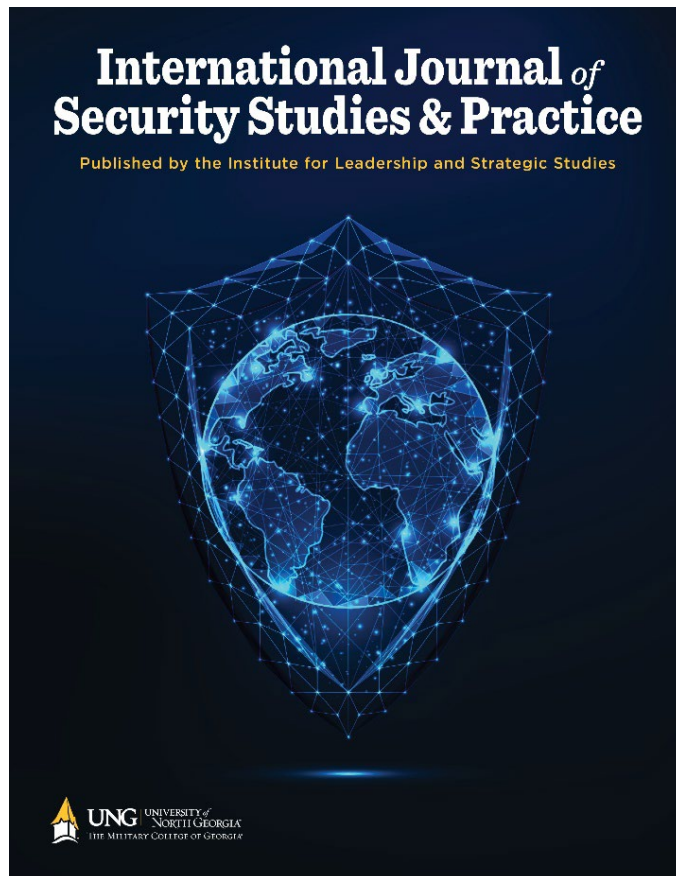


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A Lesser-Known Arms Race: The Military Application of Artificial Intelligence in Non-Major Power Developed States and the Implications for Global Security



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A Lesser-Known Arms Race: The Military Application of Artificial Intelligence in Non-Major Power Developed States and the Implications for Global Security

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Abstract

A large amount of scholarly attention has focused on the Artificial Intelligence (AI) arms race between the United States, China, and Russia. While informative, there has been less focus on the development and military application of AI technology in developed states that are not major powers. Thus, this study aims to examine how non-major power developed states are developing and applying AI technology in their militaries and the resulting effects for international security. We conduct case study analyses in which we examine the development and application of AI technology in 6 non-major power developed states (France, Germany, India, Israel, South Korea, and the United Kingdom). In addition, we conduct expert interviews with 10 international AI experts from academia, think tanks, multinational technology companies, defense, and cyber security to assess: 1-how non-major power developed states are developing and applying AI technologies in their militaries, 2-to determine the gap between developed states and major power states regarding the development and military application of AI, and 3-to better understand how the evolution and military application of AI technology in non-major power developed states affects global security.

KEY WORDS: Artificial Intelligence, Developed States, Military Applications, Balance of Power, Global Security

A Lesser-Known Arms Race: The Military Application of Artificial Intelligence in Non-Major Power Developed States and the Implications for Global Security

A significant amount of research in the areas of Artificial Intelligence (AI) and security studies has focused on the AI competition between the United States (U.S.), Russia, and China. This is logical given that many scholars contend that the development of AI technology will play an important role in shaping the international balance of power in the coming years, and the U.S., Russia, and China have devoted large sums of resources to the development and application of AI technology. However, less attention has been given to the development and application of AI technology in militaries in developed states that are not major power states. This is surprising since some researchers have acknowledged that the development and application of AI technology in non-major power developed states can also affect the international balance of power (Horowitz, 2018). As Horowitz remarked, “The potential for diffusion would make it more difficult to maintain ‘first-mover advantages’ in applications of narrow AI [AI used for a specific purpose]. This could change the balance of power, narrowing the gap in military capabilities not only between the United States and China but between others as well” (2018, p. 39). In addition, the race to implement AI technology in militaries internationally could lead to heightened AI competition and potentially dangerous end-products, not just in major power states but also in other developed states. As Morgan et al. (2020) posited,

Competition between states creates incentives for them to rapidly develop and integrate AI technology into military applications. However, there is a risk that rapid development will come at the cost of safety, reliability, or compliance with humanitarian principles.

Although some states have sought to develop effective legal reviews, testing and evaluation regimes, and other safeguards for military AI, many states do not have such restrictions or have not publicly explained how they will ensure that risks are mitigated. (p. 121).

Thus, given the potential effects that the global AI competition can have on international security and the frequent focus on major power states, this study examines the precise manner by which non-major power developed states are developing and applying AI technologies in their militaries to assess the implications for the international balance of power and global security. To understand how non-major power states are developing and applying AI technology, we conduct a case study analysis with six non-major power development states from multiple regions and interview 10 international AI experts from academia, think tanks, multinational technology companies, defense, and cyber security.

We contend that analyzing the development and military application of AI in non-major power developed states is important for two primary reasons. One, as previous research suggests, while the major power states (U.S., China, and Russia) may currently have an advantage in the competition to develop and implement AI technology, states outside of the major power states also have the capacity to develop and apply AI in a sophisticated manner that potentially rivals the major power states, and examining these patterns is critical given the important role AI technology has in affecting global security. Thus, we contend that it is important to expand the analysis of the development and military application of AI to non-major power developed states to better understand how AI technology is evolving and is being applied by non-major power developed states to examine the implications for international security. Second, and relatedly, the military

application of AI in one state can diffuse to other states leading to potential changes in power balances as well as ethical concerns regarding the use of AI weaponry. As a 2020 RAND study finds:

International competition in the development of military AI could escalate into a full-blown arms race. The lack of international consensus on norms of responsible development and use creates risks that states will have an incentive to rapidly acquire and integrate military AI without putting appropriate policies in place. Such an environment could generate ever-increasing pressure to quickly identify and develop new military AI applications without sufficient precaution to ensure they are safe and reliable. This situation could result in a “race to the bottom,” ultimately threatening the ability of humans to exercise agency over military AI systems. Such an outcome would have serious ramifications for the entire international community. (Morgan et al, 2020, p. 122).

Therefore, we contend that examining the precise manner by which non-major power developed states are applying AI in their militaries and the regulations that are in place regarding the use of AI can increase our understanding of potential AI technologies that may spread to other states, which can ultimately affect the international balance of power and global security.

The layout of the remainder of the paper is as follows. First, we explain our process for selecting and interviewing our AI experts. We then discuss our methods for selecting the non-major power developed states that are examined in our study. Next, we analyze the results from our AI expert interviews regarding how AI may affect global security and the international balance of power from a general perspective. We then examine the development and application of AI technology within the six non-major power developed states included in our study. Next, we discuss the results from our expert interviews regarding the development and application of AI

technology in the developed states examined. Lastly, we consider the implications of our research findings and discuss how the development and application of AI technology in non-major power developed states affects global security.

AI Expert Interviews: Participant Selection

To examine how AI technology is being developed and applied in non-major power developed states, and the implications for international security, we conducted interviews with 10 AI experts in multiple nations. We interviewed 10 experts for our analysis for multiple reasons. One, previous scholarship finds that 10 respondents is an appropriate number for studies that involve in-depth, qualitative expert interviews, and increasing the number of respondents could present issues regarding saturation due to the size of the field (Guest et al., 2006). Second, interviewing more than 10 experts presents difficulties due to the time and resources needed to conduct more than 10 interviews. Third, we contacted approximately 100 AI experts and 10 agreed to participate in the interviews. Thus, due to the finite number of AI experts that exist and concerns regarding saturation, obtaining more than 10 interviews was not appropriate for our study.

Conducting interviews with subject matter experts is a method that is often used by researchers and is regarded a valuable tool to obtain valuable information (Doringer, 2021; Kaiser, 2014; & Meuser & Nagel, 2009). The AI experts we interviewed in this study are from academia, think tanks, multinational technology companies, defense, and cyber security. To identify the experts, we utilized a deliberative selection method based on individuals' demonstrated knowledge in the field of AI. Utilizing a deliberative selection method allowed us to identify highly qualified AI experts across a range of fields (Edwards & Holland, 2013). We used this method based on prior scholarship in which researchers often use deliberative selection methods to identify interviewees to obtain high quality information from a diverse pool of experts (Flick, 2018). We

constructed our definition of an expert according to previous research that conceptualizes experts based on their demonstrated knowledge in a particular field along with their given position or perceived status (Doringer, 2021; Kaiser, 2014). Thus, based on previous scholarship on identifying and conducting expert interviews, experts were identified by analyzing publicly available data that indicated a high level of expertise in the field of AI based on the following criteria: peer-reviewed scientific publications, government and privately sponsored research, and professional appointments. We selected experts from multiple countries from academia, think tanks, multinational technology corporations, defense, and cyber security to obtain a broad range of expertise and perspectives regarding the development application of AI technology in developed and the implications for international security. The disciplines of the AI experts interviewed in the study are as follows: three experts were from academic institutions, three experts were from think tanks, one expert was from the military, two experts were from leading multinational technology companies, and one expert was from the field of cyber security. The identities of the experts are anonymous to protect the individuals participating in the study and to ensure they could provide answers to our questions without concerns regarding external influence. Each interview lasted approximately one hour. In order to provide for consistency across interviews, we asked each expert identical questions in identical order. Our research project was approved by the Institutional Review Board at Augusta University, and we received written and verbal consent from each expert prior to each interview.

Case Selection Method

Regarding our case selection method, there is often debate regarding whether some states are considered developed or developing. To attempt to accurately identify states as developed or developing, we utilize the categorizations provided by the United Nations Secretariat Development

Policy and Analysis Division (2014). We recognize that in using this categorization debate may remain regarding the classification of some countries, but our aim is to provide the most agreed upon classifications of states based on prior categorizations by reputable sources. Also, throughout the study we use the term major power states when referring to the United States, China, and Russia. We use this classification based on previous research that contends that the United States, China, and Russia, are currently considered the major power states in the international system (Radin, 2021). However, we do not argue that these states are superior to others regarding many areas of development (economic, technological, etc.). Rather, we argue that the major power states tend to receive more scholarly and public attention regarding AI development due to their classification as major power states and based on their geopolitical influence. Thus, we argue it is important to examine AI development in other developed states as well to more fully understand global AI competition. Also, for the remainder of the paper, we refer to non-major power developed states as developed states for purposes of parsimony.

We selected the states to examine in our study based on three criteria. First, we included cases in which there was verifiable and available information regarding AI development. There is limited information regarding AI development for many states, both developed and developing. Thus, we selected states in which we could obtain meaningful information regarding the development and application of AI technology, with specific emphasis placed on the military application of AI technology. Second, we attempted to include states across a range of geographical areas. Thus, we included non-major power developed states in Europe, the Middle East, and Asia. Third, our expert interviews guided our decisions to include certain states. For many of the states included, our AI experts expressed the importance of discussing AI development in these states for multiple reasons noted in the sections below. In summary, we do not contend

that our sample represents the full universe of non-major power developed states or is an exhaustive analysis of AI development in developed states. However, we contend that the states included in our analysis are important to consider regarding AI development due to their technological potential and geopolitical influence.

For each state in our study, we reference the state's ranking on the Artificial Intelligence Readiness Index (ARI 2020). The ARI is an Oxford Insights Project that produces an annual report ranking each state's AI capabilities in the international system based on 33 indicators across 10 dimensions. States that rank higher on the index display greater capabilities regarding the development and application of AI technology. In addition, where applicable, we reference sub-components of the ARI that indicate specific areas of AI development, such as the *responsible use ranking*, and *governance and ethics score*. The responsible use rank indicates how each state ranks comparatively regarding their use of AI as it pertains to the rules and regulations governing the application of AI technology.¹ The governance and ethics score is indicative of whether there “are the right regulations and ethical frameworks in place to implement AI in a way that builds trust and legitimacy” (ARI Report 135, 2020). The governance and ethics score runs from 0 – 100 with higher values indicating a state has greater regulations and frameworks in place for the development and use of AI technology.

When discussing the development and application of AI technology in the states included in our analysis, we discuss AI technology as it pertains to military applications and in respect to AI development in other state sectors as well (e.g., private, corporate, government). This is done to provide a holistic perspective of AI development within the developed states examined and

¹ Only 34 states are included in the ARI responsible use sub-component index. Thus, some states' rankings are not included, and the ones that are included are ranked out of a total of 34 possible states.

because AI development in one sector can frequently spread to other sectors. For example, AI development by a non-military firm, or government agency, can be used for defensive purposes if individuals decide to transfer the technology from one sector to another. Thus, we contend that it is important to examine AI development across sectors within states due to the diffuse nature of AI technology. We now turn to analyzing the results from our AI expert interviews regarding the importance of AI development and its effect on the international balance of power and global security. Later in the paper we will discuss the results from our expert interviews regarding AI development in the states included in our study.

AI Expert Interview Findings: General Overview of the Implications of AI Development

In examining our expert interviews, every expert considered the development of AI technology to be important to the international balance of power. When asked the question: *Regarding the international balance of power, how important is the development of AI technology on a 1-10 scale (1 = Not Important at all; 10 = Extremely Important)*, the average response was 9.40. Six experts answered 10, two experts answered 9, and two experts answered 8. Thus, every expert answered 8 or higher. When stating the reasons for their responses, several factors were mentioned. Every expert, with the exception of one, noted the ability of AI technology to create power asymmetries between states and across numerous sectors (economic, education, medical), and especially in respect to defense. Factors that were mentioned regarding the importance of AI technology to the international balance of power included: managing information flows, decision making, surveillance, intelligence gathering, communications, data management and analysis, and reduced production costs. The recurring theme in most of the responses (except one) was that AI has the potential to exacerbate power asymmetries in the global system because states that can effectively develop and apply AI technology will have significant advantages over states that lag

in AI development. Specifically, the experts emphasized the notion that AI is a potentially transformative technology that can generate significant economic and military advantages for states that lead in the development and application of AI technology in their economies and militaries. Thus, according to the experts, AI will play an important role in shaping the international balance of power and military competition in both the short and long term. Later in the paper we discuss the responses for our AI experts regarding the development of AI technology in the developed states included in our study and how the application of AI technology in these states affects the international balance of power and global security. We now turn to examining the development and application of AI technology in the states included in our case study analysis.

Developed States Case Study Analysis

The United Kingdom

The United Kingdom (U.K.) is widely considered to be at the forefront of modern warfare technology and has been since the 20th century. The U.K. ranks second in the world and first in Western Europe on the AI Readiness Index (ARI, 2020). Britain is home to some of the most advanced robotics and technology development corporations in the world, including BAE Systems, QinetiQ, SELEX, and Tasma (Springer 2013, p. 68). These corporations have been prolific in terms of global cooperation for technological development, forming partnerships across numerous other powerful states such as the United States and Israel. Beyond robotics, Britain has also played an influential role in the history of AI development thus far. Alan Turing's "Turing test," designed to determine the threshold for true artificial intelligence, is still considered an essential benchmark for AI development (Walch, 2020). Beyond reputational maintenance and

tactical advantage goals, the U.K. is also poised to benefit significantly from AI economically, with a potential 22% boost to the U.K.'s economy possible by 2030 if the economic potential of AI technology is realized (Bughin et al, 2019).

Cognilytica reports that Britain currently has “one of the strongest AI strategies in the world with strong government funding for AI, strong research activity in the field, strong venture capital funding and AI startups, and strong enterprise activity and adoption of AI” (Walch, 2020, para. 3). The McKinsey Global Institute also finds Britain to be “one of Europe’s leaders” in AI development (Bughin et al., 2019, p. 1). The British Parliament has taken an active interest in AI development as well, establishing an All Party Parliamentary Group on Artificial Intelligence in 2017 to address ethical issues associated with AI as well as “industrial norms, regulatory options and social impacts for AI” (Walch, 2020, para. 4). Well defined plans and an interested parliament will likely serve Britain’s AI development goals well in the future (Walch, 2020).

Bughin et al. argue that “the United Kingdom is in a stronger starting position to capture the AI dividend than Europe as a whole,” which may prove crucial in a technological race where development stalls could mean long-term irrelevance for states as the exponential development of competitors outpaces them (2019, p. 3). They further argue that the U.K.’s foundational strength in the field of AI is based on its “position on seven AI enablers” (p. 3). These enablers are divided into two sub-categories: AI-specific (“research activities, startup investments, and automation potential”) and foundations for AI (“digital absorption, innovation foundation, human capital, and information communications technology connectedness”) (Bughin et al., 2019, p. 3). These seven enablers are bolstered by the governmental support and significant pool of AI talent present in the U.K., though the state has struggled thus far to truly capitalize on its strong foundations to turn them into commercial successes (Bughin et al., 2019, p. 6).

The U.K.'s Ministry of Defense (MoD) has taken particular interest in AI as the next step in military technology (Gronlund, 2019). The MoD has established several developmental programs directly related to AI, including the "Autonomy program" which researches "algorithm development, artificial intelligence, machine learning, 'developing underpinning technologies to enable next generation autonomous military systems,' and optimization of human autonomy teaming" (Gronlund, 2019, para. 28). In a similar vein, the MoD Defense Science and Technology Laboratory (Dstl) has an established AI Lab which has been in operation since 2018. The U.K.'s efforts have thus far resulted in at least one well known example of autonomous technology: the Taranis armed drone. This drone has been claimed as the "most technically advanced demonstration aircraft ever built" by the MoD (Gronlund, 2019, para. 15).

State cooperation with the U.K. private sector has also been normalized with the MoD's Defense and Security Accelerator (DASA), a cross-government organization launched in December 2016 to "find and fund exploitable innovation to support UK defense and security quickly and effectively, and support UK property" (Gronlund, 2019, para. 33). DASA functions similarly to the U.S.'s Defense Advanced Research Projects Agency, granting financial support to research deemed potentially useful for the state's security apparatus. DASA has shown interest in drone swarming technology, awarding a 2.5 million GBP contract to Blue Bear Systems in March 2019 to fund their "Many Drones Make Light Work project," which aims to realize low-cost autonomous drone swarming systems (Gronlund, 2019, para. 33).

The U.K.'s Responsible Use of AI score is 54.57, and the U.K. ranks 22/34 in the Responsible Use of AI Ranking. The UK's AI Governance and Ethics Score is 89.48 (ARI, 2020). AI technology and weaponry pose a number of potential legal issues in the UK. Beyond issues of data processing and collection for the private sector, non-civilian potential applications of AI have

produced significant political debate regarding the fate and regulation of lethal autonomous systems, sometimes referred to as “killer robots” (Article 36, 2016, p. 2). Article 36, a non-profit organization opposed to the creation and use of autonomous weapon systems, evaluates the U.K.’s current public stance on such weaponry as too futuristic and vague (2016). While the organization’s evaluation is undoubtedly colored by its operational goals of preventing autonomous weapon system development, their evaluation identifies a common issue across many current governments’ attempts to approach the issue of AI: a misunderstanding of its present capabilities. Governmental ambiguity towards AI could lead to political and legal conflict as the technology develops further. The UK’s public position on AI remains that it is capable of “understanding higher level intent and direction” and that autonomy will offer significant advantages such as greater precision and efficiency of military operations once fully realized (Gronlund, 2019, para. 28). However, it also firmly asserts that “the application of lethal force must be directed by a human, and that a human will always be accountable for the decision” to use lethal force (Gronlund, 2019, para. 28). The U.K. remains less than confident about any legal prohibitions regarding AI given the “lack of consensus on key themes” globally regarding AI technology (Gronlund, 2019, para. 28).

Overall, the U.K. is likely to remain an international leader in the development of AI technology, commercially and militarily, due to its strong technological foundations, defined vision for future developmental goals, and ideological and financial government support. Its greatest obstacle appears to be determining how best to maximize the potential it wields to generate economic and technological success. Given its partnerships with other AI developmental leaders such as the U.S. and Israel, and the state’s history of strong technological development and integration, these obstacles may be easier to overcome for the U.K. compared with many other

states. See Table 5 in the Appendix for a summary of Germany's AI developments and applications.

France

As one of the major states in the European Union, France will likely remain in a similar position as many other developed EU states regarding AI development. France ranks eleventh in the world and eighth in Western Europe on the AI Readiness Index (ARI, 2020). France is very conscious of the potential for AI technology to be beneficial or problematic depending upon its mission and purpose, and France has already considered regulatory framework regarding AI's incorporation into its armed forces. France's Responsible Use of AI score is 73.77, and France ranks 20/34 in the Responsible Use of AI Ranking. France's AI Governance and Ethics Score is 85.65 (ARI 2020). Florence Parly, France's Minister of the Armed Forces, has publicly described the role AI is expected to play in the French military as it develops, stating in a 2019 address to the Institut de Convergence DATA IA in Saclay that "France refuses to entrust the decision of life or death to a machine that would act fully autonomously and escape any form of human control" (Parly 2019, p. 5). Parly expects France to develop defensive AI technology in accordance with "three major principles: abiding by international law, maintaining a sufficient human control, and by ensuring the permanent responsibility of the chain of command" (p. 5). Parly goes on to explain that this means France will develop and adopt any new AI technology with a posture of caution and responsibility that prioritizes human control and upholds the clearly defined boundaries of warfare currently established.

France has a number of potential political and legal issues emerging relative to AI. Anxieties surrounding permanent job loss due to AI are high in France, and over half of the state's population expressed feared of AI in general according to a 2016 survey from Microsoft and Odaxa

(Brans, 2017). Complex debates over the morality of AI development and use also threaten to stall the state's AI developmental progress (Brans, 2017). The French philosophy that it cannot simultaneously be a "major player" in a new technological field as well as the judge of the ethics and usefulness of AI is a major theme in the French approach to the development and application of AI (Brans, 2017, para. 11). As a result, debates over AI include a wide range of scholars including philosophers, theologians, psychiatrists, and other socially motivated actors in lieu of those motivated only by economics or politics. Concerns regarding data privacy and accuracy are also frequently debated in the public square in France, cumulating in a public atmosphere of caution towards AI across France (Brans, 2017).

Parly further identifies six specific development areas that France will pursue relative to AI defensive technology: decision-making and planning, intelligence collection and processing, collaborative warfighting to integrate defensive capabilities more cohesively, robotics development to relieve human operatives of dangerous tasks, cyberspace defensive and offensive capabilities, and logistics and maintenance improvements to prioritize the safety of operatives and functionality of equipment (2019, pp. 8-9). Parly argues each of these focal areas will allow France and, by association, Europe, to take a leading position in defensive AI development and integration, which she argues is imperative for the defense of French society. Further comments from Parly indicate France is likely to continue to push its posture of responsibility and ingenuity as the norm for AI development and military integration on the international stage as well, indicating a desire for established standards and, potentially, regulations associated with AI.

To complement its ambitions and future goals, France has also begun the development of several AI powered devices aimed at air, land, sea, and command and control applications. France has been somewhat ambiguous with its command and control and information warfare plans for

AI. Official comments have indicated only that AI will be used to assist in general decision making by senior leadership, boost collaborative warfighting efforts between military branches, and streamline intelligence collection and processing. Regarding land capabilities, France is currently working towards constructing smart robotics which are capable of relieving human operators of dangerous tasks such as landmine detection and removal. This is consistent with the doctrine outlined by Minister Parly previously (Parly, 2019). However, France's air and sea developments have focused on more traditional military strategy and firepower. Their primary naval development involving AI is the "RAPIDfire" system developed by Thales and Nexter, which is designed to provide navy surface vessels with "an effective close-in defense capability against modern air and surface threats" in close proximity situations (Thales Group, 2020, para. 1). The French air force has combined its efforts with Germany for a joint AI incorporative project called the "air combat cloud," which aims to construct a networked system of new generation manned fighters, unmanned aircraft, and current generation fighters all assisted in varying capacities by AI programs.

France's prioritization of an early lead in general AI development for military purposes is well minded, but it remains to be seen whether this goal is realistic given its competition. However, its relatively clear doctrine that specifies goals, relatively structured timeframes, and ideological directives for development will likely serve its developmental efforts well. Its potential limits lie in its ability to fund AI research and the ethical and regulatory concerns it has imposed on itself in an effort to spur global conversations beyond what AI *can* do in favor of what it *should* do. Overall, France is likely to remain a capable actor in the developed states category regarding the development and military application of AI technology. See Table 1 in the Appendix for a summary of France's AI developments and applications.

Israel

Israel ranks 20th in the world and 2nd in the Middle East and North Africa on the AI Readiness Index (ARI, 2020). In addition to intelligence gathering, data processing, and cyber capabilities development (The Israeli Defense Force, 2017), Israel's Israeli Defense Force (IDF) has taken a more traditional combat centric approach to AI development, which focuses on developing new combat systems to support human operatives on the ground. Israel's posture towards AI development appears to be needs based rather than focused on advancement for the sake of AI development, with priority given to solving limitations on the battlefield (The Israeli Defense Force, 2017). One newly developed combat system, Fire-Weaver, is designed as a "networked sensor-to-shooter system" that connects AI powered smart targeting systems to command centers and the weapons sights of human operatives on the ground, ideally providing them with timelier and more accurate information in urban environments where the potential for civilian casualties is high (Frantzman, 2020a, p. 1). The technology is designed to protect the warfighter and ensure maximum attack efficiency against critical targets while also prioritizing safety standards and preventing mistakes caused by misperception or delays in communication between mission control commanders and ground soldiers (Frantzman). This benefit of real-time data and communication for ground operatives is significant, and such technology could use data received from both ground troops and satellites to help the IDF reduce the fog of war (Frantzman).

The development of this type of AI system along with others currently underway in the IDF has the potential to shift combat standards and traditional approaches to warfare, something Israel appears motivated to do (Frantzman, 2020b). The IDF is even aiming to revolutionize combat training using AI by constructing adaptive augmented reality environments that can more accurately simulate a battlefield for troops to train in (Frantzman, 2020a). Israel has expressed a

desire to be at the forefront of future AI armored vehicle development as well, with research focusing on cutting the number of crew needed to operate vehicles and, potentially, self-driving armored vehicles using the same autopilot technologies civilian car manufacturers currently employ (Frantzman, 2020b). Israel is also working towards developing autonomously functioning and AI assisted tanks for battlefield use (Frantzman, 2020a). Collectively, such advancements could result in better trained, more effective fighting forces on the ground and less need to deploy armed personnel in large numbers.

While the IDF's AI efforts appear primarily focused on ground forces, they do extend beyond purely ground forces and land vehicles. Israel has demonstrated interest in advancing its air and naval capabilities using AI technology. Israel is currently developing AI piloted autonomous drones and smart targeting weaponry including air-to-surface missiles. These drones could eventually be used for aerial reconnaissance and intelligence collection, perimeter monitoring, and air support while smart targeting missiles could be used to quickly and precisely eliminate threats with only limited input from a human operator. Israel's naval developments thus far have been more limited in scope, focusing primarily on intelligence collection and some limited smart targeting systems for ship-based weapons (Frantzman, 2020b).

Israel's Responsible Use of AI score is 52.03, and Israel ranks 23/34 in the Responsible Use of AI Ranking. Israel's AI Governance and Ethics Score is 60.89 (ARI 2020). Israel has been somewhat proactive in its attempts to confront the potential legal and political issues surrounding AI technology. The Israeli legislature has yet to clearly establish how AI technology will be regulated or patented, but the Prime Minister's office has organized a "specially-commissioned task force" to begin researching and presenting its recommendations to the Israeli government (Renaud et al., 2019, para. 3). However, most of the questions addressed by the task force appear

to be based on patenting according to Renaud et al. Regulating AI development and monitoring its trends is an important step in addressing issues surrounding AI, but this leaves the ethical questions of military AI development and use, data privacy, and potential loss insufficiently addressed. This could result in greater political and legal confusion and conflict in the future, should these topics remain under-analyzed.

Regardless of the specifics of IDF's vision for the future, their focus appears to involve multiple elements: preserve and prioritize the human element of warfighting, revolutionize how war is conducted, ensure Israeli dominance in the fields of emerging weapons, new technology, and AI driven systems that bolster warfighting capabilities (Frantzman, 2020b). AI is not expected to change Israel's posture or grand strategy. Currently, Israel has adopted ambitious AI goals that are driven by relatively clear and focused doctrine which encourages target development to solve priority issues (The Israeli Defense Force, 2017). They also enjoy a strong alliance with the U.S., which has historically been willing to share its own technological innovations and funding to boost Israel's technical capabilities. However, regional tension allows for a heightened risk of conflict that can lead to pressure on the Israeli leadership to engage in premature deployment of AI technologies before they have been properly tested and evaluated for battlefield use (Frantzman, 2020b). Assuming Israel can overcome this pressure, the IDF's ambition and doctrinal clarity will likely serve it well in its AI development track. See Table 2 in the Appendix for a summary of Israel's AI developments and applications.

India

India ranks fortieth in the world and first in South/Central Asia on the AI Readiness Index (ARI, 2020). The creation of the Defense AI Council (DAIC) and early development stages of a Defense AI Project Agency (DAIPA) are indicative of the India's ambitions regarding AI

development (Sahu, 2019). The national government's 2016 request for cyber directives from its ministry of defense has produced research objectives currently under evaluation from its military and navy (Godbole, 2020). Lieutenant General Panwar of the Indian military identifies several applications for AI technology within both the Indian air force and its land military (Panwar, 2019). From a ground force perspective, Panwar references anti-Improvised Explosive Device (IED) operations, defensive robotic sentries, lethal robotic ground soldiers, and robot soldier counter-insurgency operations as the most likely applications of AI technology. Bansal et al. (2019) suggests that viable uses for AI and machine learning technologies include: surveillance, training and decision making, aid to automated target recognition problems, and automated vehicles. Each of these strategies are aimed at improving current resources and human capital to overcome the relative disparity in these areas compared with other states such as China and the U.S. (Horowitz et al., 2018). India's AI strategies are also designed to assist ground troops and craft more effective fighting forces, though India's focus thus far has been primarily economic in nature rather than military (Horowitz). Regarding air force applications, Panwar identifies three major potential uses of AI, including automated surveillance drones, drone swarming technology, and autonomously piloted Unmanned Aerial Vehicles (UAVs) (2019). Each of these innovations are targeted at reducing the man-power necessary for the air-force to operate while maximizing its efficiency (Panwar, 2019). India has also taken an interest in utilizing AI technology to revolutionize its naval operations.

India's ministry of defense identified five areas of development priority for AI technology in 2018. These five use areas include "lethal autonomous weapon systems and unmanned surveillance, simulated war games and training, cybersecurity, aerospace security, and intelligence and reconnaissance" (Godbole, 2020, p. 12). In addition to these general military uses of AI,

Commander Godbole of the Indian Navy highlights four uses of AI relevant to the navy specifically which include more accurate and streamlined inventory management, training through virtual, augmented, and mixed reality to provide more realistic scenarios for warfighters, prescriptive maintenance based on condition monitoring and smart sensors rather than more costly preventative maintenance, and security and surveillance using trip wires, radars, and underwater autonomous patrol drones. Commander Dutta (2020) of the Indian Navy also highlights the potential for AI in the Navy, identifying several of the same uses as Commander Godbole (2020). However, Commander Dutta also identifies Maritime Domain Awareness (MDA), or the real-time collection and processing of ship positioning data from sensors at various domains and locations, and autonomous vehicles for surveillance and offensive purposes as potential uses for AI.

From an operational command and control perspective, India's developmental goals indicate a desire to boost the effectiveness of its existing forces and eliminate unnecessary operational costs. Intelligence collection and processing conducted either autonomously by AI or by a human operator with AI assistance has the potential to decrease the Indian military's response time to potential threats and allow for more complete and accurate understandings of developing situations. It may be able to further provide assistance to policy makers and control centers by rapidly analyzing information and automatically suggesting targets based on patterns identified within collected intelligence. AI controlled adaptable virtual training environments may provide more accurate battle training scenarios for soldiers and officers. From a financial standpoint, AI live monitoring of military assets for component degradation or system failures create an opportunity to normalize prescriptive maintenance. This would promote better resource management, allowing the military to pinpoint which specific equipment is in need of repairs rather than engage in blanket routine maintenance of its assets (Bansal et al. 2019). These developmental

goals could expedite the process of modernizing India's military and conserve valuable materials and financial resources.

India has entered the AI development race trailing the major power states and some developed states, and some researchers contend that the current state of AI competition may offer the Indian military the advantage of mimicking the achievements of other states without having to assume the burdens of development that other states have endured. However, some researchers argue that India currently lacks a clearly defined vision for AI development put forward by some of its rivals, though it has taken steps to establish a more cohesive framework moving forward (Sahu, 2019). As Lieutenant General Panwar notes, India's traditional stance has been oppositional to military technology advancements out of fear of degrading the "balance of conventional power that it currently enjoys in the sub-continent" (2019, para. 36). However, India's previously identified strategies indicate that India's progress in AI development offer it substantial benefits that it may not be able to avoid (Dutta, 2020; Godbole, 2020; Panwar, 2019). Consequently, some scholars contend that India will likely move towards a more technologically progressive AI stance in the near future which places more focus on better resource management, warfighter skill improvement, and greater technological synergy (Godbole, 2020). Therefore, the Indian military will likely continue to move towards the AI developments highlighted previously, according to many observers. These strategies echo the previously identified posture of other states that indicate a desire to implement AI in predominantly supportive roles to human operators in a military context and allow them to keep pace with other developed states if adopted.

India is also faced with the same legal and ethical questions as other states seeking to become major players in the AI landscape. India's Responsible Use of AI score is 41.19, and the India ranks 32/34 in the Responsible Use of AI Ranking. India's AI Governance and Ethics Score

is 57.69 (ARI, 2020). Questions of legal responsibility, consumer protections, intellectual property, technological accessibility, and data privacy and protection are some of the dominant topics in the discussions surrounding AI adoption in India (Kalyanakrishnan et al., 2018). Kalyanakrishnan et al. argue that the solution lies in rigorous academic study of both the benefits and risks of AI adoption. They argue that constructing a “robust AI ecosystem in India” beginning with simple data collection and analysis is necessary to fully benefit from the technology (Kalyanakrishnan et al., 2018). Furthermore, this is unlikely to be accomplished unless this technology is made widely available to the broadest section of India’s population possible (Kalyanakrishnan et al., 2018). Regardless of the perspective the Indian government adopts, it is imperative that the state begins to address the potential political and legal conflict that AI might induce as AI impacts Indian society to a greater extent. See Table 3 in the Appendix for a summary of India’s AI developments and applications.

South Korea

South Korea ranks seventh in the world and second in East Asia on the AI Readiness Index (ARI, 2020). South Korea launched its own Artificial Intelligence Research and Development Center early in 2019 with the goal of building “the vision and concept for military applications of AI and to develop the next generation of combat power” (Fei, 2019, p. 33). This goal is bolstered by efforts from both the federal and private sectors, with notable cooperation occurring between groups such as the Korea Advanced Institute of Science and Technology (KAIST) and the Hanwha Group, a defense business corporation (Fei). The ever impending need to securitize itself against its North Korean neighbor has likely driven these collaborations, as both the public and private sectors are immediately threatened by any hostility from North Korea. South Korea’s Ministry of National Defense is also interested in the intelligence capabilities AI may provide or improve (Cho

et al., 2020). Thus far, the Ministry has initiated research and development on reconnaissance, surveillance, big data mining and processing, and analysis involving AI and machine learning (Cho et al., 2020).

South Korea has launched developmental initiatives for several sectors of its military, including AI driven robotics and smart targeting systems for its land forces, aviation training systems for pilots and unmanned drones for its air force, and autonomous underwater vehicles for its navy (Fei, 2019). The cooperative effort between KAIST and Hanwha currently includes research and development on large scale unmanned underwater vehicles, AI command systems, AI-based aviation training systems, and AI-based object tracking techniques, cyberwarfare capabilities, and AI driven robotics (Fei 2019, p. 33). From a command-and-control perspective, South Korea seems to have adopted a primarily defensive posture, focusing on improving operations and weapons systems command with AI systems monitoring to provide early detection and warning relevant to cyber-attacks (Fei, 2019). Finally, in regard to information warfare, the state is focusing its efforts on automated reconnaissance and threat surveillance and big data mining and processing (Cho et al., 2020). The Korean Internet and Security Agency (KISA) is focused on this goal, using data mining and machine learning to develop better AI-driven cyber security (Fei, 2019).

North Korea's track record of cyber aggression against South Korea may drive AI development in South Korea at a faster pace than other states, particularly as South Korea looks to bolster its defensive capabilities (Cho et al., 2020). Each of these tools could provide non-lethal responses to North Korean aggression, allowing South Korea to defend itself and retaliate against non-nuclear strikes while minimizing risks of escalation to an undesirable degree (Fei, 2019). AI-based cyber defense systems would also allow South Korea to better prepare itself for North

Korean cyber aggression through early attack detection and blocking. These developmental goals support a continued defensive posture from South Korea with a mixture of proactive strategies in the cyber realm and deterrence/retaliatory capabilities in the conventional context.

South Korea enjoys a number of advantages that will likely boost its efforts to develop and apply AI. The state's openly defensive posture, due to the threat posed by North Korea, may allow it to develop its AI capabilities with a lower risk of perceived hostility from states other than North Korea, potentially enhancing its ability to develop AI technologies without encountering significant resistance internationally (Fei, 2019). Joint development efforts between the private and federal sectors will also likely drive development at a faster pace, as South Korea has its best and brightest minds working cooperatively rather than competitively on AI projects (Fei). The state's alliance with the U.S. also provides it with access to more advanced technologies (Fei). However, South Korea's significant reliance on cyber systems make it more vulnerable to cyber-attacks and information theft than its rival North Korea. Costly attacks on development centers and AI technology theft will likely be strategic goals for North Korea and may prove to be a significant impediment to AI development for South Korea in the long-term.

From a legal perspective, the South Korean government has played a significant role in fostering the growth of its Virtual Realty, AI, and robotics industries thus far (Hyo-sik, 2016). These efforts are multi-faceted and multipurposed, designed to both keep South Korea viable during the fourth industrial revolution and guide technological development while providing jobs for South Korean youth (Hyo-sik 2016). South Korea's Responsible Use of AI score is 56.48, and South Korea ranks 21/34 in the Responsible Use of AI Ranking. South Korea's AI Governance and Ethics Score is 85.62 (ARI 2020). The South Korean government's perspective on AI appears to be that encouraging positive AI development can be accomplished through selective financial

and legal support. The construction of a detailed “master plan” by the South Korean government as early as 2016 is indicative of the foresight necessary to address the dynamic legal and ethical issues likely to emerge as AI continues to develop globally (Hyo-sik 2016, para. 5). The subsequent 2019 announcement of guidelines to promote ethical AI development in South Korea further exemplifies South Korea’s preparedness (Kang & Jang, 2019). Should this trend continue, South Korea may be better prepared than most of its rival states to address the complexities of AI development and adoption in the coming years. See Table 4 in the Appendix for a summary of South Korea’s AI developments and applications.

Germany

Germany ranks fourth in the world and third in Western Europe on the AI Readiness Index (ARI, 2020). Germany, like its other neighbors in the EU, has displayed significant interest in AI research (German Center for Research and Innovation, 2021). Germany has a developed cyber strategy and boasts of its “Cyber Valley,” a Silicon Valley inspired assortment of universities in South-West Germany that has been geared towards developments suited for the fourth industrial revolution since 2016 (German Center for Research and Innovation). Cyber Valley is currently one of the largest cooperative research projects in Europe and has courted the involvement of leaders from the science and industry worlds, including Amazon, to develop machine learning, robotics, and computer vision projects relevant to AI (German Center for Research and Innovation). The Max Planck Institute for Intelligent Systems, which specializes in theory, software, and hardware development pertinent to AI (German Center for Research and Innovation), is also situated in Germany and has contributed to the state’s surge in AI start-ups and patent applications (Zhao, 2020). However, Germany’s interest and strategy for AI has been limited to economic ventures and applications thus far, with military, security, and geopolitical applications being sidelined (Zhao, 2020).

Despite this previous reluctance to discuss military and defense policy in general over recent years, the German armed forces have displayed significant interest in potential military applications for AI since at least 2018 (Zhao, 2020). The German Army Concepts and Capabilities Development Center's (GACCDC) "Artificial Intelligence in Land Forces" position paper outlines several potential applications for AI within Germany's Bundeswehr (2019). Among these applications are suggestions to explore new weapon systems and weapon armaments, find ways to incorporate AI capabilities into "personnel and material management" through predictive maintenance and staffing suggestions, and use of AI in training systems such as automated and augmented teaching and learning structures. The paper also recommends that the Bundeswehr establish an AI Development Center, an AI Data Center, and an AI Work Bench that are designed specifically with military and defense applications developments in mind (GACCDC, 2019, p. 12). The Bundeswehr themselves have also expressed an interest in AI-based "situation forecast" that synthesizes classified and public document information to "improve the forecasting and evaluation of potential crises and to make the results of the evaluations available to the politically responsible persons" (Freist, 2018, para. 1).

Many of these suggestions echo those seen in other developed states in the EU and the United Kingdom. However, Germany's military AI projects will require funding and governmental support if they are to be successful. Germany's current AI plan has only one sentence referencing future military AI developments: "the use of AI-based technologies and systems will have implications for the armed forces and is therefore an important issue to be taken into account for the future of the Bundeswehr" (Zhao, 2020, para. 2). Germany will be required to place greater priority on the development of AI capabilities in the military if it is to maintain pace with other developed states (Zhao, 2020). As Zhao notes, Germany is traditionally expected to fill a

leadership role by its allies and maintaining a modern and effective military is essential to fulfilling that role (2020). Thus, according to some scholars, from a military perspective, Germany's most significant weakness is its reluctance to engage with the defense potential of AI technology (Zhao, 2020). According to some researchers, should Germany involve its military apparatus in AI developmental plans in a greater capacity moving forward, it can capitalize on the academic and industrial resources in Cyber Valley to create economic and defense-related benefits that place the state as a leading developer of AI, both regionally and globally.

Germany's Responsible Use of AI score is 59.72, and Germany ranks 16/34 in the Responsible Use of AI Ranking. Germany's AI Governance and Ethics Score is 63.04 (ARI, 2020). In 2018, Germany established a Data Ethics Commission specifically to produce recommendations for rules around algorithms and AI (Meyer, 2019). The commission found that "the Federal Government's strategy on artificial intelligence should promote and demand attention to ethical and legal principles throughout the entire process of developing and applying AI" to such a degree that "the strategy's action areas should be defined with this objective in mind" (Daten Ethik Kommission, 2018, p. 3). German technological strategy, particularly regarding data privacy and security, has historically been exceptionally influential on a global scale (Meyer, 2019). As such, this trend towards defining and upholding legal and ethical principles regarding AI may be indicative of the example that other AI enabled states will follow. If the German strategy for addressing legal and ethical issues in the developmental stages is successful, the state will likely benefit from avoiding several major political and legal conflicts regarding AI that other states may have to endure. Having analyzed the development and military application of AI in the six developed states in our study, we now turn to examining our AI expert interviews regarding how developed states are developing and applying AI technology and the implications for international

security. See Table 6 in the Appendix for a summary of Germany's AI developments and applications.

Developed States Overview and AI Expert Interviews

Regarding AI development and the military application of AI in non-major power developed states, when asked the question: *Do you have any knowledge regarding non-major power developed states progress in AI development?* Many of the AI experts stated that Australia, Canada, France, Germany, India, Israel, Switzerland, and the United Kingdom have made notable progress in AI development. One expert placed Germany, Switzerland, and France at roughly equal levels regarding AI development. In respect to Australia, two of the experts stated that Australia is developing impressive AI technology given its limited resources and population size. One area that was highlighted was in respect to France and Australia's use of AI technology regarding e-government, and how this application could lead Australia, in particular, to make important advances in the public utility and governance aspects of AI development. The experts stated that Canada and Germany have made significant investments in AI technology regarding vision systems, financial systems, and autonomous vehicles, and the U.K. has invested in these areas as well with additional emphasis on risk assessment, financial markets, economics, and intelligence. The experts also stated that Israel is heavily investing in AI development regarding medicine, cyber security, defense, and is openly committed to developing autonomous AI weapons systems. One of the experts also emphasized the importance of the AI Google Deep Mind program based in London and its potential to bolster AI development in the U.K.

When asked the question: *Are developed states lagging behind the major powers regarding AI development, and if so, why?* The experts stated that many developed states have made important advancements in developing and applying AI technology in the area of medicine for

specific applications such as DNA mapping. A recurring theme in the expert interviews is that most developed states have access to open-source AI algorithms that can be used across numerous platforms. However, many states do not have possess the hardware or products to take advantage of the AI software. The lack of resources or focus on AI development in this area leads to an imbalance in AI development across states. Thus, the major power states such as the United States and China have more end-products to incorporate AI software whereas many non-major power developed states do not, leading to an imbalance regarding the application of AI.

Multiple experts stated that for developed states to close the AI development gap more resources are needed to develop AI end products and for additional investment to support AI scientists. In addition, multiple experts stated that a few individuals can make a significant difference in the ultimate advancement of AI technology. They stated that some of the brightest AI researchers are working in non-major power developed states, but these researchers often do not have the resources needed to actualize their development projects. One expert discussed the importance of the European Union's (EU) "Horizon 2020" programs that fund ambitious long-term AI projects. The expert stated that many breakthrough developments emerge from these "Blue Sky" type of projects and the EU is assisting AI scientists in developed states to bring their projects to fruition, and these types of projects could assist in closing the technological divide between developed and major power states. The expert also stated that the US is somewhat lacking in this regard with its overemphasis on short term AI projects, except for a few funding sources such as DARPA that prioritize longer-term, more ambitious projects.

Throughout the interviews, most of the AI experts (except one) re-emphasized the ability of AI technology to create large gaps between "have and have not" states. They stated that the development and application of AI technology can create significant advantages in many areas

including: healthcare, economics, education, and especially in respect to cyber security and defense. According to most of the experts, states that can harness the power of AI and apply it for data analysis and data collection purposes, to assist leaders with decision making processes, will have profound advantages regarding military competition. Many of the experts also contended that the gap between the major power states and the develop states has not been fully realized yet but could be in the near future as the major power states (specifically the U.S. and China) continue their development of AI technology, although some experts questioned if the U.S. was the current leader in AI development or was positioned ahead of the non-major power developed states. The experts generally agreed that the U.S. and China were ahead of most non-major power states in the development and military application of AI technology, but the divide was not insurmountable, and if some developed states devoted more resources to AI development, they could close the gap. In addition, many of the experts expressed their concern with unregulated AI weapons that could lead to unnecessary deaths, especially if humans have less involvement in the decision-making capacity of autonomous weapons systems.

Discussion

When considering AI development and the security ramifications regarding the states examined in our study, the U.K., South Korea, France, and Israel have made notable progress in AI development and are actively applying AI in their militaries for both offensive and defensive purposes. Germany has also made significant strides in AI development in numerous sectors but is not incorporating AI technologies within their militaries, although researchers have noted that states such as Germany could apply AI for defensive purposes if they chose to do so based on their development levels in other areas, human capital, and existing infrastructure. India appears to possess the human capital and resources to expand AI development but ongoing conflicts among

its political leaders have limited progress. Also, India has not committed to incorporating AI into its military due to concerns India's military leaders have regarding the effect AI technology would have on its conventional forces.

Regarding the rules and regulations surrounding the use of AI within states - France, and Germany appear to be at the forefront of discussions surrounding the proper use of AI technology. These states have provided guidelines for the use of AI and have initiated discussions domestically and internationally regarding the proper role of AI. Problematic issues that could emerge in other states due to conflicts over the effects of AI technology may be less likely in states such as France and Germany because they have taken proactive steps to engage the public in conversations regarding the appropriate use and possible ramifications of the proliferation of AI. In addition, while the UK and Israel are developing and applying AI technology in a sophisticated manner, future concerns could emerge surrounding the role of AI technology within various areas of domestic life and in respect to the defensive uses of AI.

In respect to AI development and the military application of AI technology in non-major power developed states and its effect on the international balance of power and global security, The United States and China appear to maintain advantages over most developed states regarding the military application of AI technology. However, much remains to be determined. Previous scholarship and our AI experts contend that future advancements in AI technology may lead to greater power asymmetries between states, with one or two states having military superiority over the use of AI technology that could prevent other states from being competitive. In this scenario, states with less capable AI systems would be at significant disadvantages regarding military competition. However, states that have formidable AI capabilities in numerous sectors, such as Germany could potentially transfer their technologies, resources, and human capital to military

applications if needed. This presents a dilemma for many developed states. If states fail to incorporate AI into their militaries, they risk having obsolete militaries in the face of potential adversaries that could possess significant defensive advantages due to the application of AI. However, developing AI for combat and security purposes raises several regulatory and ethical questions for leaders and their citizens. Thus, many developed states are in difficult situations regarding how to best navigate the proper path to harness the power of AI in a manner that enhances the well-being of their citizens but also allows states to remain competitive on the global stage.

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Appendix

Tables of Artificial Intelligence (AI) Military Developments and Applications: Non-Major Power Developed States

Table 1

AI Military Developments and Applications in France

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
Robotics: take on dangerous tasks Ex: landmine removal and detection (Parly 2019)	“Air Combat Cloud” ¹	RAPIDFire System ²	General decision making and planning (designed to assist senior leadership in making strategic judgements) Collaborative warfighting between branches of the military	Intelligence collection and processing	Prioritizing an early lead on general AI development for military purposes Clear doctrine (establishes AI direction, designated goals, semi-defined development timeframes)	Possible ethical and regulatory concerns that could limit AI capability

Notes. ¹Collaborative plan between France and Germany to combine new generation fighters, unmanned aircraft, and current fighter jets into a network system (Tran, 2020).

² Developed by Thales and Nexter, provides navy surface vessels with “an effective close-in defense capability against modern air and surface threats” (Thales Group 2020, para. 1).

Table 2*AI Military Developments and Applications in Israel*

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
Fire-Weaver smart targeting ¹	Air-surface missiles	Intelligence gathering	Fire-Weaver ¹	Intelligence collection and processing	Ambitious AI goals for tactical and technological purposes	Regional hostilities and regulatory concerns bring risk of conflict that could lead to pressure to implement AI technology before it has been fully developed and tested
Autonomous/AI aided tanks	Unmanned drones	Smart targeting	Greater integration between mission control and warfighters on the ground		Relatively clear AI doctrine of focused development	
Augmented Reality-based training	Smart targeting					

Notes. ¹The Fire-Weaver smart targeting system is designed to establish real time connections between rifle scopes of warfighters on the ground, satellite targeting systems, and mission control for the purposes of target identification and neutralization from a bird's eye view (Frantzman, 2020a).

Table 3*AI Military Developments and Applications in India*

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
Anti-IED	Automated surveillance drones	Simulated war games and training	Surveillance	Automated surveillance	May benefit from starting AI development with ability to learn from predecessors' successes and failures in other states	Late to the AI race, currently lagging other states in AI development
Automated vehicles	Drone swarms	Lethal autonomous weapons	Training/Decision-making	Intelligence collection and processing		
Robo-sentries	Autonomous UAVs	Cyber/aerospace security	Automated targeting aid	Unmanned reconnaissance		Doctrine for AI development objectives less clear than rivals
Robo-soldiers		Maritime Domain Awareness (MDA)	Resource management and prescriptive maintenance			

Table 4

AI Military Developments and Applications in South Korea

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
AI driven robotics Smart targeting	Aviation training systems for pilots Unmanned drones	Large scale unmanned underwater vehicles AI driven robotics	AI command systems regarding operations and weapons systems Object tracking techniques Cyber: AI system monitoring can provide early warning and detection related to hacks	Big data mining and processing Automated reconnaissance and surveillance Cyberwar capabilities interest may drive AI development to a faster pace	Defensive posture regarding AI and cyber development may allow South Korean to develop AI capabilities with a lower risk of perceived hostility (aside from North Korea) Cooperative efforts from private and federal sector regarding AI development Alliance with U.S. makes technology accesses easier thereby assisting in AI development	Country is very cyber reliant, making it more vulnerable to cyber offensives by default. Theft of AI technology or costly attacks against development centers are more likely, especially given North Korea's hostility

Table 5*AI Military Developments and Applications in the United Kingdom*

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
Mostly command control use- predict enemy movements, analyze behaviors, suggest strategic options on the battlefield. May also be used for training exercises	Taranis armed autonomous drone	Royal Navy is testing AI's ability to counter supersonic missiles The U.K.'s Defense and Science Accelerator (DASA) has funded early development of smart ships with onboard AI capable of "supportive decision-making during pre-mission preparation, mission execution and post-mission analysis" as well as engineering crew support. The targeted integration date for this technology is 2030	"Autonomy program" aimed at researching "algorithm development, artificial intelligence, and machine learning" for military use	Unknown	Home to some of the most advanced robotics and technology development corporations in the world Private/public partnership has been normalized in the field of AI development Partnerships with two other AI leaders: Israel and the U.S. Well-defined developmental plans and goals for AI technology, actively interested parliament	Despite its massive potential for AI developmental success and political interest in such advancements, U.K. has struggled to capitalize thus far and has not seen the major military or economic benefits it is capable of fostering

Table 6*AI Military Developments and Applications in Germany*

Land	Air	Sea	Command and Control	Information Warfare	Strengths	Weaknesses
None in progress- State has pledged not to use “killer robots” 2019 position paper “Artificial Intelligence in Land Forces” by the ACCDC outlines several potential goals- mostly related to command, control, threat analysis, and intelligence- but no publicly known active development has begun	“Air combat cloud”¹	Unknown	German military wants to use AI to streamline information flow and processing according to the 2019 position paper “Artificial Intelligence in Land Forces” by the ACCDC	Unknown	“Cyber Valley” represents a large pocket of developmental capability regarding AI in Germany and the Max Planck Institute for Intelligent Systems Military is interested in AI and academic discussion amongst the defense sector regarding AI applications	AI strategy is borderline non-existent regarding military applications State leadership appears reluctant to discuss military applications of AI.