Do We Believe What We Know?

Capitalize on emerging technology

by LtCol David W. Pinion

A company combat team is located in a combat outpost in the vicinity of Range 220 in Twentynine Palms, CA. The team is assigned the mission of attacking a platoon outpost at Range 400 approximately 30 kilometers away at 0400 the following morning. The company maintains strict signature management to prevent enemy detection. A detailed fire support plan is developed, orders are issued, equipment is checked, and rehearsals are conducted in the predawn darkness. At 0200, the company embarks its amphibious combat vehicles (ACV) and begins the movement toward the objective. Augmented reality allows the drivers to maintain necessary dispersion and negotiate the predetermined route deemed least likely for enemy observation. Loitering munitions and intelligence, surveillance, and reconnaissance drones are launched to provide responsive fires if needed along the route to the objective.

When the company is approximately fifteen kilometers away from the objective, a large volley of enemy precision strike munitions decimates the formation. Anti-air defenses succeed in eliminating some of the threat, but approximately 70 percent of the ACVs are destroyed. The volley is followed by a swarm of anti-personnel drones that attack any surviving dismounts. Little did the commander know, the enemy had been tracking the location of the Marines since their arrival in Twentynine Palms by analyzing social media posts from locals and realtime updates through the creative use of discrete sensors found in the Internet of Things (IOT).[1] Even though Marines at every level performed their duties flawlessly, unit destruction is the logical conclusion when an outdated model of fighting is confronted with a new paradigm.

>LtCol Pinion holds a doctorate in philosophy and is the author of the book* Do Good and Fear No Man*. He is currently assigned as a faculty member of Marine Corps University.

An alternate scenario might play out differently. Instead of attacking Range 400 with direct fire weapons, the commander determines the enemy composition and disposition from a mix of overhead imagery and signals intelligence. He then task organizes the munitions necessary to effectively neutralize the position. At 0300, a convoy of autonomous vehicles travel to a release point and launch the predetermined mix of munitions, which target the bunkers, vehicles, and mortar and infantry positions, destroying each in detail. Shortly after the strike, a site exploitation team travels to the objective via distributed electric lift and extracts before the enemy can conduct a counterstrike. The enemy detects the movement of the autonomous convoy and attacks it with its own mix of rockets and anti-personnel drones, which destroy several friendly autonomous vehicles as they begin their return trip. No friendly lives were lost during the engagement, and the commander begins reconstituting his combat power by printing, assembling, and programming new vehicles and munitions before his surviving vehicles return to base.

The "so what" to the Marine Corps is that the growing availability of sen-

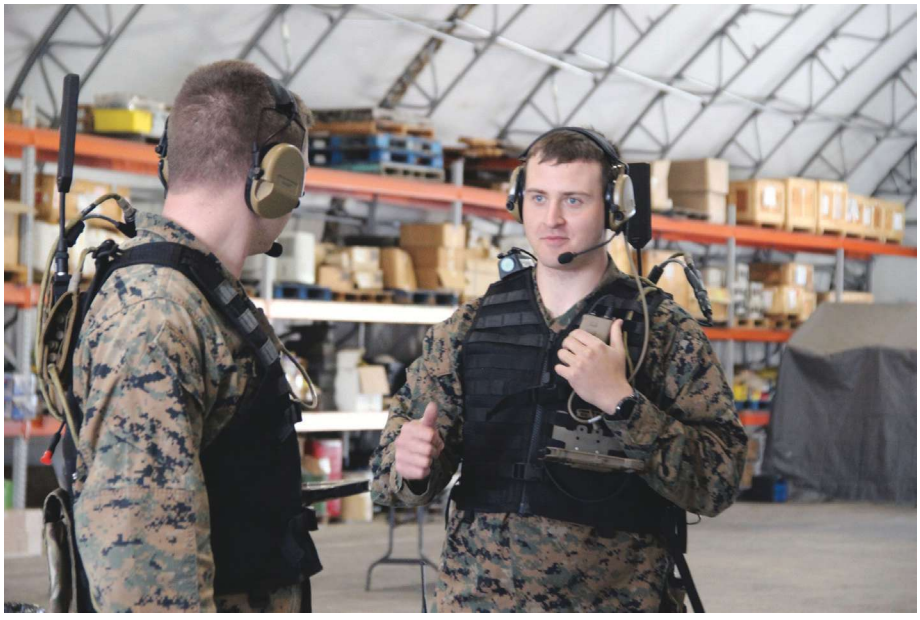
During the Advanced Naval Technologies Exercise West, military and civilian participants assessed emerging technologies. *(Photo by Matt Lyman.)*

sors and extended range of precision munitions indicate that the days of the infantry locating, closing with, and destroying the enemy by fire and close combat are likely coming to an end. Just as in naval combat, the battleship could—and still can—deliver more firepower faster than any other ship; however, it cannot get within range of other ships or land targets to deliver its devastating firepower because of the long range of anti-ship missiles. The battleship's lack of range made it irrelevant in a naval fight rendering it obsolete. Consequently, as the ranges of adversary reconnaissance and precision strike systems increase, the short range of direct fire weapons and the vehicles that carry them will become increasingly less useful and relevant. The Marine Corps can have the most lethal infantry squad in the world, but if the squad cannot make it to the fight, then its superior lethality is irrelevant.

This shortfall does not end with the maximum effective range of weapons systems. There is also a fundamental disconnect between the capabilities of emerging technology and current operational concepts. The Senate Armed Services Committee has taken notice and is openly questioning the Marine Corps' relevance in a South China Sea scenario given the currently programmed force. Even in continental warfare, data analytics, sensor technology, and precision strike systems might shift the advantage toward the defense, much like a land version of the maritime anti-access/area denial conundrum. The hider/finder competition among combatants will likely become a striker/shielder competition. Without surprise, the adversary who moves first will likely be disadvantaged among a network of sensors and smart weapons systems. The operational environment as we know it is changing.

A Technological Inflection Point

War will always remain a violent clash of wills, as described by *MCDP 1, Warfighting*, (Washington, DC: 1997); however, advances in technology will soon shift the primary instruments that carry out the clash of wills from humans to automated systems.



Command & control and communications were two areas where emerging technologies were assessed during Advanced Naval Technologies Exercise West. *(Photo by Matt Lyman.)*

Until now, the fundamental purpose behind military technology has been to enable human cognition to employ weapons more effectively against the enemy. This will soon change because of the operating speed of future threat systems, which will eventually outpace and overwhelm human cognitive capabilities.[3] Even with artificial intelligence (AI) augmentation, the limited reaction times of humans competing against the growing efficiency and lethality of threat sensors and shooters will eventually render the human obsolete as a warfighting platform.

The Marine Corps can have the most lethal infantry squad in the world ...

As adversaries engage each other from ever increasing distances, future conflict will likely find humans in roles that support and enable the maneuver of autonomous systems, many of which could be sent on one-way missions. The reason for this transition will not be to preserve valuable human lives but because, in a lethal contest between man and machine, human abilities will simply not survive.[4] Much like animals whose senses are not able to detect the threat of moving cars on a highway, humans in a combat zone will find it equally difficult to identify the variety of miniaturized sensors networked to the adversary kill chains.[2] This has profound implications for every aspect of how the Marine Corps organizes, equips, and trains Marines as well as the character of future war itself. Instead of imposing our will on the enemy, the goal of future operations may be to eliminate the enemy's ability to retaliate, as described by *MCDP 1* with the a strategy of incapacitation.

This represents a fundamental paradigm shift from human brain power to artificial cognition as the driving force behind the Nation's premier warfighting platforms. The Defense Science Board's study on autonomous systems asks us to imagine if:

- We could covertly deploy networks of smart mines and [unmanned underwater vehicles] to blockade and deny the sea surface, differentiating between fishing vessels and fighting ships … and not put U.S. Service personnel or high-value assets at risk.
- We had an autonomous system to control the rapid-fire exchange of cyber weapons and defenses, including the

realtime discovery and exploitation of never-seen-before zero day[5] exploits ... enabling us to operate inside the "turning radius" of our adversaries.

- We had large numbers of small autonomous systems that could covertly enter and persist in denied areas to collect information or disrupt enemy operations … a "sleeper presence" on call.
- We had large numbers of low-cost autonomous unmanned aircraft capable of adaptively jamming and disrupting enemy [position, navigation and timing] capabilities … destroying their ability to coordinate operations.
- We had autonomous high performance computing engines capable of not only searching "big data" for indicators of [weapons of mass destruction] proliferation, but of deciding what databases to search … to provide early warning and enable action.[6]

Imagine if we had AI counterparts for each member of our combat operations center doing predictive analysis in realtime, enabling a staff and commander to make vastly more informed decisions at vastly increased speeds. Imagine, too, "if we are unprepared to counter such capabilities in the hands of our adversaries."[7]

The development of machine learning and AI means that adversaries will no longer adapt between engagements but will do so during engagements. What works now may not work an hour from now because of networked machine learning. A near instantaneous transfer of effective tactics, techniques, and procedures will allow systems that have never before been in combat to have the same experience as the most seasoned combat veteran in realtime. If a human warfighter is seriously wounded or killed, it takes years to recruit, train, and build the same level of experience, but a new autonomous system can be assembled and put into action in a fraction of the time and expense.

Big data analytics, sensor technology, and the IOT will shift the advantage in warfare toward the defense. The defensive advantage will solidify the gains of those who are able to accomplish strategic surprise and present unprepared adversaries with a *fait accompli*. In this environment, autonomous systems provide a much higher tooth-to-tail ratio for operations that must take place inside the adversary weapons engagement zone. This has significant applicability to expeditionary advance base operations.

Historical Context

We have missed historic opportunities to modernize before. In 1921, the World War I German battleship *Ostfriesland* was sunk off the coast of Virginia by Marine Corps, Navy, and Army aircraft in a live fire experiment that heralded a new era in the character of naval warfare. The sinking of the *Ostfriesland* exposed the battleship's

vulnerability from the air but failed to dissuade the Navy's reverence for the battleship in favor of the aircraft carrier until World War II decisively settled the issue. Japanese admirals, however, remained proponents of the battleship throughout the war despite their success with carrier air power at Pearl Harbor and the use of aircraft to sink the HMS *Prince of Wales* and HMS *Repulse* at the beginning of World War II. Fortunately for us, Japanese admirals failed to see how new technology changed the battlefield and remained proponents of the battleship throughout the war.

What Do We Know That Could Inform Future Procurement Strategies?

We know large constellations of commercial CubeSats are being launched to provide the uninterrupted observation of every part of the planet, including vast tracks of ocean, for anyone who buys a subscription.[7] This capability will allow adversaries to track the movement of every ship from the time it leaves ports in the continental United States and has significant implications for the survivability of amphibious ships and the surface fleet.[8]

- We know that future technology will make sensors more capable and weapons more precise and lethal.
- We know that the military procurement process will not keep pace with civilian technology.
- We know that the speed of weapons delivery and its associated effects will compress reaction times necessary for survivability.[9]
- We know that the range of modern aircraft is insufficient to penetrate the adversary's defenses, making the aircraft carrier, aerial refueler, or base of launch vulnerable to enemy attack.[10]
- We know everything that runs on electricity will likely be given some type of cognition and ability to communicate via the IOT.[11]
- We know the increased capability of adversary ISR and precision strike systems require increased dispersion, which will degrade situational awareness.
- We know that "smart" improvised explosive devices will be able to target U.S. vehicles and personnel without affecting the local populous.[12]
- We know that physical victories will not be as decisive as years past because of social media and persistent global ideological networks.[13]
- We know that extraordinary coordination will be required among all domains to successfully defeat the system of systems that will make up the modern defense.

There are many in-depth studies on the future operating environment, a common theme of which is that the tsunami of future technology will make the current Cold War model of organization and leadership obsolete. By continuing to invest in platforms that only marginally improve legacy capabilities, such as the ACV, the Landing Craft Utility, or the CH-53K, the Marine Corps is missing a fleeting opportunity to design a credible and survivable force based on what we know of the future operating environment.

Challenges in the Development of Autonomous Systems

There is an effort among many in science and government around the world to ban lethal autonomous weapons. However, there are worldwide bans on the use of chemical weapons, yet rogue regimes still employ them. The United States will be negligent if autonomous capabilities are not developed with proper controls. There is valid concern that lethal autonomous systems with the wrong parameters could mistake noncombatants for the enemy and result in a catastrophe. Additionally, there are considerable moral, legal, and ethical aspects that need to be addressed in the development of lethal autonomous systems as well as other operational concerns such as:

- How do we introduce unmanned systems without becoming predictable?
- How do we introduce them without introducing a new vulnerability?
- How much autonomy do we give autonomous weapons to attack emerging targets of opportunity in a communications-denied environment?
- How much specificity about target selection can be delegated to a machine?
- Do we want autonomous vehicles to use force to defend themselves? What about strikes against preemptive threats?

An autonomous system may be operating with different sensors and data sources than any of its human teammates and with different assumptions of the operational environment, making its behavior unpredictable.

The Way Forward

Update the Marine Corps Operating Concept (MOC). The MOC must be updated to include the employment of robotics and autonomous systems, AI, and additive manufacturing. The update must incorporate directives from the National Defense Strategy and provide clear (classified and unclassified) guidance to all operational and functional concepts on how emerging technology will impact future operations and establish budgetary priorities toward their development. A robust experimentation schedule should be directed to validate the operational approach described in the update. Given the time it takes to develop robust systems, we need to look past 2025 if we are to effectively incorporate emerging technology that counters future threats. In the near term (five to ten years), AI can be used to automate processes, communicate across stovepiped data systems, and shorten decision cycles that consume most staffs. In the long term (11 to 25 years), AI and autonomy should seek to develop platforms that can accomplish missions in the future operating environment where humans cannot survive.

Stop incremental improvements of existing systems. Investment should be focused instead on emerging technology that will have a much higher return on investment.[14] The majority of capabilities currently being procured is a mere incremental improvement of 20th century capabilities and will be operationally obsolete long before the equipment wears out. Planned obsolescence must be incorporated into procurement strategies. The opportunity costs for investing in expensive legacy capabilities is unacceptably high, given that our strategic competitors are outspending us 1,000 to 1 on emerging technology.[15] Senior leaders have the opportunity to make a generational leap in capability

rather than a single step. The challenge is to achieve an acceptable level of programmatic and operational risk while making this leap.

Restart the process for identifying future threats and capability gaps. The process to identify future threats and prevent strategic shortcomings needs to be reinvigorated. Within the Marine Corps Warfighting Lab, the Futures Assessment Division has been disbanded, and Marine Corps Intelligence Activity analysis only looks ten years into the future. The now defunct support for the strategic analysis process once provided detailed scenarios of how we would fight in future years, but it is no longer producing (or updating) mid- and far-term scenarios from which to discern those joint capabilities and capacities required to defeat future threats or to explore future concepts. Operations plans by themselves are insufficient for depicting future environments for analyses as they are largely based on near-term threats pitted against programmed U.S. and multinational forces and rely on different assumptions. Significant analyses, war games, and simulations based on future scenarios can provide insight to the impact that emerging technology will have on air, land, sea, and cyber capabilities and what will be needed to be successful in the future. Analysis based on future threat technology should feed into a roadmap that critically examines the point in which current tactics and programmed equipment are no longer survivable or relevant and whether they are worth the continued investment.

Reform the manpower system. The current Marine Corps manpower model is unsuited to recruit and retain the human talent necessary to keep the Marine Corps relevant. Approximately 70 percent of the Marine Corps leaves the active service every four years. As weapons and data systems become increasingly complex, it will take more time and experience for an individual to learn his additional craft and effectively apply it under the stressful conditions of combat. There is a litany of currently needed reforms: change the up-or-out paradigm; pay Marines according to skills instead of rank; eliminate 4-year enlistments in favor of indefinite enlistments (similar to the British Royal Marine model); eliminate mandatory 36-month permanent change of station/permanent change of assignment moves; and evaluate creativity, innovation, and the command climate as part of the performance evaluation system. The use of data analytics in manpower management will enable planners to manage populations more accurately than the purely reactive model currently used.

An AI program of record is needed to implement solutions to problems ...

Make AI a program of record. An AI program of record is needed to implement solutions to problems across the doctrine, organization, training, materiel, leadership, education, personnel, and facilities spectrum. Many of the commercial solutions are fully operational and already in use with many government agencies and parts of the U.S. Army.[16] AI has tremendous cost savings in terms of money and manpower.[17] Accreditation needs to be made a priority. Unlike the fielding of traditional software procurements, which are pushed out as a one-size-fits-all group, individual commanders could request innovative AI solutions for their specific problems in accordance with the Service AI strategy or guidance in the updated MOC. The proposed solutions would be evaluated and prioritized by an AI panel with the Deputy Commandant for Information and implementation paid for by AI program funds. This model will transform the Marine Corps into a more efficient, innovative, and lethal organization.

In a race against adversaries to develop and incorporate emerging technology into viable operating concepts, the Marine Corps is still in the starting blocks. The biggest obstacles to progress are the hesitancy to upset programs of record and our penchant for honoring the sunk costs of traditional power projection platforms. Although viable in the nearterm, the majority of the programmed force doubles down on legacy capabilities with new versions of old equipment. Disruptive technology should be prioritized and programmed for with a Service-level strategy to guide investments, not treated as a collateral duty as it is now. There is technology that can be used to improve and sustain our current operations in the near term while completely disrupting the Marine Corps

As technology changes, we need to take advantage of those changes. *(Photo by LCpl Haley McMenamin.)*

The Corps and the Joint Force cannot afford to allow changes caused by disruptive technologies to be forced upon them. *(Photo by LCpl Haley McMenamin.)*

operational model in the long term. As an institution, we must be positioned to recognize and capitalize on both. If we fail to recognize and incorporate disruptive technology, then the efficient, well-executed leadership of an obsolete operating paradigm will only hasten our organizational defeat.[18]

The pace of global commercial technology development cannot be stopped, so the question is whether the Marine Corps (and the joint force at large) will change in order to capitalize on emerging technology, or if change will be forced on us in catastrophic ways. As our foundational document, *MCDP 1,* states:

> It is important to understand which aspects of war are likely to change and which are not. We must stay abreast of the process of change for the belligerent who first exploits a development in the art and science of war gains a significant advantage. If we are ignorant of the changing face of war, we will find ourselves unequal to its challenges.

Notes

1. Andre Meola, "What is the Internet of Things (IoT)? Meaning & Definition," *Business Insider,* (May 2018), available at http://www.businessinsider.com.

2. Staff, "A New Camera Can Photograph You from 45 Kilometers Away," *MIT Technology Review*, (May 2019), available at https://www.technologyreview.com.

3. Henry Kissinger, "How the Enlightenment Ends," *The Atlantic*, (Boston, MA: June 2018).

4. Department of the Army, "The Operational Environment and the Changing Character of Future Warfare," (Fort Monroe, VA: U.S. Army's Training and Doctrine Command, July 2017).

5. Staff, "Zero-Day Vulnerability: What It Is, and How It Works," *Symantec Corporation*, (Mountain View, CA: 2019).

6. Defense Science Board, *Summer Study on Autonomy*, (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, June 2016).

7. David Thornton, "CNO Warns about 'Changing Character' of Military Competition," *Federal News Network*, (Washington, DC: July 2017).

8. William Lynn, "Are We Addressing Tomorrow's Threats with Yesterday's Technology?" *Defense News*, (Washington, DC: May 2017).

9. Henry R. Jeffress, "Countering Hypersonic Threats with Directed Energy," *Over the Horizon*, (January 2018), available at https://othjournal.com.

10. Greg Knepper and Peter W. Singer, "Short Legs Can't Win Arms Races: Range Issues and New Threats to Aerial Refueling Put U.S. Strategy at Risk," *War On the Rocks*, (May 2015), available at https://warontherocks.com.

11. Margaret Rouse, Linda Rosencrance, Sharon Shea, and Ivy Wigmore, "Emerging Data Center Workloads Drive New Infrastructure Demands," *TechTarget*, (Newton, MA: March 2019).

12. Joseph Redmon and Ali Farhadi, "YOLO9000: Better, Faster, Stronger," *Cornell Univeristy,* (December 2016), available at https://arxiv.org.

13. Derek Stoffel, "Down, But Not Defeated: What is the Future of ISIS after Raqqa?" *CBC News*, (October 2017), available at https://www.cbc.ca.

14. Jacques Bughin, et al., "How Artificial Intelligence Can Deliver Real Value to Companies," *McKinsey and Company Report*, (June 2017), available at https://www.mckinsey.com.

15. Louise Lucas, "China Seeks Dominance of Global AI industry," *Financial Times*, (October 2017), available at https://www.ft.com.

16. Frank Konkel, "Army Logistics Renews $135M Cloud Contract—and Gets Watson," *NextGov*, (September 2017), available at https://www.nextgov.com.

17. Scott Nicholas, "IBM Helps Army Materiel Command Evaluate Stryker Vehicles with AI Platform; Sam Gordy Comments," *ExecutiveBiz*, (July 2017), available at https://blog.executivebiz.com.

18. Jeffrey Engstrom, "Systems Confrontation and System Destruction Warfare How the Chinese People's Liberation Army Seeks to Age Modern Warfare," *RAND Corporation,* (Santa Monica, CA: 2018).