# Next Generation Intelligence Integration

## Leveraging artificial intelligence to enhance human-machine analytic collaboration

by Ryan R. Gorman

The ever-evolving character of war appears in the midst of a paradigm shift and is perhaps on the cusp of revolutionary technological change.[1] Although war remains a violent, dynamic conflict between opposing wills determined to achieve political ends, each element that comprises Clausewitz's famous "trinity of war"[2] is rapidly changing because transformative technologies are poised to dramatically alter how humans interact with machines and one another. Both in the present and future, the primordial elements of violence and passion, which intensely influence human judgments in war, will be mitigated by a greater reliance on objective criteria programmed into machine learning (ML) algorithms to aid human judgment and decision making. The element of chance will always remain in war, but artificially intelligent machines are becoming increasingly adept at forecasting probabilities and could reduce some of war's inherent fog and friction. War remains an instrument of policy intended to achieve rational political objectives; however, those objectives often appear to be in flux because of the highly globalized and enmeshed character of contemporary international relations, as well as the exponential increase in the volume, variety, and velocity of information being created, shared, analyzed, and utilized across the interconnected globe. These technological changes will have profound implications for how Marines and fellow servicemembers will plan and operate in complex, contested future environments.

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***Our target is ever increasing transformative technologies and the impact they will have on the human-machine relationship.*** *(Photo by Sgt Kirstin Merrimarahajara.)*

Recognizing the vital importance of maintaining informational and cognitive advantage against rivals and potential adversaries, the Marine Corps recently followed the Joint Chiefs of Staff's lead in officially establishing "information" as the seventh warfighting function.[3] Additionally, the 2016 capstone *Marine Corps Operating Concept* (MOC) recognizes the imperative to develop and integrate capabilities in order to conduct information warfare. The MOC declares,

> The 21st century Marine Air-Ground Task Force (MAGTF) conducts maneuver warfare in the physical and

> cognitive dimensions of conflict to generate and exploit psychological, technological, temporal, and spatial advantages over the adversary.[4]

With this increased institutional emphasis on the informational and cognitive dimensions of war comes the need to better understand how emergent technologies can augment the military's capabilities to operate in the information environment.

This article explores how artificial intelligence (AI) and ML technologies can help address emerging military problems that are likely to become increasingly pervasive and complex in future operating environments. It describes how AI and ML applications can enhance current intelligence processes and capabilities to provide rapid and insightful intelligence support to military decision makers operating in those complex environments. Although AI and ML hold enormous potential to help resolve challenges, no technological solution or set of solutions should be regarded as a panacea. Competitors will relentlessly seek to exploit vulnerabilities, and human creativity and character will continue to be decisive elements needed to gain advantages and win future battles. Some technological capabilities suggested in this article are speculative, but many sophisticated AI and ML applications are already commercially available from a variety of vendors. Differentiating between applications that sound great in theory (or appear great in elegant presentations) and those that actually deliver reliable and replicable results will be critical. Further experimentation is necessary to test commercial AI and ML technologies' interoperability with existing military systems and processes, tailor specific algorithms using large quantities of training data, and assess the effectiveness of the technologies in various simulated military scenarios.

The argument presented here assumes that American private sector technology firms and interagency partners will be willing to share information and cooperate with the U.S. military to help develop non-lethal AI and ML applications. It also assumes that competitor nations will actively militarize AI technologies garnered from the commercial sector, often without the same degree of legal and ethical scrutiny that the U.S. Government and populace demands. It further assumes AI and ML innovations will progress rapidly but not evolve to general AI capabilities (in which machines can perform as well or better than humans at solving complex, adaptive problems and conducting most daily tasks) within the next 20 years.[5]

The greatest risk, regarding AI and ML technologies, is to spurn them or implement them so circumspectly that adversarial nations are able to outpace the U.S. military in developing more dynamic, resilient, and efficient systems. However, AI and ML applications do entail risks. For example, algorithms tend to work best when developed in fairly controlled environments with vast quantities of relevant training data; these conditions are not readily available in many military contexts. If the algorithms are insufficiently trained and validated, or if the data is corrupted or manipulated (whether intentionally or inadvertently), then the systems can perform unpredictably. Moreover, many of the inner workings of ML algorithms are opaque, so humans might not fully understand how or why the machine generated a particular output or conclusion. This lack of process transparency can hinder accountability and dissuade people from trusting the systems, especially in risky environments where lives are at stake. A final risk is that an overreliance on technological solutions can lull people into a false sense of security that the machines will consistently provide accurate and reliable information with little human effort or input. Human judgment and decision making must always remain paramount over technology, lest we endow AI-enabled machines with greater autonomy than is prudent.

***However, AI and ML applications do entail risks.***

## Military Problem

The U.S. military in general, and the Marine Corps in particular, is inadequately prepared to implement and integrate AI and ML technologies in a systematic manner across the warfighting domains despite growing recognition of the need to operate quickly, seamlessly, and coherently in a highly contested and data-saturated information environment (IE). Commercial technologies that can rapidly convert large and diverse data sets into actionable information likely will continue to progress at an alarming rate. These advances will present military organizations with both opportunities and challenges. Competitor nations, such as China and Russia, are investing in AI technologies to gain asymmetric advantages in the IE as well as future battlespaces.[6] Without codified international norms and agreements regarding AI and ML military applications, competitor nations threaten to outpace the U.S. military in repurposing, implementing, and weaponizing commercial AI and ML technologies. Furthermore, competitor nations might encounter fewer legal, social, and ethical restraints when adopting new technologies for military use, which could put them at an advantage in a potential AI and ML arms race. The U.S. military needs to help set favorable conditions for employing AI and ML technologies in a manner consistent with democratic values and international norms.

## Central Idea

The Marine Corps can play an important role in operationalizing AI and ML applications as it builds its capacity and capabilities to conduct operations in the IE.[7] Focusing on developing and implementing non-kinetic AI and ML applications is less controversial than developing lethal, AI-enabled autonomous weapons.[8] By investing in AI and ML capabilities, the Marine Corps, in partnership with the other Services, can shape the perceptions of competitor nations and the international community; this will potentially dissuade adversary nations from applying AI and ML technologies in overly aggressive or provocative ways. In particular, the Marine Corps could play a key role in

developing and implementing collaborative human-machine teams (sometimes known as "centaur teams")[9] and augmenting intelligence collection and analysis capabilities to enhance cognitive maneuver in the information domain.

Human-machine collaboration will continue to increase as AI and ML technologies mature and become increasingly capable of conducting a wide range of tasks.[10] In this type of environment, centaur teams will play a critical role in completing many routine and complex cognitive tasks, such as assessing potential adversaries' order of battle and predicting probable courses of action. Human-machine teams can leverage the speed and ability of artificially intelligent computers to rapidly process and analyze vast amounts of data from numerous different sources, to include ground-, air-, and space-based collection platforms, human intelligence sources, and publicly available information. Additionally, the more objective character of computer models and algorithms can augment, the more subjective element of expert human judgment to predict future outcomes with increasing accuracy. Yet, even the most technologically advanced machines lack vital attributes of human cognition, such as the ability to intuitively contextualize data and to make ethical decisions based on incomplete or ambiguous information. Therefore, it is vitally important to leave sufficient decision space within any AI-enabled systems for humans to apply judgment, expertise, and moral sensibility with the ability to amend or override automated machine recommendations.

Furthermore, human-machine teams will be most effective if they included specialists with a variety of disciplinary perspectives (human intelligence, signals intelligence, geospatial intelligence, open-source intelligence, and data science) to maximize the cognitive diversity of the teams and optimize the different mental and computational models that each team member contributes.[11] These teams would function like high-speed intelligence fusion cells with AI-enabled machines operating as force multipliers and integral members of the team. The dynamic interplay between machines and humans likely will become increasingly complex as machines become more capable of learning and simulating human-reasoning patterns, but human judgment should continue to be the decisive element that directs human-machine interactions.[12]

***How will artificial intelligence and machine learning impact current information sharing processes?*** *(Photo by Cpl Rachel Mendieta.)*

Another key element for developing AI and ML capabilities is discovering ways to integrate technologies with existing information systems and intelligence processes to enhance cognitive maneuver in the IE. The 2016 MOC recognizes "changes in the operating environment and adversary capabilities drive us to increase emphasis on maneuver in the cognitive dimension."[13] Operations in the IE do not fit neatly with the traditional mode of phase-based military operations. As the National Defense Strategy suggests, the U.S. military operates persistently and globally in the contact layer with com-

***AI and ML application will eventually impact how the Marine Corps utilizes "human-machine" teams.*** *(Photo by Sgt Ronald Spotswood.)*

petitors and adversaries, especially in the cognitive dimension of the information domain.[14] The battle for informational and cognitive advantage will continue to be an essential precondition for conducting successful military operations. Adversaries will seek to exploit technologies that deny, degrade, distract, restrict, or otherwise obfuscate the U.S. military's understanding of their capabilities and intentions.

To generate cognitive advantage and maneuver space, new AI and ML technologies could be integrated with current Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise (MCISRE) systems to speed up intelligence processes, lighten the cognitive load on human analysts, and present decision makers with a holistic set of options to counter adversarial actions. The MCISRE can leverage emergent AI efforts, such as the Intelligence Advanced Research Projects Activity (IARPA)'s research project called Crowdsourcing Evidence, Argumentation, Thinking, and Evaluation (CREATE). This project is testing systems that "use crowdsourcing and structured analytic techniques to improve analytic reasoning."[15] IARPA has partnered with several academic institutions and labs to develop state-of-the-art applications to augment intelligence analysis. Additionally, the DOD recently established the Joint Artificial Intelligence Center to accelerate the delivery and adoption of AI technologies across the Services.[16] Close collaboration with entities like IARPA and the Joint Artificial Intelligence Center will favorably position the MCISRE to experiment with and adopt operationally relevant technologies.

AI and ML applications can perform tasks like pattern recognition and change detection faster and perhaps more reliably than human analysts, thereby providing users with informational and cognitive advantage. For example, algorithms can be designed to rapidly analyze large volumes of satellite imagery to detect significant changes or activities that are of interest to military intelligence organizations. Such automated analyses could allow human imagery analysts to more efficiently allocate their time, energy, and expertise. Furthermore, adversaries employ sophisticated AI and ML technologies to produce misinformation and propaganda to influence and deceive specific audiences, including U.S. citizens and military personnel.[17] The U.S. military could develop applications to detect and counteract adversaries' use of these technologies to produce fake news and deep fake images and videos.[18] Creating automated defenses against these types of offensive influence operations will reduce risks posed by adversaries' misinformation and lend credibility to the U.S. military.

***AI and ML technologies could be integrated with current MCISRE systems.*** *(Photo by Sgt Luisa Torres.)*

**The MCISRE can leverage emergent AI efforts.**

A popular branch of AI technology known as natural language processing (NLP) allows computers to ingest large amounts of unstructured data and convert the data into understandable, user-friendly formats.[19] NLP technology supports a range of useful automated applications, such as machine translation of foreign languages, speech recognition, and text-to-speech conversion. Advances in NLP enable virtual assistants (like Amazon's Alexa or Apple's Siri) to answer increasingly complex questions and generate more sophisticated sentiment analysis, produce concise summaries of large volumes of text, and even create coherent paragraphs from limited pieces of information.[20] Such NLP applications create potential vulnerabilities and security risks to military organizations; however, NLP technology could also assist military personnel in comprehending large and diverse data sets and extracting key points that impact their specific missions. Experimentation and validation of NLP applications to facilitate and expedite intelligence and information operations will be key to maintaining an informational advantage.

Although complete information dominance is unlikely in future battlespaces, the U.S. military must not allow adversaries to gain asymmetric informational advantages that degrade or diminish friendly capabilities. Ingenuity and adaptability of forces will continue to be hallmarks of success as the technological terrain becomes increasingly competitive and complex. As a highly adaptive and innovative institution, the Marine Corps is well-positioned to play a formative role in shaping how emerging AI and ML technologies are ad-

opted and integrated to support a wide range of military operations, especially across the informational dimension of war. While policy debates often have focused on the use of AI to enable lethal autonomous or semi-autonomous weapons, the technology can serve numerous non-kinetic uses that raise fewer ethical concerns. Although artificially intelligent machines cannot replace the ingenuity and determination inherent in Marines, new modes of collaboration between humans and machines could significantly increase the timeliness and utility of intelligence analysis in support of future military operations.

**Notes**

1. For an insightful discussion of paradigm shifts and revolutionary changes in the scientific community, see Thomas S. Kuhn, *The Structure of Scientific Revolutions, 4th Edition,* (Chicago, IL: University of Chicago Press, 2012).

2. Carl von Clausewitz, *On War*, edited and translated by Michael E. Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1984). Book 1, Chapter 1, Section 2: Clausewitz describes his trinity as follows: war is "composed of primordial violence, hatred, and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason." See also Christopher Bassford, "Teaching the Clausewitzian Trinity," *Clausewitz.com*, (Online: January 2003), available at https://www.clausewitz.com.

3. Headquarters Marine Corps, *Marine Corps Bulletin 5400 (MCBUL 5400), Establishment of Information as the Seventh Marine Corps Warfighting Function*, (Washington, DC: January 2019); Joint Chiefs of Staff, *Joint Publication 1 (JP 1), Doctrine for the Armed Forces of the United States*, (Washington, DC: July 2017).

4. Headquarters Marine Corps, *The Marine Corps Operating Concept: How an Expeditionary Force Operates in the 21st Century,* (Washington, DC: September 2016).

5. For an overview of the distinction between "narrow" and "general AI," see Kate Baggaley, "There are Two Kinds of AI, and the Difference is Important," *Popular Science*, (Harlan, IA: Bonnier Corporation, February 2017); and A 2017 survey indicates that AI researches believe there is a 50 percent chance that AI will be able to outperform humans in all tasks within the next 45 years. See Grace Katja, John Salvatier, Allan Dafoe, Baobao Zhang, and Owain Evans, "When Will AI Exceed Human Performance? Evidence from AI Experts," *Journal of Artificial Intelligence Research*, (Palo Alto, CA: AAAI Press, May 2017).

6. Gregory C. Allen, "Understanding China's AI Strategy: Clues to Chinese Strategic Thinking on Artificial Intelligence and National Security," Center for a New American Security, (Online: February 2019), available at https://www.cnas.org; and Alina Polyakova, "Weapons of the Weak: Russia and AI-driven Asymmetric Warfare," Brookings Institute, (Online: November 2018), available at https://www.brookings.edu.

7. In July 2018, the Joint Chiefs of Staff released guidance titled *Joint Concept for Operating in the Information Environment (JCOIE)*. The Marine Corps appears to be updating its 2013 *Operating Concept for Information Operations* and 2017 *Marine Air Ground Task Force (MAGTF) Information Environment Operations Concept of Employment* to align more closely with the joint concept's approach and terminology.

8. For an insightful presentation of how the U.S. military is adjusting to the evolution of automated and autonomous weapons systems, see Paul Scharre, *Army of None: Autonomous Weapons and the Future of War*, (New York, NY: W.W. Norton & Company, April 2018).

9. The term "centaur team" derives from the mythical Greek beast that was half man, half horse. AI researchers have pointed out the advantages of combining human insight with machine speed and processing capacity to generate better solutions to complex problems. For an overview of this concept, see Mark Stefik, "Half-Human, Half-Computer? Meet the Modern Centaur," Palo Alto Research Center, (Online: December 2016), available at https://www.parc.com.

10. This point is underscored in the United Kingdom Ministry of Defence, *Joint Concept Note (JCN) 1/18, Human-Machine Teaming*, (London, UK: May 2018).

11. For an illuminating discussion of the value of cognitive diversity, see Scott Page, T*he Diversity Bonus: How Great Teams Pay Off in the Knowledge Economy*, (Princeton, NJ: Princeton University Press, 2017).

12. Many prominent thinkers, including Stephen Hawking, have warned that AI-enabled systems could eventually develop an independent will that conflicts with its designer. See Stephen Hawking, *Brief Answers to the Big Questions*, (New York, NY: Bantam Books, 2018).

13. *Marine Corps Operating Concept*.

14. Department of Defense, "Summary of the 2018 National Defense of the United States of America: Sharpening the American Military's Competitive Edge," (Arlington, VA: 2018).

15. Office of the Director of National Intelligence, Intelligence Advanced Research Projects Activity (IARPA), (Online), available at https://www.iarpa.gov.

16. Staff, "Joint Artificial Intelligence Center," Chief Information Officer U.S. Department of Defense, (Online), available at https://dodcio.defense.gov.

17. S. Padgett, "The Art of Digital Deception—Getting Left of Bang on Deep Fakes," *Small Wars Journal*, (Online: April 2019), available at https://smallwarsjournal.com.

18. Several research and advocacy organizations are working to address the growing threat of misinformation in the media. See, for instance, Staff, "AI: Media and Information Quality," Berkman Klein Center for Internet and Society Project at Harvard University, (Online), available at https://cyber.harvard.edu.

19. Staff, "Natural Language Processing," *Techopedia*, (Online), available at https://www.techopedia.com.

20. Open AI is the leading innovator in the field of natural language processing. See Staff, "Better Language Models and Their Implications," *Open AI*, (Online: February 2019), available at https://openai.com.