

AI CONSIDERATIONS FOR THE MARINE CORPS

Artificial intelligence has seen groundbreaking developments in recent years that have yielded commercial and scientific applications affecting daily life around the world. In national defense, AI technology will advance — and even transform — warfighting. The Commandant of the Marine Corps emphasized this in his 2019 Planning Guidance:

Autonomous systems and artificial intelligence are rapidly changing the character of war. We have already seen these changes on today's battlefields, but we are only at the leading edge of revolutionary changes. Our potential peer adversaries are investing heavily to gain dominance in these fields. We must aggressively research, innovate, and adapt to maximize the potential these offer while mitigating their inherent vulnerabilities and risks.¹

In this era of great power competition, **it is imperative that the U.S. Marine Corps pursue AI rapidly and strategically.** Marine Corps leadership must choose areas of exploration and investment wisely while simultaneously moving forward with needed enablers. Yet the technology, requirements and implementation associated with AI are complex. Proceeding without sufficient understanding risks wasting crucial time and resources. In the following pages, we provide a short overview of AI technology to give Marines Corps decision-makers a high-level understanding of key concepts.



U.S. Marine Corps photo by Cpl. Brennan Priest/Released

WHAT IS AI?

The ultimate aim of AI is to solve problems by replacing human cognition with a combination of hardware and software. It is a continually evolving area of research focused on the development of new concepts, approaches and toolkits in pursuit of this goal.² In the 1960s, early AI techniques enabled some of the first applications of natural language processing, symbolic reasoning and chess playing. In the 1990s, more advanced AI techniques showed their capabilities in IBM's Deep Blue, the system that defeated chess champion Garry Kasparov in 1997.

¹ *Commandant's Planning Guidance*, 38th Commandant of the Marine Corps, 2019, https://www.marines.mil/Portals/1/Publications/Commandant's%20Planning%20Guidance_2019.pdf?ver=2019-07-17-090732-937.

² Andy Ilachinski, *Artificial Intelligence: Emerging Themes, Issues, and Narratives*, CNA Occasional Paper DOP-2020-U-028073-Final, Sept. 2020, https://www.cna.org/CNA_files/PDF/DOP-2020-U-028073-Final.pdf.

HYPOTHETICAL AI APPLICATIONS FOR THE MARINE CORPS

AI holds great promise for the Marine Corps. It has the potential to increase the force's lethality against adversaries, better protect friendly forces and civilians, help to sustain the high quality of the force, and save resources. Potential applications include:

- A mixture of unmanned air and ground vehicles that assist a platoon in urban environments by providing intelligence, surveillance and reconnaissance around corners and inside of buildings ahead of Marines.
- A fleet of autonomous, unmanned vehicles that can resupply forward bases, even in communications-denied environments.
- Synthesis and analysis of multiple intelligence streams to flag anomalies and predict adversary activity.
- Improved identification and targeting of adversary unmanned aerial vehicles.
- Improved prediction of which recruits will make successful Marines.

Today, AI refers to modern methods such as machine learning. Machine learning encompasses a wide variety of techniques to detect patterns in data and to learn and make predictions from them. Machine learning is the source of most major AI advancements in recent years.³

Machine learning algorithms can be classified by how they obtain information about the data they receive. For example, in supervised learning, AI agents are given data that have been labeled with the type of information the agents must learn to discern. By contrast, in reinforcement learning, AI agents gather their own data and learn from it through trial and error. Deep learning is an important subcategory of machine learning that

uses multiple computational layers, each of which is modeled on biological neural networks. The impact of this new generation of fast-learning algorithms has been amplified by substantial increases in computing power, the declining cost of digital storage, and the availability of large datasets on which the algorithms can "train."

AI APPLICATIONS

Today's AI technology enables decision-making at levels of complexity and speeds that often greatly surpass human capabilities. Modern techniques have enabled groundbreaking advances such as:

- Machines that can defeat elite players at games that are computationally complex — notably Go, poker, and the videogame StarCraft II.
- Self-driving cars.
- Sophisticated image processing, such as facial recognition.

But **AI is not a panacea**. AI technology is ill-suited for some environments and problem types. It struggles with unpredictable environments and unstructured tasks that require common sense or an understanding of context. And even in situations where AI performs adequately, it may not offer meaningful improvements over legacy methods. AI today is generally well-suited for applications that require, for example, detection, pattern recognition, optimization and natural language processing.

LIMITATIONS AND RISKS

AI applications are also limited by intrinsic requirements and risks. For example, machine learning applications may require large quantities of high-quality data. Furthermore, the test and evaluation of AI systems requires processes that deal effectively with differences between AI and legacy technologies. Leveraging AI will require a workforce with technical AI expertise, and it is critical that commanders and operators employing AI technology have an appropriate understanding of how these systems function. Moreover, robust ethics and safety policies for AI need to be developed and subsequently revisited as needed.

The need for robust test and evaluation processes, as well as ethics and safety guidelines, comes from risks associated with the technical limitations of

³ Andy Ilachinski, *Artificial Intelligence: Emerging Themes, Issues, and Narratives*.

today's AI technology. Such limitations include the following:

- **Brittleness.** AI technology can fail under conditions that differ only slightly from those in which systems were designed or trained.
- **Explainability.** Understanding why a decision was made by an AI-enabled system can be difficult or impossible to determine.
- **Bias.** AI technology is subject to a risk of biased decision-making. One reason bias can emerge is the reliance of many algorithms on large quantities of representative data, while available data may not be large in quantity or representative.
- **Vulnerability to manipulation.** AI technology can be vulnerable to adversarial "attacks" on system inputs, such as manipulations of real-time sensor inputs or the data used to train machine learning algorithms. Such manipulations may be imperceptible to human observers.

ENABLING AI WITH DATA INFRASTRUCTURE

Data infrastructure is a key enabler the Marine Corps will need in order to move forward with AI effectively, efficiently and at scale. Many AI applications will depend on large quantities of high-quality data, so there is a corresponding need to collect, clean and securely store data. The ability to share such data will be a force multiplier. Thus stored data must be accessible to authorized users. Another challenge is to determine whether stricter handling or classification rules are needed for databases than for individual data points.

Other parts of the Department of Defense, including the other services and DOD's Joint AI Center, are examining data infrastructure needs and challenges. Consistent with the Commandant's Planning Guidance, the Marine Corps should leverage these efforts while examining any outstanding or unique needs.

AI RISKS IN WARFIGHTING

DOD is committed to using available technologies, including AI, only in a manner consistent with the Law of Armed Conflict and other legal obligations. But unintended outcomes are possible even when acting in accordance with the law. In war, these outcomes can include fratricide, civilian casualties, and unintended escalation. They can lead to tactical and/or strategic failure for U.S. forces. Because the risks and limitations of AI raise particular concerns of unintended outcomes, it is critical that the Marine Corps and DOD robustly address these factors for any AI-enabled technology it plans to deploy.

These technical limitations raise the risk that the technology will not act as intended. Moreover, the deployment of AI technology in systems that act autonomously, at great speeds, or in large numbers (such as swarms) raises the possibility of malfunctions occurring at a large scale or without the opportunity for human intervention. **The onus is on policy-makers, as well as those developing and deploying AI, to address limitations and risks with a thoroughness commensurate with the potential consequences of failure.** Technological solutions are one component of addressing these challenges. Another is defining how and in what circumstances the technology should be used, and ensuring that those who deploy and operate AI-enabled systems understand their risk factors.

MOVING FORWARD

These risks and limitations — including AI's suitability for solving only certain types of problems — together with the resources required to develop AI, demand a strategic, focused approach. **The Marine Corps should strive to use AI not for its own sake, but to meet the needs of the force when those needs intersect with AI capabilities.**

In moving forward with AI, the Marine Corps will need to address key strategic and technical questions at each step: determining suitable AI

applications, setting requirements and evaluating and mitigating risks. This will require Marine Corps leadership to develop a broad understanding of the topics outlined here and to draw on technical experts.

In summary, AI technology is highly complex and yet critical to the Marine Corps in the era of great power competition. The Corps must invest in AI strategically, with a focus on the needs of the force, the capabilities and limitations of the technology, and effective mitigation of AI's inherent risks.

CNA CENTER FOR AUTONOMY AND AI

CNA's Center for Autonomy and AI supports the U.S. goal of effectively incorporating autonomy, AI, and related technologies in military capabilities. Throughout history, the ability to adapt technological advances to warfighting has led to fundamental changes in how war is conducted and the tools used in its conduct. Autonomy and AI represent revolutionary technologies in warfare which offer opportunities to the U.S. for countering and deterring emerging threats, addressing security challenges and advancing U.S. national interests. But this opportunity is by no means certain, since autonomy also offers potential asymmetric advantages to near-peer competitors, some of which have been pursuing these capabilities aggressively. Likewise, rapid innovation in the private sector and a commercial research and development sector dwarfing that of the U.S. military creates new challenges for the U.S., which will need to quickly identify and integrate cutting edge technological developments in this rapidly changing environment.

Because of the foundational impact autonomy and artificial intelligence will have on the character of warfare, CNA created the Center for Autonomy and Artificial Intelligence to focus on these emerging technologies and their contribution to national security. The Center capitalizes on the ability to leverage the scientists and analysts of CNA's staff of 600, with their experience base in military operations, test and evaluation, security and intelligence analyses, technology assessment, and autonomy and AI.

ABOUT CNA

CNA is a nonprofit research and analysis organization dedicated to the safety and security of the nation. It operates the Center for Naval Analyses — the only federally funded research and development center serving the Department of the Navy — as well as the Institute for Public Research. CNA is dedicated to developing actionable solutions to complex problems of national importance.

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