The Robotic Revolution in Military Affairs: Implications for Leaders - Part I

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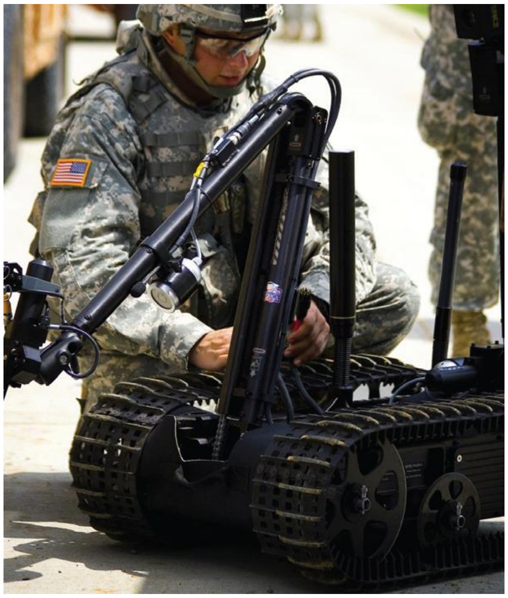
> *"In a typical tour in Iraq, each team will go on more than six hundred IED calls, defusing or safely exploding about two IEDs a day. Perhaps the best sign of how critical the EOD teams became is that the insurgents began offering a rumored $50,000 bounty for killing an EOD team member. Unfortunately, this particular mission would not end well. By the time the soldier had advanced close enough to see the telltale explosive wires of an IED, it was too late. …The IED erupted in a wave of flame. A U. S Navy Chief Petty Officer who had the duty of writing condolences after an incident remarked that, "When a robot dies, you don't have to write a letter to its mother"* (Singer, 2009, p. 20-21).

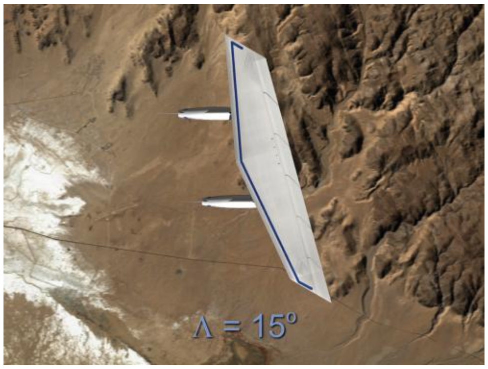
Background: Robots and Sensors The impact of the "war on terrorism" resulted in second and third order consequences, most significantly, new conceptions about homeland security. This spurred the creation of an extensive industry that supports military and government agencies' missions to defend the homeland. There were nine companies with federal contracts for homeland security in 1999; by 2003 the number rose to 3,512; it accelerated to 33,890 by 2006, generating about $30 billion a year. Additionally, in 2003 the budget for Department of Homeland Security included $4 billion for technology research (Singer, 2009). Protecting the homeland from terrorists, especially at airports, borders, power plants, and ports propelled interest in "sensory bots" and unmanned vehicles.

Although robots are showing their value in the war on terrorism both at the battlefield and at the home front, they already reveal their worth in responding to natural and man-made disasters. During the Deepwater Horizon oil spill disaster, at least four Remote Operated Vehicles (ROV) and 15 robotic submarines were deployed to the wellhead 5,000 feet below the ocean surface. Unmanned Arial Vehicles (UAV) searched for survivors after Hurricane Katrina and during 9/11, PackBots and TALONS (unmanned vehicles) assisted in search and rescue missions. Robotic boats (USV) have already proven their advantage by operating in conditions too dangerous for sailors such as "sea state six" when waves are eighteen feet or higher (Singer, 2009).

During the Persian Gulf War in 1991, the U.S. military began deploying unmanned systems and drones: the Army and Air Force used a few converted M-60 tanks to clear land mines and the Air Force flew only one UAV drone (Singer, 2009). However, the Navy successfully used the Pioneer drones, purchased secondhand from the Israelis, at Faylaka Island when Iraqi troops offered to surrender to a UAV (Navy, 2009). In 2008, Senator John Warner mandated that by 2010, one third of all aircraft slated for use behind enemy lines should be unmanned.


TALON III-These 100-lb robots, developed for EOD applications, are successfully used to counter IEDs in military theaters of operations saving many EOD technicians' lives. Today over 3,000 are currently used by the military (DARPA, 2010a).


C-TAR/C-TALON. Primarily in response to the inability to land forces in a direct beach assault in Desert Storm, a swarm of six TAR-class robots were waterproofed and instrumented for mine detection and neutralization (DARPA, 2010a).



The Oblique Flying Wing, a new X-Plane currently under development by DARPA, can vary the angle of its wing with speed, shifting between an unswept-wing design at lower speeds and a swept-wing design at high speeds (DARPA, 2010a).

By the 21st century, the adoption of robotics and sensors are considered "normal" and gaining importance in air, space, sea, and land missions (Singer, 2009). Leaders realize they must be ready to lead change and prepare their followers to adapt to dynamic environments. They need to grasp and understand emerging technologies, ensure members acquire competencies, and discern the impact on operations. More importantly, it is essential for leaders to consider the second and third order effects that technology presents, especially unmanned robots with artificial intelligence. The Coast Guard Leadership Competency, "*Leading the Coast Guard, Technology Management"* recognizes that leaders also need to be cognizant about the impact of technological changes. More than ever, innovative technologies, especially autonomous robots and sensors, challenge each of us to confront and reflect upon the ethical implications on our nation, organizations, and our humanity.

Part 2 examines implications for leaders; continues with next publication issue.

SUGGEST PART 2 BEGIN HERE

Part 1 (Summer Issue) presented an overview of robotic technology and how the military is adopting this technology to meet operational needs. Part 2 proposes some implications for leaders to contemplate in adapting to robotic technology.

SWOT Analysis: Leaders need to ascertain the risks and challenges of adopting technology, particularly robotics, to make informed decisions. This section presents a brief analysis of strengths, weaknesses, threats, and opportunities which illustrate that even a few points are sufficient to reveal the implications for leaders.

Strengths**:** Robots are especially adaptive to challenging environments such as the 3 "D's": Dirty, Dull, and Dangerous. Robots preserve the health and lives of soldiers and rescuers when they enter in places where suspicious biological or chemical hazards pose threats. Besides, robots often perform faster and with greater accuracy, such as in clearing mines (Singer, 2009). Robots also eliminate concerns about human weaknesses such as requirements for sleep or food and working long hours without degrading performance. They provide a "multiplier effect" by completing numerous, dangerous missions and tirelessly gather intelligence for days. Robots offer a means to collect and triangulate data sources to enhance decision making at lower levels. This expands opportunities for more leaders, from various remote locations, to review information. In several ways, robots reduce the number of troops and time required to accomplish missions in addition to preserving lives.

"However, writing software without defects is not sufficient. In my experience, it is at least as difficult to write software that is safe - that is, software that behaves reasonably under adverse conditions." -Wietse Venema--Dutch Scientist

Weaknesses: The enormity of data collected by robots and drones require increased human resources to assess and interpret the information. Robots do not discriminate in gathering data; sorting and determining the relevancy takes human effort. Sharing vast amounts of data increases accessibility at all levels of command, however, leaders who previously delegated decisions and encouraged "on-scene initiatives" are challenged to forego the urge to retake control.

Although robots overcome several environmental obstacles better than humans do, some conditions threaten their operability. For example, extreme weather such as temperature, wind, sand, and water affects electronic components. Additional threats come from physical blows during transportation and power-related issues involving connectivity or batteries. Moreover, despite the numerous advantages that robots possess, they cannot compare to the mobility and manipulation qualities that humans demonstrate in various environments (DARPA is currently researching solutions to these limitations).

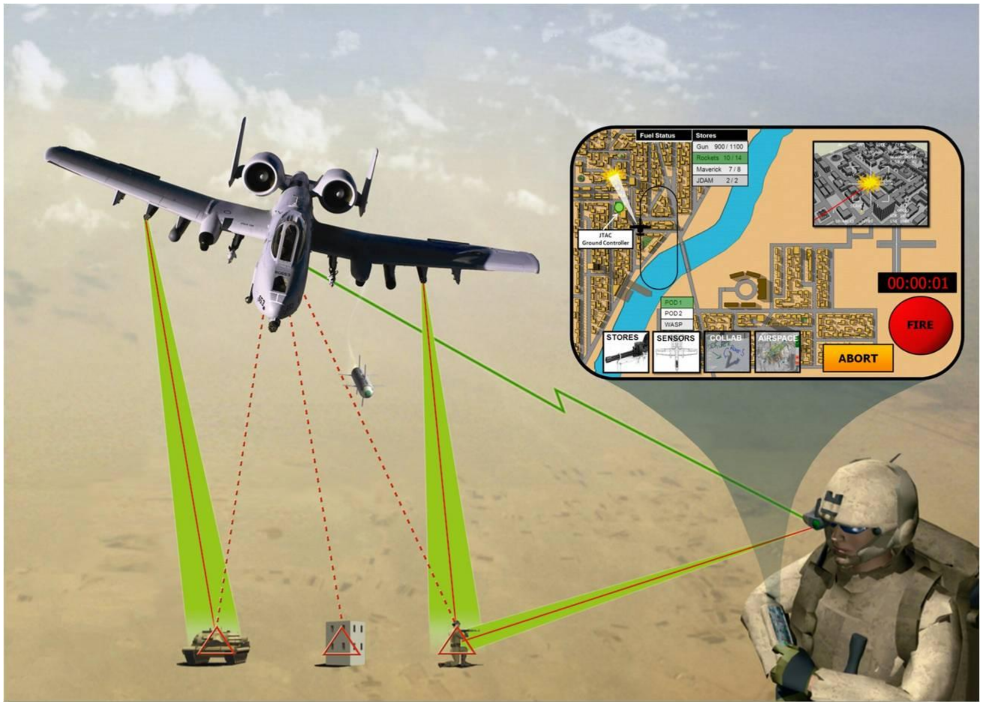
Competing product designs also produce unintended consequences, such as compatibility issues, both internally within the service branches and between them. Increasingly, available software is commercial off-the-shelf, outsourced, or imported from other nations. This may be an indicator of weaknesses in U.S. education, specifically in math, science, and engineering. Since 2003, trends in U.S. high school students' scores are significantly below the average on math and science (China, Finland, & Korea lead) as measured on the International Student Assessment (OECD, 2010). Recognizing educational gaps, DARPA announced several initiatives aimed at middle and high school students, including a robotics academy, to promote math, science, technology, and engineering (According to DARPA (2010b, Oct), the decline in students graduating with Computer Science and related degrees is 58%).

Threats: If the "enemy" or unauthorized persons gain access to robotic technology, this may pose several threats to U.S. national security. For example, equipment is vulnerable to sabotage (such as "jamming" or viruses), hackers may gain access to systems or information, and the wrong person can use technology to make adaptations and use it against the U.S. (or innovate and win a technological edge).

Our national and international policies do not address the current conditions of military operations that deploy robotic technology. For example, does the Geneva Convention apply to remote military pilots who deploy drones? What policies or laws protect U.S. contractors who operate robots in combat?

Opportunities: Military leaders should seek opportunities to collaborate in joint operations, including sharing and combining emerging technological equipment. Partnering may reduce compatibility problems by adopting standard robotic technologies across military branches while also accelerating innovation. Funding early adoption of technology and innovation is often costly, but partnerships can reduce the expenses and increase pragmatic adoption of emerging devices. Furthermore, exchanging lessons learned and distributing examples of successful applications increases preparation for continuity of operations and homeland security.

“Our technological powers increase, but the side effects and potential hazards also escalate”. - Alvin Toffler



Persistent Close Air Support (PCAS) will be a ‘system-of-systems’ approach demonstrating the ability to digitally task a CAS platform from the ground. The system will be designed to reduce collateral damage and potential fratricide to friendly forces. Enabling technologies are: manned/unmanned airborne platforms, next generation graphical user interfaces, data links, digital guidance and control, and advanced targeting and visualization tools (DARPA, 2010).

Consequences: Adopting technology and implementing change often presents unintended consequences. Leaders need to be ready and project not only first order consequences, but also the impact of second and third order effects.

First Order: Benefits - The first order effects are usually the ones we predict more readily and typically have positive outcomes. For example, robots that disarm IEDs save U.S. lives and possibly civilians as well. DARPA is hopeful that the next generation of robots can rewrite urban warfare cases such as *Black Hawk Down*. The greater use of drones and robotics imparts even disabled soldiers with the ability to remain on active duty and engage in combat missions.

Robots assist soldiers at the battlefield, provide sensory watches for threats against the homeland, and assist rescuers by searching in hazardous places during disasters. Various robots and drones provide a broad scope of information for better decision making by allowing leaders to combine information sources, increase clarity, and assure greater accuracy. Drones offer an advantage for Intel missions because they can collect greater amounts of information, in less time, especially in dangerous situations. Additionally, drones are not constrained by human vulnerabilities such as losing consciousness, bleeding to death, or succumbing to fatigue.

Second order: Wrong Hands - Software is increasingly complex and interdependent, suggesting that systemic network equipment will continue to pose novel risks and add new meanings to damage control as it becomes harder to confine impact. Furthermore, software is expanding to open source designs and the U.S. is becoming more reliant on commercial products, many imported, to provide needs for the military and national security. If U.S. technology falls into the wrong hands, it may be used to gain advantages on multiple fronts; tactically at the battlefield and politically or economically at the home front.

The Unthinkable -In April 2011, it happened: The U.S. military began an investigation of the deaths of a Marine and Navy corpsman that were killed while attempting to rescue other Marines under fire in Afghanistan. This incident marks the first deaths of U.S. soldiers from an unmanned drone (Predator). The military believes that the drone fired missiles at the U.S. soldiers, mistaking them for militants (friendly fire).

Third Order: Ethics – Perhaps the greatest challenge for leaders to ponder and reflect upon are the ethical consequences that robotics presents. For example, how do we consider the human cost of combat on a pilot who is flying a drone over Iraq or Afghanistan, but assigned to a U.S. base? Do we consider virtual pilots who fly remote drones from the U.S. and engage in "combat" missions with the same combat status as those physically at the battlefield? How does remote piloting or combat change the conception of "Free Fire"?

Imagine that a remote combat pilot witnesses one or more traumatic situations, in real time, that may include U.S. soldiers, enemy combatants, and civilian deaths. What are the assumptions about the effects of "shock and awe" from a remote distance? Some researchers purport that emotionally detaching and distancing from those we fight dehumanizes the "enemy" and reduces empathic responses (Moller & Deci, 2010; Zimbardo, 2008). How does the remote context impact decision-making and reflection? Is the level of confidence in decisions rendered by AI (artificial intelligence) "expertise" different from confidence in human experts?

Conclusion

"It has become appallingly obvious that our technology has exceeded our humanity."-Albert Einstein

The robots are coming to a service near you; at the battlefield and home front. The Coast Guard will increasingly require and rely upon members with technological competencies; therefore, leaders can support formal and informal training and experiences. Moreover, leaders should consider searching for ways to foster technological innovation and collaborate across services.

Robotic technology calls upon leaders to seek answers to compelling questions such as, how does interfacing with robotic and sensory technology affect assumptions about human nature? What are the effects on decision-making when we depend on robotic technology? Do we trust technological memory more than human judgment? What are the implications for emphatic and moral reasoning given remote capabilities and immense power? Leaders who anticipate and reflect upon second order effects and ethical implications will be better prepared to lead the

Coast Guard during dynamic change. More importantly, they will exemplify leaders of character.

Leadership Competencies Addressed: *Leading the Coast Guard, Technology Management*

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