Jone's) (Burrows, 2018). Both the US and China have initiated policy measures and dedicated considerable resources and investment dollars to ensuring such a thing does not happen. However, in their determined rush to dominate AI technologies, concerns have been raised by administrators and managers at their mid-tier agencies and ministries that rampant AI algorithm creation and unchecked military integration programs could prove to be unsafe and a serious danger to themselves and the world (Scharre, 2018). Representatives from these agencies and ministries have also expressed worries internationally that their nation's senior leadership appear less concerned with ethical matters or dangers the associated with the rapid and unchecked integration of AI and digital technologies into every facet of their society than they are about not attaining a first mover position. This rampant rush for AI research and product development is turning out to be one of the biggest drivers of leadership anxieties and a major underlying factor of the growing the tech war (Allen, 2018: 5-6).

To illustrate this point, the US and China have already reached the point where they are recklessly embedding AI into unmanned drones, developing ML military robotic systems, using AI to increase the precision and lethality of weapons platforms such as hypersonic missiles, and both nations are only in the early stages of proposed defense integration schedules (Gertz, 2019). Every new dual use AI technology integrated into a military weapons platform or a support system is considered by the other nation leadership as menacing, even if they are doing the same, or if the integration is just part of routine upgrades or a military modernization programs (Kania, 2018).

All of the previous leadership misperception does not exist in isolation but are interwoven and in some cases are in direct competition with one another (Flagella, 2019). As

AI's integrative capacity, enabling capabilities, and the speed of implementation all increase, the difficulty each nations leadership will have in assessing an AI embedded product, system, or programs performance will also increase. The same applies to determining which lines of AI integration will prove to be most beneficial or where long-term integration problems could occur. These problems whether alone or in aggregate creates additional layers of uncertainty and complexity and further complicates the process of quantifying the success of AI strategies, plans, and policies required for proper legislation since success will be contingent upon many variables (Atherton, 2019). Leadership perceptions are ~~a~~ driving factor behind distrust, tension, and the action – reaction downward spiral that is leading both the US and China towards a complex form security dilemma and that will have significant global impacts (Jervis, 1978: 175; Kania, 2018).

<u>**Technological Complexity of AI Integration**</u>

The other structural modifier of significance is technology. AI and digital technologies are growing more complex and their vast integrative potentials present unprecedented challenges to each nation's leadership and is intensifying the security dilemma (Jervis, 1978: 187; Taliaferro, 2000: 137; Kania, 2018). The technologically advanced developed nations have been utilizing AI primarily as an enabling technology for enhancing existing systems, but recently these nations have started developing and embedding AI into weapon systems at the design phase. Take for example, AI that has been embedded into hundreds of unmanned drones that comprise a swarm drone collective assigned to target a ship. Each drone receives its initial commands from a central command and control source but during the attack is also capable of communicating with each of the other drones in real time to coordinate their movements ~~and~~ as they swarm the target and attempt to avoid the ships defense systems. (Meserole, 2019).

Now consider the same swarm drone collective that has been designed as a functioning AI unit that is not only able to communicate and coordinate with the other drones movements but can anticipate the movements of the ship defense systems (predictive analytics), immediately reassess battlefield conditions, and reassign their targeting profiles all in microseconds. Now multiply these capabilities throughout an entire military force which consists of thousands of weapons systems all designed with tactical interconnected AI command elements capable of calculating every possible battlefield scenario and identifying the highest probabilities of success on a moment-by-moment basis then relaying in real time all this back to a strategic command (Meserole, 2019). The rapid decision making and complexity of analysis that AI provides could render military commanders and national leaders powerless to react in a time sensitive manner. This loss of tactical control could lead to insecurities and further uncertainty among leaders, limiting them to strategic planning and long-term policy making (NSITEAM, 2018: 143-144; Meserole, 2019; CRS, 2019a: 12-13).

This technological complexity and the integrative capacity that AI and digital technologies offer is unparallel. At no time in history have leaders needed to comprehend such sophisticated technologies and processes (Sharikov, 2018). The senior leadership from each of the technological advanced developed nations are already having difficulty grasping the full potential of these technologies or their ultimate uses. Even in AI's first mover phase of government and commercial sector development what is becoming clear is that these technologies are on course to revolutionize existing systems at a pace our leaders will struggle to keep up with (Bey, 2018).

In addition, as AI systems become more complex and difficult to contend with, many US and Chinese leaders will find it hard to fully trust them. AI is becoming a "black box' and it is difficult for people, particularly leaders, to trust something if the manner in which AI decision making is made is so complicated that it is virtually incomprehensible (Marr, 2017). This issue of trust, especially among battlefield commanders, can be uniquely problematic. Trusting a new AI system that functions in ways that are beyond the understanding of command elements or enables a weapons platform to operate successfully but in unpredictable or unexpected ways, presents a new series of challenges. This become even more relevant when lives are at stake or mission success is of paramount importance (Button, 2017; CRS: 31-32).

AI and digital technologies will present an array of distinctively complex challenges to the US and China as each pursue first mover advantages considered on par with the introduction of the Gatling gun or the German blitzkrieg in a battlefield environment (Meserole, 2019). These challenges will include: 1) Evaluating the costs vs benefits of increasing a nation's defense capabilities against exposing troops and equipment to ever more lethal weaponry (Harkins, 2018). 2) Keeping humans "in the loop" of tactical decision making and accepting slower reaction times vs unleashing AI potential and restricting humans to "on the loop" or "outside the loop" decisions (Kania, 2018). 3) Proper utilization of data that is classified, of limited access, potentially manipulated, and time sensitive for AI algorithm use in battlefield conditions. 4) Appropriate allocation of resources towards integrating AI into a hodgepodge of existing weapons systems (cheaper) or investing in new state of the art weapons designed with AI at its core (more expensive) (Harkins, 2018). 5) Integrating AI as a multi-domain operational and command element throughout each nation's sea, air, land, space, and cyberspace training programs, exercises, and wargames, then incorporating the results into real-world confrontations (Freedberg, 2019).

These new challenges facing the US and Chinese militaries, state security offices (homeland security), and intelligence collection agencies are only the tip of the iceberg when it comes to levels of complexity that each nation's senior leadership, policy advisors, and military commanders will need to contend with as AI integration becomes commonplace throughout their government functions (Harkins, 2018; Horowitz, 2018). Equally problematic will be navigating through all the hype and promises that purveyors of AI claim that AI will provide. Uncovering the true capabilities of ML and DL algorithms and finding the appropriate cost-effective uses for these technologies will present its own challenges (SAS, 2018).

Complex New Form of Security Dilemma

A consensus is growing among military analysts and policy advisors alike that AI and digital technology development could result in an AI – enabled "Revolution in Military Affairs" (AI-RMA). If this conjecture turns out to be true then the first nations who successfully integrate AI technology throughout their military systems would not only establish a dominant first mover position but could redefine modern warfare (Kania, 2018). The US and China are fast approaching this threshold and as each nation's AI technology advancements accumulate, tensions and uncertainties between the two will rise as well. Both nations already consider themselves the world's pre-eminent S&T rivals. Leadership suspicions regarding the true intention behind why their counterparts are developing AI and digital technologies are rising. Counterbalancing measures by the US have already been implemented against China, some of those directed explicitly at AI, with China immediately retaliating. The tit-for-tat action-reaction responses between the two countries has become routine and global analysts fear they will lead to a high-tech decoupling between the two nations **(**Kania, 2018; Broadman, 2019). Add to this the increasing pressures of a tech war and mounting concerns that both countries are headed for an arms race over AI and the other emerging digital technologies (Bey, 2018). Even one of these conditions would be a good indicator of a security dilemma, all of them combined presents clear evidence of one.

This security dilemma is different than others in the past. Each new advancement in AI technologies adds additional complexity to the security dilemma. AI's dual use nature and vast integrative capacity alters and potentially improves both civilian products / services and military systems in ways that are difficult for world's foremost prominent technologists to accurately assess much less a nation's senior leadership and policy advisors. Global analysts believe that the US and China are already overreacting to one another's AI development, citing each nation's rapid escalation in AI related policies, investments, and military program development which are occurring at a pace that has not been seen in decades (Kania, 2018). The problem with AI and digital technologies and its widescale integration is that the landscape is filled with too many unknowns and as the technologies evolves this problem will evolve as well. This growing environment of complexity and uncertainty is a breeding ground for fear and distrust. Suspicions of intentions and accusations of ulterior motives have replaced communication and trust (Pandya, 2019). Both nations are in a downward spiral of excessive competition that has capitulated into a tech war and could very well culminate into an AI and digital technology arms race (Bey, 2018). In essence, all the makings of a humdinger of a security dilemma are present.

Where this security dilemma differentiates itself, and the reason I refer to it as a new form of complex security dilemma, is that in addition to all the complexities and uncertainties already mentioned, this AI driven security dilemma is occurring in a global environment of largescale electronic interconnectedness where no borders or boundaries exist, where leaders and policymakers are finding it exceedingly difficult to navigate, and where cyberattacks and AI directed decision-making will happen too fast for humans to control (Pandya, 2019). This new form of security dilemma, if not reined in, will transcend all previous security dilemmas. It will render the offense-defense balance difficult to assess and each nation's peaceful intention for security of little consequence as the US and China race to integrate AI throughout every electronic medium (Walt, 2002: 197; Kania, 2018). It will be something our leadership are not be prepared to adequately deal with, and they will therefore be reactionary and in a constant state of reinforcing the security dilemma.

While the security dilemma may appear to be inevitable, there might be some remedies that could help ease leadership tensions and mitigate its occurrence. One option would be for the senior leaders in the technologically advanced, developed nations to establish a regulatory regime focused on controlling or limiting AI technologies and their integration. The leaders of most developed countries already agree that there is a need for legal, regulatory, and ethical constraints on the rapid development of dual use AI (Lee, 2018). Ideally, a global technology forum designed to provide a regulatory environment conducive to responsible AI development could be created to address the circumstances that are sending the US and China headlong into a Thucydides trap. However, even this common-sense approach may be difficult to implement due to the reluctance of each nation to fall behind in AI and digital technology development, and their preference to pursue these technologies for the economic and military benefits it provides with little regard to the dangers. Another problem would be China's leaders preferring a state centric regulatory approach with China at the head of the decision-making body while the US and European leaders would consider this unacceptable favoring instead the current more democratized system (Barton, 2017; Lee, 2018).

Even if a viable global technology forum dealing with AI could be formed, each nation's leadership perceptions are too focused on suspicions and distrust and this limit a forums effectiveness from the outset. These same leadership perceptions would limit the effectiveness of any mitigation efforts attempted. China's leaders have for some time been suspicious of their US and European counterparts' intentions and will likely believe any forum established simply another Western attempt to stifle China's technological progression. US and European leaders on the other hand would consider China's state centric approach just another tactic to attain AI commercial and military superiority by promising to remain regulatory compliant while engaging otherwise (coercive gradualism) (NSITeam, 2018: 20, 164).

Conclusion

Central to defensive realism is the security dilemma which occurs when a state attempting to increase its security inadvertently decreases the security of other states who feeling threatened respond in kind. This triggers an action – reaction cycle and initiates a downward spiral of tensions where no aggression was originally intended (Loebel, 2010). Security dilemmas can be aggravated by structural modifiers, in this case technology (i.e. AI integration) and leadership perceptions (i.e. suspicions and distrust). The US and China view AI and digital technologies as the next world changing innovation and each nation's senior leadership is dedicated to developing these technologies (He, 2017: 2). To accomplish this, both governments have invested considerable resources dedicated to establishing comprehensive and proficient AI ecosystems. They have also created encompassing national AI strategies and supporting policies realizing that these will be the keys to attaining global technological leadership (Dutton, 2018; Johnson, 2019)

Chief among China's AI strategies is the AIDP, it was designed to reduce gaps in basic AI research, promote applied AI research, create high value high tech products and services, establish efficient manufacturing processes, and develop new AI industries. These measures in turn help to reinforce China's international competitiveness, national security, and military modernization goals (He, 2017: 6; Kania, 2017a: 9-11). The US has countered with the White House American AI Initiative, this strategic initiative was enacted to fully develop AI's dual use integrative capabilities in order to stimulate US economic growth and strengthen national security goals. The initiative was released alongside counterbalancing measures targeted at China's digital technology companies (The White House, 2019b).

AI advancements have been traditionally driven by innovation. Much of the cutting-edge dual use research and state of the art AI product development over the past decade has come from private sector businesses over the past decade. Both the US and China have realized this trend and increased fiscal support, incentives, and P3 collaborations for their large private sector AI related companies (CFR, 2018). Venture capitalist and private equity ~~is~~ are also being strongly supported by each nation's government since these firms finance the highly innovative startups and small businesses (Davenport, 2019).

AI and digital technology R&D for military integration is becoming increasingly more instrumental to the US and China's national security. As AI embedded weapon platforms evolve and are integrated throughout their militaries it will change how each nation will conduct warfare (Kania, 2017a: 37). The scope of AI integration is already expanding, and the pace of integration will soon increase as well. What is unclear is whether it will be the US's senior leadership or China's that will enact more sustainable strategic policies or simply focus on their AI military integration programs. The development and integration of new AI technologies is not the only factor, how these two nations actually use their AI embedded weapon systems could be of greater importance. Each nation’s leadership and military commanders will also have to decide on the appropriate operational strategies, tactics, and doctrines ~~to~~ they will utilize in ~~a~~ the fast paced and rapidly changing battlefield environment and to what degree decision making will be turned over to more efficient AI systems (NSITeam, 2018: 97-98).

The US and China are on course to becoming first movers in thoroughly integrating AI throughout their commercial and military sectors. Technological competition is intensifying and along with leadership perception of suspicion and distrust. This is creating a downward spirally action – reaction cycle. Both nations are finding themselves trapped in a security dilemma that is growing in complexity with each new introduction of an advanced AI or digital technology. The rapid pace and vast integrative capacity of AI is making this security dilemma unlike anything experienced in the past and exceeding difficult for senior leadership to comprehend much less navigate (Kania, 2018).

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