AIR WAR COLLEGE

AIR UNIVERSITY

ARTIFICIAL INTELLIGENCE INTEGRATION, BUILDING A HUMAN-MACHINE TEAMING ENTERPRISE

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

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Mar 15, 2021

Disclaimer

Biography

Lt Col Kevin Rowlette is assigned to the Air War College, Air University, Maxwell AFB, AL. Lt Col Rowlette joined Air Force Special Operations Command (AFSOC) as an AC-130H Fire Control Officer after completing an initial assignment as an E-3 Navigator. He was selected to crossflow to U-28 Combat Systems Operator following the retirement of the AC-130H Spector gunship. Lt Col Rowlette has severed at multiple operational levels and has deployed numerous times as part of joint special operations air components in the Middle East and Africa. He most recently commanded the 34th Special Operations Squadron, Hurlburt Field, FL.

Abstract

U.S. Air Force Special Operations Command (AFSOC) 2020 strategic guidance states it is no longer ready for "full-spectrum" warfare and readiness. The integration of AI will increase AFSOC's warfighting capacity and capabilities through automation and technology while reducing personnel requirements across multiple weapon systems. AI, as it matures, gives leadership the option between fully autonomous or augmented weapon systems with consideration of mission requirements, policy, and risk. Moreover, AFSOC can best integrate technology through a family of systems approach, using technologies that are easily adaptable across multiple airframes, and increasing capabilities across every weapon system. Additionally, through AI teaming these new technologies will increase mission effectiveness even in the contested environment enabling "full-spectrum" readiness in an evolutionary manner.

Introduction and Problem Statement

Over the past two decades the United States has been conducting operations focusing on countering violent extremist organizations (CVEO). This focus has led to changes in military doctrine, integration of technology, and military joint operations; unfortunately, it has also prioritized warfare against a less capable adversary with unfettered multi-domain supremacy. The reemergence of long-term "strategic competition" through state actors such as China and Russia led to a strategic shift for the United States over the past three years.[1] Senior Leaders are taking active measures in an effort to maintain U.S. military superiority. The 2018 U.S. National Defense Strategy (NDS) requires refocusing military training beyond the permissive environments with significant modernization and sustainment directives that clearly focus on great power competition and technology. The strategic focus has shifted as great power competition reemerges, and the U.S. military must realign their efforts.

The Chief of Staff for the United States Air Force (USAF) General Charles Brown Jr's guidance directs accelerated change through integration of digital high-tech solutions to remain dominate and credible. China and Russia are developing capabilities to counter U.S. strengths and have asymmetrically sought and applied their strengths toward U.S. weaknesses, and we must rapidly divest incapable technologies while seeking technology modernization opportunities to ensure future dominance.[2] Moreover, General Brown directs the USAF to focus effort on missions and capabilities, not on platforms or weapon systems.[3] There is a large-scale effort to ensure the USAF is aligned with strategic guidance, maintaining effectiveness in current operations while changing due to the rise of great power competition. Many weapon systems fielded to enable best effects in CVEO are mission ineffective in contested domains, and legacy weapon systems failure to adapt leave them vulnerable to advancing systems.[4]

Finally, U.S. Air Force Special Operations Command (AFSOC) 2020 strategic guidance states it is no longer ready for "full-spectrum" warfare and readiness due to the issues highlighted above, and a sustained high operational tempo. AFSOC must change to meet the demands of the U.S. defense strategy and Air Force strategy; however, the command cannot make changes that will inhibit their current CVEO operations. Rather, AFSOC must become better at CVEO while also updating weapon systems to enable "full-spectrum" readiness in line with strategic guidance. AFSOC strategy looks to increase their capabilities through technology integration building "human-machine" collaboration or teams through automation enabled by artificial intelligence (AI).[5] Automation, AI, and integration of capabilities through new technologies could transform AFSOC operations and revolutionize how the air arm of SOF integrates with conventional forces in a contested environment. AFSOC must look to new technologies that will enable access and effects across their various weapon systems for CVEO and peer competition. AI will provide the next asymmetric revolution in warfare, increasing force agility, while decreasing risk to mission and force across the spectrum of conflict.

Thesis

The integration of AI will increase AFSOC's warfighting capacity and capabilities through automation and technology while reducing personnel requirements across multiple weapon systems. AI, as it matures, gives leadership the option between fully autonomous or augmented weapon systems with consideration of mission requirements, policy, and risk. AFSOC can best integrate technology through a family of systems approach, using technologies that are easily adaptable across multiple airframes, and increasing capabilities across every weapon system. Additionally, through AI teaming these new technologies will increase mission effectiveness even in the contested environment enabling "full-spectrum" readiness with current

or less manpower in an evolutionary manner. This paper recommends creating an AFSOC AI task force to oversee every aspect of AI integration from policy to new capability fielding. Additionally, it introduces AI levels of automation architecture for technology modification and integration building a human-machine teaming enterprise. Finally, it suggests pairing AI with existing technologies will produce new capabilities that will alter the dynamics on the battlefield, and offers increased capabilities today ensuring "full-spectrum" readiness well into the future.

Why Artificial Intelligence

Why is AI enabled automation so important as the USAF looks to modernize weapon systems? Russian President Vladimir Putin stated, "Artificial Intelligence is the future…whoever becomes the leader in this sphere will become the ruler of the world".[6] Additionally, China has developed and published a state sponsored objective for AI with milestones, setting the objective to lead all countries in AI development and to be the worlds unquestioned controller of AI.[7] The US government also recognizes the importance of AI development and integration. The US Congress is calling for a "Manhattan Project" for AI to ensure the national security.[8] Additionally, Congress requested multiple research efforts to inform legislative efforts for AI, recognizing the critical advantages from AI for the military but also understanding risk. When individuals are paired with AI they are able to make decisions faster, but more importantly human AI pairing has thus far proved better than human or AI alone.[9] This revolutionary technology has potential to change global dynamics, and if the U.S. Department of Defense (DoD) and USAF do not seek to rapidly explore and onboard these capabilities then potential exists for U.S. displacement in the world order; moreover, the USAF may find itself completely incapable as a service facing near-peer competitors integrating AI.

Artificial Intelligence Integration

While AI is new to most people, it has been in development for more than three decades and it is just another form of technology. Just as the radio, television, internet, and smartphone have all changed the world through technology, AI is technology that has fundamentally changed information utilization and distribution, through data, to target desired audiences. This highlights the potential for AI applications to influence multiple domains simultaneously. So, what is AI?

There are several ways to explain what AI is and the components, layers, and software that give it purpose. The DoD AI strategy refers to AI as the "ability of machines to perform tasks that normally require human intelligence – for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action – whether digitally or as the smart software behind autonomous physical systems".[10] The intelligence community uses a better definition, referring to AI as a machine, software, and data combination that "empower computer systems to perform the higher kinds of intellectual functions we've traditionally thought are only possible by humans".[11] This definition offers more opportunity when thinking of AI integration, and offers key information about AI architecture to include the need for data. I will explore this more in the automation section below, just understand that AI can weave more data together, quicker, that will revolutionize how we use different technologies through replicating cognitive or mental intellect. Moreover, because we are integrating technology that replicates human intellect it is best orchestrated through a team of experts, or an AFSOC AI integration task force.

AFSOC needs to create an AI task force to lead integration through policy that synchronizes DoD and USAF strategy with AFSOC desired capabilities, to overcome issues like

training bias and ethical limitations, and for identifying capability development requirements. Given the potential scale of influence or impact of AI implementation, AFSOC needs this task force to oversee careful integration throughout the command, and across weapon systems. Understanding the limitations and issues outlined above will enable AFSOC to develop an AI task force, comprised of both AI experts and senior weapon systems operators, to develop policy, identify pain points and build an AI integration execution plan.

The AI task force needs to consist of at least a data scientist, a software developer, a systems designer, multiple weapon systems experts and a team leader.[12] The AI task force leader should be someone with a basic concept of AI limitations, potential capabilities, and understand general timelines for computing and technology advancement.[13] This will provide the optimal linkage between AFSOC leadership and the team tasked with AI integration for the command. The weapon systems experts should be from different backgrounds with knowledge of mobility, strike and intelligence, surveillance, and reconnaissance (ISR) missions, for both manned and unmanned weapon systems. Additionally, I highly recommend at least one individual be a weapons officer for expertise of AFSOC weapon systems, and integration of their capabilities into warfighting requirements. The remaining team members are the experts in AI integration through software blends, pattern finding in small and large data sets, data management, algorithm development and implementation, software development, and systems designer interface. These experts, due to their knowledge and data management, will likely be the large expenses for AFSOC to successfully integrate AI and grow command capabilities with minimal risk. The task force composition recommended above represents the minimum, and as more pain points and mission requirements are identified additional experts will likely be needed;

moreover, individual hires may prove impossible due to cost, and contracting an external organization with these capabilities to work with the AFSOC task force may be required.

The task force will need to understand AI advantages and limitations to appropriately manage risk. AI processes data in nanoseconds enabling quick action based on what the AI has been trained to do, and while this gives AI purpose it also limits potential. Currently, AI cannot learn beyond the data it is exposed to which automatically leads to two limitations. First, when training AI humans are teaching AI information based on their perception of data, where AI sees raw data. Second, it is difficult for humans to label or categorize every part of data used to train AI. Think of a picture of a truck, then try to label or categorize every part of the picture at max magnification. It becomes difficult to explain, in detail, the background of every picture, but AI is going to see the data and believe it to be something. Additionally, the items we think are easy to label, the truck in the picture, individual perception causes deviations in labeling. Both these factors lead to a training bias since humans see data differently than machines and interpret the data without limited learning capabilities. There are programs that assist with this problem, which I discuss in the automation section below, but it causes AI to ignore some data instead of exploiting it. This should be a temporary solution because ignoring data may also cause missed opportunities, or negative outcomes. Training bias is not the only problem that leads to limitations. What about ethics and values?

Currently there is no AI with "self-realization, fulfillment, emotion, or values and beliefs."[14] AI does not act based on ethics or emotion. AI acts only on the information, called data, to perform its intended function. For now, that may limit AI integration to tasks requiring accurate repetition, sustained awareness, and precision. Even limiting AI integration to these functions does not solve the ethical or moral understanding AI issue. The complex environment

is shrouded in uncertainty, meaning AI is fallible. The AFSOC AI task force must understand these issues to implement mitigation efforts like creating standardized labeling for training, knowing what information AI is ignoring so trust in capability is not lost, and knowing when the person is better than AI and vice versa. Understanding these limitations are also critical to creating effective policy intended to action strategy and directives.

Strategy and directives ensure human trust in AI enabled automation preventing misplaced risk and possible mission failure. The DoD and USAF AI strategy directs accelerated integration of AI across the services and major commands. Additionally, department resources are outlined to enable accelerated integration from capability development to implementations.[15] The DoD Directive for AI clearly outlines intent for human control of AI while enabling AI to assume many of the function our weapon systems operators currently execute. Additionally, there are requirements for fully AI operated weapon systems to be commanded by humans.[16] This is a risk mitigation effort for times of uncertainty or moral ambiguity, and commonly referred to as human-on-the-loop verses human-in-the-loop. I will further explain this in the automation section below, but it is an important difference. To meet the requirement for rapid AI implementation AFSOC needs to start now. The best way to meet these requirements, and overcome the AI limitations outlined above, is through an AFSOC AI task force, with the experts discussed above, integrated with other DoD AI integration agencies.

An additional resource available to the AFSOC AI task force is the Joint Artificial Intelligence Center (JAIC). The JAIC has spent the last two years creating the foundation for DoD AI integration, and is the DoD hub for all AI efforts.[17] The JAIC has a team of developers and a consortium of AI integration mechanisms to assist AFSOC's AI task force through information sharing, direction, and contracting solutions. The JAIC can assist with policy

development, developing clean protected data storage that also makes the data usable, addressing ethics of AI usage, and facilitating rapid acquisition programs once requirements are identified. Moreover, the JAIC is working with other commands for new capability development and would be able to facilitate cross command, industry, and academia sharing.[18] For AFSOC to remain at the forefront of warfighting capabilities it is imperative to convene an AI task force, staffed with industry experts and military officials that are integrated across commands and services to achieve and maintain "full-spectrum" readiness.

Automation Preparation

AI integration is not a "plug and play" capability regardless of the weapon system. AFSOC must address any upgrades needed to the weapon system to ensure AI integration compatibility. The existing hardware and software of any weapon system may be incompatible with AI processing requirements, and the architecture not capable of routing the high levels of data for AI to function correctly. In most cases, modifications throughout the weapon system must be made to ensure AI reliability and effectiveness. For AI to operate effectively the "artificial neural network…require[s] two things: huge amounts of computing power and enormous amounts of data"; thus, AI requires more sophisticated software and hardware due to processing requirements of the neural network.[19] If the computer network on the weapon system cannot keep pace with AI neural networks data needs, then latency issues will prevent AI from performing the correct action at the correct time.

There is some ability to limit architecture upgrades where limited AI integration is utilized. When level one through level four automation, discussed below, is used only the network computers and routers communicating with AI need to have high-level processing capability. However, I caution against making the decision for limited architecture change

without fully understanding the level of AI automation desired for the complete mission, and future missions of any weapon system. AI integration will only increase over the next five to seven years as the technology is better understood and proliferates. Thus, limited architecture upgrades should only be considered if the weapon system is retiring, going through mission change, or it is a steppingstone due to funding.

Automation level

There are multiple aspects of automation that must be managed to ensure there are no negative mission impacts while seeking increased capability. First, the command needs to address the level of AI enabled automation per mission capability and for the overall weapon system while also managing risk. Developing a method to discuss desired change in capability, articulate desired AI integration, and manage risk is necessary to ensure mission success. Next the command needs to look at where they can share AI enabled automation across multiple weapon systems. Current AI application is not cheap due to the high cost of research and development required; thus, pursuing automation that can be utilized across weapon systems in the early stages will help offset cost while further increasing capabilities. Finally, AI teaming will have impacts beyond operating the weapon system. There is potential to effect maintenance, communications, and the intelligence community at a minimum. The foundation to AI integration is addressing the desired level of automation.

Automation, through AI teaming, of current mission systems enables the weapon system operators to reallocate cognitive ability to newly onboarded systems effectively increasing the totality of weapon system capability. Progressive automation seeks to increase mission capability through gradually increasing levels of automation to near full automation while new systems continue to be integrated. This method acknowledges the risks involved with AI innovation, and

ensures risk acceptance is understood. Automation provides tailorable levels of control, outlined on the scale seen in Table 1, breaking down each level based on what AI accomplishes. Starting with level 0, humans make all the decisions, and moving to level 9 where AI makes all the decisions, automation analysis can be better measured and articulated to support the growing limits of autonomous tasks. By using this analysis process to measure system automation, decision makers can be better informed as to how much automation AFSOC wishes to employ for each task and for the overall weapon system. This also gives the command a clear transition point from human-in-the-loop to human-on-the-loop automation level. Although these levels seem to be close on the spectrum, the true level of autonomy is very different and demonstrates the clear level of AI control per task for accurate risk analysis.

HUMAN IN THE LOOP

HUMAN ON THE LOOP

LOA	MEANING
0	Automation without AI
1	AI operates in background
2	AI operates in background listing set of potential options
3	AI operates in background listing best 3 options
4	AI operates in background listing perceived best option
5	AI lists options and executes operator commands
6	AI lists options and executes perceived best option unless operator override
7	AI executes mission, and reports action
8	AI executes mission, and reports action if asked or encounters a problem
9	AI executes mission

For example, when building a weapons loader for an AC-130 gunship you may be able to reallocate cognitive capability from a repetitive requirement such as grabbing ammunition, loading a gun, and emptying casings in a repetitive cycle. Labeling the ammunition would enable automation without AI to accurately select between different ammunitions as well. This represents level zero automation in Table 1, as it does not require AI teaming but does increase cognitive capacity available. However, a gun operator does more than sling ammunition. If you want to reduce the number of gun operators this is a sound method, but if you want to replace

them you need to replace the cognitive capability to think through misfire issues, fixing broken systems, and the multitude of other things a gun operator does as part of the aircrew. By reducing the number of personnel required to run the gun deck you gain capability to run other onboarded systems. This represents the cheapest automation and the very early stages of upgrades available with no risk to credibility.

The next four levels of automation involve AI assisting only through recommendations or providing information otherwise unobserved and represent human-in-the-loop AI operations. The DoD is working to integrate Project Maven to analyze airborne video footage near real-time and provide leaders the information to make better decisions through a battle management network.[20] This already has large manpower implications for the intelligence community, but what if AI could do more than just analyze the footage offboarded and provided real-time typography labels or analysis as the operator runs the sensor. This could include labeling structure type and composition, labeling personnel through facial recognition, identifying weapons, and labeling noncombatants all overlaid on the video footage. This is level one automation that starts to provide enhanced situational awareness for the sensor operator and may be dismissed or overlay removed. If we pair that capability with the fire control system on the AC-130, AI can provide potential firing solutions for identified targets based on known weapons capabilities and real-time sensor footage analysis. This would represent level four AI automation. Level one through four gradually shifts cognitive capability from the operator to AI but the operator is still performing all activity; additionally, operators are more informed with real-time sensor analysis, and it builds in operational evaluation of AI credibility in complex environments.

Level five through eight automation AI starts to truly execute the mission with operator oversight known as human-on-the-loop. Now several subsystems on the aircraft must be

integrated to allow true mission execution with AI. Continuing to build on the AC-130 scenario, level five AI automation would control the sensors for identifying targets or threats and taking input form the operator on what to track or where to look. AI would be able to control the gun loads or initiate weapons startup if using smart weapons; however, AI is still dependent on operators' commands to act. Level six through eight this gradually shifts to AI acting without commands, but operators maintain oversight and could take control. Finally, level nine automation the AC-130 operates without any aircrew member. AI has complete control of the weapon system but may still be bounded by processes and procedures through its training logic; however, no human is in the loop to help or override AI at this level.

A well-developed AI task force working with defined levels of automation will give the command a common framework to address and discuss automation goals with respect to mission, capability, credibility, and risk. It enables the command to evaluate automation level based on capability, and where it is possible to share the AI investment across multiple weapon systems. Moreover, it gives the command perspective for discussing AI impacts on other issues from AI integration such as maintenance, communications, and intelligence. Finally, as AI continues to improve, doubling in capability every two years, increased cognitive capacity will be available for off-ramping personnel or on-ramping additional capabilities. The AI task force will be instrumental in guiding the command through the on and off-ramping recommendations based on level of automation, ensuring continued optimization of AI, and creating a system of systems.

Developing a System of Systems

Weapon system requirements for a complex SOF mission generally resembles the following vignette. An AC-130J alert launches for a time sensitive target (TST) in support of a capture/kill high-value target. Other aircraft such as the EC-130H, MQ-9, and U-28A aircraft are

also alert launched or diverted to support this TST due to various requirements and capabilities. To avoid burning the target, the joint terminal attack controller (JTAC) also directs multiple aircraft to maintain a target standoff for noise; however, the standoff has the negative effect of degrading operator situational awareness (SA). Once the team is on target all aircraft move overhead the objective and try to gain SA as the target is executed. On-ramping new capabilities can eliminate the SA problems by putting near silent sensors over the target and combining the effects of AI likely reduces the number of weapon system requirements. On-ramping scalable systems, based on actual mission needs and system capabilities, enables the command to tailor the weapon system. AI gives the command options of on or off-ramping personnel to manage human machine teaming. The battlefield requirements, the weapon system capabilities, and the cognitive capability or capacity will inform when to off-ramp capacity and when to on-ramp capabilities. Moreover, some of the capabilities, enabled through pairing existing technologies with AI, will be new and change the way SOF operates.

The AI task force will be pivotal to managing weapon system cognitive capacity and requirements, matching the need to the desired weapon system capabilities. In some cases, off-ramping personnel will be advantageous, such as replacing personnel weight with fuel, resulting in desired change in capability. In other cases, on-ramping capabilities may eliminate the need for other weapon systems. The AI task force will be able to identify weapon systems with opportunity for either on or off-ramping, and this will enable the command to optimize capability and cognitive capacity while managing risk. Before expanding on this idea, familiarization with the system of systems AFSOC is researching is necessary.

Small, unmanned aircraft systems (SUAS) capabilities bring many operational needed capabilities for near peer and peer competitors. SUAS systems have hardened components

making them viable in a contested domain, and likely reduce risk in the current CVEO mission. For the last four years, AFSOC has been working with multiple agencies to integrate air launched SUAS technology and plans to employ this technology with weapons systems technology already shared known as a common launch tube (CLT).[21] Moreover, it is adaptable to aircraft without the CLT weapons system and ground teams through trailer and cage system employment.[22] The trailer and cage system allows for large swarm capability. AFSOC should also consider other easily adaptable SUAS technologies in development utilizing a pilon mounted systems approach for places the CLT system is not viable. One such program is the Dynetics and DARPA Gremlins program. The pilon mount system is not as restrictive on size as the CLT launch method allowing for larger unmanned systems increasing duration and mission options for the SUAS.[23] Both approaches offer significant increases in overall mission capability when paired with AI and human machine teaming.

The advantages to both these approaches are ease of sharing technology across multiple airframes and they enable onboarding emerging technologies as they become available without airframe modification beyond software updates. The AC-130J, as illustrated in the vignette, could use the SUAS when directed to standoff from target location to maintain SA, but it would need to stop operating other systems without AI automation due to operator limitations and cognitive capacity. This results in increased mission effectiveness but not overall capability. AI automation plus onboarding these systems will increase capability and effectiveness. If the AC-130J onboard sensors and the SUAS systems are upgraded to level five automation or higher, as described above, then human machine teaming allows for increased capability and effectiveness. Additionally, the SUAS sensors can be tailored to mission needs, giving the AC-130J enough capabilities to eliminate the need for other weapon systems on target.

Pairing AI with sensors can exploit the electromagnetic spectrum in ways previously unavailable. One example of this is the ability to see through buildings and subterranean, amplifying SA and reducing risk. More than two years ago, a team at MIT used AI and wireless devices to sense individual positions and movement through walls.[24] Utilizing low power radio frequencies "AI can decipher those signals, to detect the presence of people, but also to see how they are moving, and even to predict the activity they are engaged in."[25] AI can show the difference between men, women, and children and highlight entry and exit points for the structure. Moreover, the radio waves reflect off metal as well, which would allow operators to know what weapons or threats to force exist before entry.[26] I engaged with experts from the Air Force Technical Applications Center and determined this capability can be developed to operate onboard a SUAS and controlled through human machine teaming changing the way AFSOC conducts any form of surveillance.[27] This is only one example of using data differently through AI to develop capabilities AFSOC wants and needs, but was previously unavailable. The AI task force will serve as the link between research and development entities in the command to work with the JAIC to facilitate capability development and acquisition.

As demonstrated above, the AI task force will be pivotal to managing weapon system AI integration requirements and matching the need to the desired weapon system capabilities. The addition of AI will drive other discussions such as off-ramping personnel where no longer needed, or on-ramping capabilities through a system of systems approach with excess cognitive capacity. The AI task force will be able to identify weapon systems with opportunity for either on or off-ramping, and this will enable the command to optimize capability and cognitive capacity while managing risk.

Conclusion

AFSOC strategy looks to increase their capabilities through technology integration building "human-machine" collaboration or teams through automation enabled by AI.[28] Automation through AI integration and new technologies will transform AFSOC operations and revolutionize how the air arm of SOF integrates with conventional forces in a contested environment. AI will provide the next asymmetric revolution in warfare, increasing force agility and lethality, while decreasing risk to mission. This paper recommends creating an AFSOC AI task force to oversee every aspect of AI integration from policy to new capability fielding. Additionally, it introduces AI levels of automation architecture for technology modification and integration building a human-machine teaming enterprise. Finally, it suggests pairing AI with existing technologies will produce new capabilities that will alter the dynamics on the battlefield and offers increased capabilities today while ensuring "full-spectrum" readiness well into the future.

AFSOC needs to create an AI task force to lead integration through policy that synchronizes DoD and USAF strategy with AFSOC desired capabilities, to overcome issues like training bias and ethical limitations, and for identifying capability development requirements. AFSOC needs this task force to oversee careful integration throughout the command, and across weapon systems. Moreover, the AI task force will develop policy, identify pain points, and build an AI integration execution plan. Then, AFSOC needs to address the level of AI enabled automation needed or desired while also understanding risk. Developing a method to discuss desired change in capability, articulate desired AI integration, and managing risk is necessary to ensure mission success. Progressive automation, scaled zero through nine, seeks to increase mission capability through gradually increasing levels of automation to near full automation while new systems continue to be integrated. This method acknowledges the risks involved with

AI and ensures risk acceptance is understood. Finally, On-ramping scalable systems, based on actual mission needs and system capabilities, will enable AFSOC to tailor the weapon system. AI gives the command options of on or off-ramping personnel to manage human machine teaming as well while increasing capabilities. The battlefield requirements, the weapon system capabilities, and the cognitive requirement will inform when to off-ramp capacity and when to on-ramp capabilities. Moreover, many of the capabilities, enabled through pairing existing technologies with AI, will be new and change the way SOF operates.

Areas for Additional Research

The research presented in this paper is a qualitative approach to building and discussing AI integration to include onboarding a system of systems approach. In 2018, James A. Stikeleather authored a paper with a quantitative approach to AI integration for command and control.[29] Adapting his approach offers a mathematical approach to calculating risk as AFSOC pursues AI integration. Additionally, AI is being rapidly fielded in other organizations and commands, for example the first U2 just flew with AI serving as the mission commander and co-pilot.[30] Understanding their methods of calculating risk and data storage may help AFSOC determine optimal AI integration practices.

Notes

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