

DEPARTMENT OF THE NAVY INNOVATION ESSAYS



PEOPLE

IDEAS

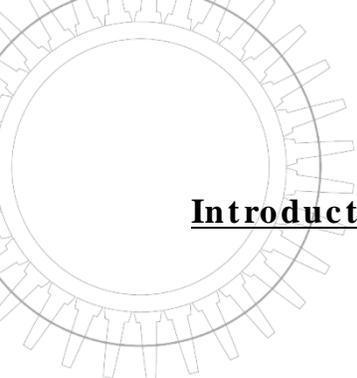
INFORMATION

“CHALLENGE THE FORCE...
CHANGE THE GAME”

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** = The opinions expressed here are solely those of the authors, and do not necessarily reflect those of the Department of the Navy, Department of Defense or the United States government.



Introduction

By Sarandis Papadopoulos, Ph.D.

In April 2015, Secretary of the Navy Ray Mabus recognized all naval innovators who use ideas to overcome barriers to change, as well as those who nourish innovation across the Department. The complexity of the world's security challenges, enabled by accelerating changes in technology, compels the U.S. Navy and Marine Corps to adjust, quickly, their thinking. The essays compiled here represent a small sample of such bold thinking inside the Department of the Navy workforce, and are circulated both to stimulate further thought and to encourage others to share ideas throughout the organization.

These 23 short essays highlight the urgent need for the U.S. Marine Corps and Navy to use innovative approaches to alter how they confront a wide array of challenges. They are grouped along four broad themes: an Adaptive Workforce; Operational Challenges; Emerging Fleet Capabilities, including unmanned systems; and the Future Environment. In essence the papers are sources for further innovative work. The hope is they will prompt Navy Department service members and civilians to think about the methods needed for innovation to succeed, now and in the foreseeable future, as well offer them ideas to make their own innovative thoughts become reality.

Ultimately, the long-term success Task Force Innovation will be measured in how far the service members of U.S. Navy and Marine Corps, and their civilian counterparts, understand the threats outlined here and develop responses to them. The stakes are high, for hostile actors can turn these new instruments into truly harmful threats to America and its allies. At the risk of putting words in these authors' mouths, all of us want the sea services to succeed, ideally by preventing wars or, if needed, by winning them. If over time the essays here support the goal of making innovation in the Department of the Navy a reality, they will have succeeded.

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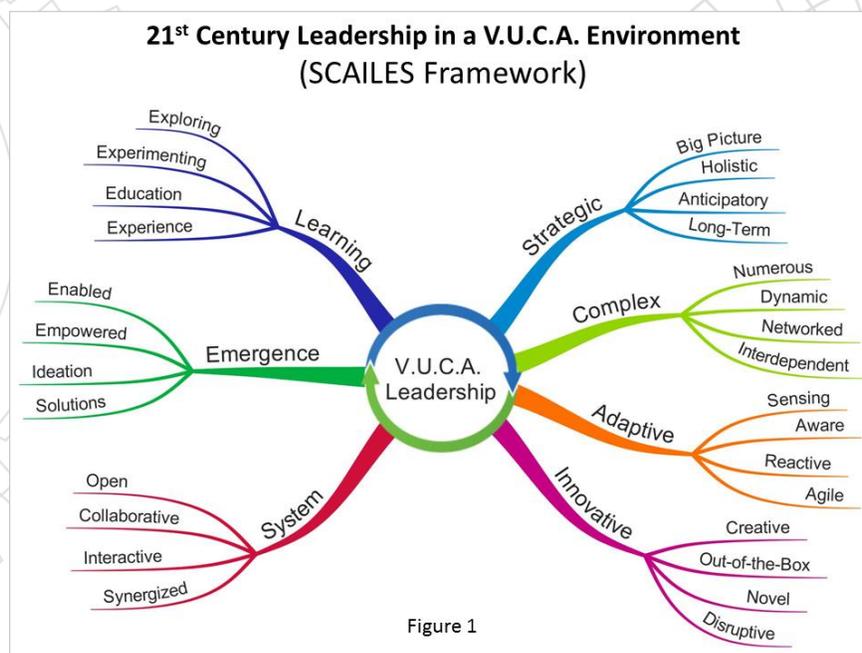
Leadership in the 21st Century Environment; A Proposed Framework

By Dr. Dale L. Moore, Dept. of the Navy **

The strategic environment of the 21st Century has been characterized as volatile, uncertain, complex and ambiguous (V.U.C.A) as new technologies, developments, disruptions, change and transformation continue to accelerate. These trends profoundly impact the ability of any organization to remain relevant and competitive. We are now entering a period where our existing views of leadership need to be reconsidered to pace these changes and our ensure superiority and competitive advantage.

Often leadership gets confused with management, which are quite different but also closely related. Management focuses on the planning, structuring and efficient execution of an activity, task or project to achieve a set of outcomes – it is highly organized, monitored and controlled to get the final product or result. Leadership is the other side of the coin and is about inspiring and motivating people in organizations to go well beyond where they thought possible, making their greatest accomplishments; these can change the game or shift paradigms to a higher level of performance, efficiency and effectiveness – essentially transforming institutions to achieve their utmost in meeting their most challenging goals and objectives.

Leadership depends on different and complex factors rooted in psychology and sociology, but ultimately focuses on what leaders know, how they think, and how they both communicate and send appropriate signals to build trust and mutual respect. Leadership is about creating an environment in their organizations which unleashes full human potential, one guiding and inspiring coalitions of participants to achieve great things. Struggling to provide leadership in an increasingly V.U.C.A. environment, leaders require new ways of looking at the world i.e. shifting their models to better adapt to and anticipate an uncertain and accelerating future, one by its very nature approaching chaos.





A framework is proposed as shown in Figure 1 integrating 7 key concepts necessary for leaders to succeed in this 21st Century V.U.C.A. environment. The elements of this framework form a system of thought, captured as a: Strategic, Complex, Adaptive, Innovative, Learning, and Emergent System (SCAILES). This framework leverages, extends and broadens concepts grounded in complex adaptive systems' (CAS) theory. SCAILES takes CAS to a new level and makes it more accessible, by addressing needed anticipatory and innovative capabilities, focused on learning, as the pre-requisite for future success. The SCAILES framework is described below:

Strategic: To succeed and achieve a desired culture of strategic thinking, leaders and their organizations need to be able to see the big picture and think holistically about how dynamic inputs affect one another. Strategic thinking is about anticipating the future based on what is known, and considering the possibilities and probabilities of each long term outcome. Strategic thinking links the past to the present, as well as to the future, as a single continuum of dynamic interactions. It links the big picture view to the tactical level. Strategic thinking helps leaders to step back and think-through plans and decisions, connecting future outcomes to today's tactical actions, and develop a credible path to achieve a desired state.

Complex: Complexity refers to the numbers of elements one considers when thinking through problems, issues or situations, to help create well-informed strategies, plans and decisions. Organizations and technologically advanced systems are increasingly complex, and their dynamic, turbulent nature creates significant leadership challenges. Leaders must try to navigate what is known, while accounting for what might not be known i.e. unknown unknowns. These are an important consideration, especially in a VUCA environment, requiring discerning judgment and wisdom. Leaders must realize the networked nature of complexity, and how its various elements are interdependent and all striving to achieve a proper equilibrium.

Adaptive: As the VUCA environment continues to change, leaders and their organizations must adeptly sense environments and be aware of changes which may influence their actions, behaviors, plans, strategies and investments. With awareness ingrained in leaders' minds and in their organizations, there must be an ability to react effectively and efficiently to stay ahead of environmental changes. This requires leaders and their organizations to be agile, flexible and adaptive. In bureaucratic organizations, with rigid processes, guidelines, workflows etc., this is very difficult and can be a "system constraint" in the fast paced competitive environment.

Innovative: Innovative leaders and their organizations place a premium on learning, knowledge and the ability to think creatively to catalyze new thoughts and connections which result in novel ideas and concepts. Innovations occur in an environment where there is an explicit need, and where it is safe to experiment and fail, summed up by "fail safe, fail fast, fail often." Leaders focus on fostering organizations which accelerate learning and the development of break-through ideas and concepts which make real and substantial differences. Organizations which can routinely develop novel solutions through collective intelligence, rooted in knowledge and effective and efficient social networks built on mutual trust and respect, will achieve a cultural nirvana. In the 21st Century VUCA environment, generating game-changers or disruptive innovations that establish completely new paradigms, or "off-sets" for distinctive competitive advantage, represent the Holy Grail to stakeholders and customers, specifically the Department of the Navy.

Learning: Learning is the foundational skill of the 21st Century – it not only affects what one knows but also how thinking takes place. In the future, knowledge dominance will determine outcomes. Learning to think strategically, creatively, critically, analytically and in terms of systems and networks is foundational to effective organizations. Accelerating learning both individually and collectively could not be more important, especially in a VUCA environment. It takes place by associating something new with what is already known, extending existing knowledge. New knowledge demands asking insightful questions, coupled to foresight, to create a better understanding. Spending time to make sense of complexity, and to think through meanings and implications, can build new neural connections. These new connections foster

even more possibilities for catalyzing new associations, i.e. accelerating learning. Along these lines, prototyping and experimenting are very powerful ways to learn something new. Continuous learning enhances one's ability to think and contribute meaningfully; it is also inspiring, self-fulfilling and ultimately self-actualizing. Experiential learning, where knowledge is applied in context, i.e. hands-on, builds personal and organizational growth and development, and wider results. Newly emerging serious games, virtual, collaborative experiences including Massive Open Online Courseware (MOOCs) and, especially, Massive Multiplayer On-line War Game Leveraging the Internet (MMOWGLI) pioneered by the Navy, provide platforms offering great potential to accelerate learning. They do so through deep engagement and immersion in a collaborative setting to achieve deeper understanding, context and perspective.

Emergence: To unleash human potential, leaders in the 21st Century must create an environment that enables the unbridled emergence of new ideas, concepts and perspectives. Leaders must set the tone, so that employees feel encouraged and possess safety of voice, perceiving a sense of openness and trust for meaningful dialogue and exchange as the norm. Just as in the rich and lush conditions of an ecosystem or rainforest, where nature can thrive in near-perfect balance, leaders create the right expectations and open-minded conditions allowing new ideas to emerge. Leaders set the stage for their environment and the culture that comes with it – emergence occurs when a genuine interest in generating productive ideas and solutions arises, and with an expressed appreciation based on the merit of ideas regardless of their source i.e. a meritocracy instead of a more traditional hierarchy. Diversity of thought and perspective, applying different lenses and backgrounds to a problem, often plays a key role in enabling the emergence of the most novel and meaningful ideas. The role of leaders is to set the stage, create the right environment, ask the right questions, and then 'let go' to catalyze productive and meaningful exchange to achieve great outcomes.

System: Successful leaders think in terms of open and collaborative systems, which foster internal and external interactions, exchanges and, ultimately, synergy to create dynamic learning and innovative social environments. Leaders must think in terms of interconnected and interdependent systems, loosely coupled and able to easily adapt. Leaders must also realize that thinking itself is a complex system that evolves new thoughts and ideas in response to influential factors. Understanding these influential factors is critical to understanding the basis of thoughts and ideas i.e. the biases and emotions of our thinking. Ultimately, the ability of leaders to consider the wide range of possibilities and their inherent probabilities, think them through, and consider their potential implications provides the basis for the insights, foresights and capabilities necessary to take action and succeed.

The SCAILES framework is a new way to think about leadership amidst the growing challenges of the 21st Century VUCA environment. Leaders and organizations that can stay acutely aware, anticipate, ideate, and lean forward in their connectedness, thinking and learning will set the example for others to follow. These organizations exemplars of thought leadership and leadership-in-action, and will have a distinct competitive advantage as the uncertainties, disruptions and nonlinearities of the 21st Century unfold.

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Creating a Culture of Creativity

By **LT Kristen Wheeler, USS IWO JIMA (LHD 7).** **

Instilling a culture of innovation and creativity is no easy task. It means stepping away from the comfort of the familiar and routine and into the realm of unknown possibilities. Here onboard USS IWO JIMA, we are doing just that, by building a culture that will allow deckplate ingenuity to bubble up to the surface. Our goal is simple; create a culture shift towards creativity, ingenuity, and innovative thought within our Wardroom and then manifest this paradigm throughout the ship. Our shift began in the Wardroom, through the implementation of a new training program.

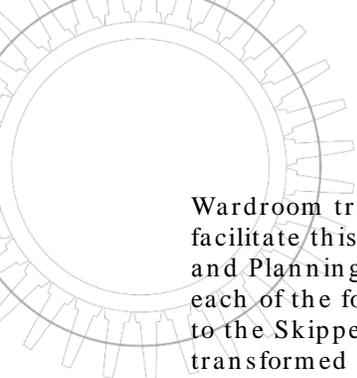
Deckplate innovation starts with leaders who champion the cause. Our Commanding Officer, CAPT Dana Gordon and Executive Officer, CAPT James Midkiff are staunch supporters of this transition and believe we have the ideal Wardroom to enable this change. After an earnest discussion with the Skipper regarding Navy training, leadership challenges, and the future of the Navy, our goal was clear; we needed to reexamine not only what we train, but how we train.

Seeking to redesign the mundane training experience, we decided that death by Power Point and rote memorization were off the table. Instead, our approach to training focuses on incorporating “systems thinking” and “experiential learning” techniques. Our training is effective, interactive, memorable, and meaningful. We also capitalize on our diverse pool of talent. The IWO JIMA Wardroom is the definition of diverse. We have over 80 Officers in 28 different designators, ranging from fresh-out-of-college Ensigns to seasoned 25+ year Limited Duty Officers (LDO) and Chief Warrant Officers (CWO). With that, we currently have two different, yet complementary, training programs. One is designed for Division Officers (DIVO SWO Training) while the other is targeted for the entire Wardroom (Officer Leadership Continuum).

Kicking off DIVO SWO Training on March 12, 2015, we explored “systems thinking” as a way to understand how the Navy is comprised, since we are a complex organization of systems within systems. In order to understand complex systems, we conducted an exercise involving every person in the room simultaneously.

The rules were simple. Each person selected a single card with a system or node (i.e. PQS, Walking Blood Bank, COMTUEX, Maintenance on SPS-48G Radar, ORM, ASA Checklists, Detection of a Threat Missile, Evacuation of Embassy, etc). After each participant chose a card, they then held it up for the others to see. Next, without communicating, each person chose two other cards that related to their card. For example, the person holding the Detection of a Threat Missile Card silently chose the person holding the PQS Card and the Maintenance on the SPS-48G Radar Card. Simultaneously, the person holding the Maintenance of the SPS-48G Radar Card silently chose the person holding Detection of a Threat Missile and Evacuation of Embassy. Next, everyone was instructed to move equal distance from the two other cards they chose, without communicating. In the end, there was a room full of people who were continually readjusting, illustrating an ever changing “complex systems”. After five minutes, we came to a stopping point. Each person in the room then briefly explained their system card and then revealed the two cards they chose, while explaining the relation. Even though the exercise was initially received with hesitation, in the end, people were energized and chatty with this new visualization of why we need to understand not only each system, but how these systems affect one another.

Toward the end of June, DIVO training will transition as we begin to explore “design thinking”. The DIVOs will be divided up into the four watch teams and tasked to redesign SWO and



Wardroom training during the upcoming yard period. There are three training topics to facilitate this project: “Introduction to Radical Collaboration”, “Introduction to Design Thinking and Planning”, and finally “Introduction to Effective Briefing/ Pitching”. The end goal is that each of the four teams will come up with four different ideas for training and then pitch them to the Skipper and the Wardroom. We expect to see shipboard SWO Training completely transformed and revitalized.

Concurrently, we hold Wardroom Training for all Officers. These topics address challenges we face as a diverse Wardroom of various ages, backgrounds, communities, and ranks. As of May 16th, our Wardroom leaders have showcased their talent in five training topics. Our Skipper (Aviator) and XO (SWO) kicked us off with “Community Briefs”, expanding knowledge on Fitness Reports, promotion boards, career advice, and guidance. This next lesson was facilitated by CDR Raymond Marsh (Air Boss) regarding “The Good, The Bad, and the Basics of Naval Leadership”. This lesson was followed by CAPT Sean Sullivan (Senior Medical Officer) and CDR Stuart Day with “Leadership under Pressure”. Recently, one of our salty Limited Duty Officers (LDO), LCDR Shawn Collins (AIMD Maintenance Officer) and our brackish Bull Ensign, ENS Mike Cuomo (SWO DIVO) teamed up to deliver “Bridging the Generation Gap”. Topics still on the horizon are “Small Things that Makes a Big Difference”, “Effective Communication”, and “Creative Leadership”.

Overall, our goal is to foster the “flip”, which is defined by the thought leader David Kelley as the point when people “see themselves as creative individuals”. We are encouraging people to ask questions, understand their systems, seek ways to improve these systems and then become champions for others. There is no instruction or doctrine developed by the Navy on how to do this, which makes the leap into the unknown rather daunting. However, with champions to back up the culture shift and an open-minded crew, IWO JIMA Sailors will certainly be Fleet game-changers.

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Creating the Time for Process Improvement

By Scott Hargate **

I am amazed at the number of times that I've been told that somebody is "too busy" for process improvement. Many of our Sailors, Marines and civilians know ways by which they can improve their jobs, if only they had the time to develop their own ideas. These individuals believe they cannot afford to spend the time to design and implement their changes, because their current tasks are barely completed in the time that they have available. Below are two real-world examples of process improvements which were implemented as a result of supportive leadership and taking personal initiative to make the time for process improvement.

Maintenance Organization

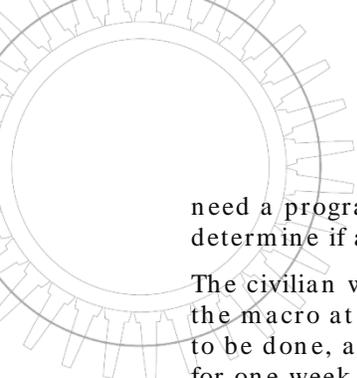
A Marine Corps Lance Corporal transferred from a combat arms battalion to an Electronics Maintenance Company (ELMACO) in a Marine Logistics Group. As a Ground Electronics Transmission Systems Maintainer, he had just spent the previous 18 months working in the Shipping and Receiving Section, and was now expected to fix radios that he hadn't seen since MOS school. The Lance Corporal noticed that the other maintainers were very proficient at determining the cause of the issues, but spent most (between 80 and 90%) of their time filling out the paperwork (Equipment Repair Orders (EROs), ERO Shopping Lists, etc...). The Lance Corporal, however, had the opposite role. He would spend almost all of the time testing the equipment, in order to determine the cause of the errors, taking almost no time to finish the associated paperwork.

The ELMACO section was swamped with more than 1300 EROs, with only a dozen maintainers. A few weeks later, the section chief announced that the team was going to start port and starboard shifts, with a day crew and a night crew, in order to try to reduce the backlog of equipment waiting in the maintenance cycle (and not available for the Operating Force Marines to use). The Lance Corporal asked the section chief if they could talk for a minute and explained his observations. The section chief noted that the section didn't have enough time to stop fixing broken equipment and to train the other maintainers on the paperwork. The Lance Corporal then briefed his plan. He recommended that the other maintainers concentrate on fixing the equipment, and that he would deal with the paperwork. Once they got "caught up" with the EROs, the Lance Corporal could teach the other maintainers how to complete all of the required documentation. The section chief accepted the risk of taking one of the maintainers off of the floor, and trying out a new process offered by his team member.

After six weeks, the section had reduced the number of outstanding EROs to less than 100—a cut of over 90%. The remaining unrepaired equipment would be fixed as soon as the repair parts arrived. The section then had the time available to teach classes on completing the paperwork, without the need to work day and night.

Spreadsheet Macros

A Department of the Navy Civilian working at the Pentagon received the task of processing procurement requests. The due diligence required for this role had many steps, including comparing five separate spreadsheets. The time required to process each request was about 2 hours, mostly taken up comparing the different spreadsheets. With an average of 10-15 requests every week, this job was taking most of his time and, worse, the quantity of requests was increasing. The civilian realized that comparing spreadsheets was a process that could be automated, saving time and increasing accuracy. To automate the process, the civilian would



need a program (a macro) to sort, compile, and compare the different spreadsheets and determine if all due diligence requirements had been met.

The civilian went to his supervisor to explain the situation and the estimated time savings from the macro at approximately 16-25 hours a week. The supervisor agreed the automation needed to be done, and was supportive of his suggestion. The two agreed to stop processing requests for one week in order to create the automation toolset. As the procurement requests had a tendency to ebb and flow, this temporary shutdown was implemented during the next slow period. A week was dedicated to its development and testing.

At the end of the week, the toolset had been created, tested, and implemented. The backlog of requests was “cleared” in just 2 days, and the time required to perform due diligence was reduced to only 20-30 minutes per request.

Way Ahead

Within the Department of the Navy, we must assume appropriate risk, within laws and regulations, to make the time to improve our processes. Along with the rest of DoD, the Department’s budget is anticipated to fall across the next five years, if not longer, without a corresponding reduction in mission requirements. As a result, Department of the Navy must urge its leaders to support innovation, and leave individual service members and civilians enough personal initiative to continue to provide and improve the defense of the American people.

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Creating Cognitive Warriors

By Robert Kozloski **

In the mid-1990s, Commandant of the Marine Corps General Charles Krulak, recognized the changing nature of modern conflict and introduced the concepts of the “Three Block War” and the “Strategic Corporal.” Both ideas stressed the dynamic challenges of the new battlefield, where leaders across the military rank structure would have to make diametrically different decisions often within moments of one another during a single operation.

Krulak’s view of the future operating environment demanded mental agility. Centrally, he recognized that poor tactical decisions would quickly turn into an adversary’s advantage, particularly in a globally connected environment. The Commandant’s prescient vision became reality only a few years later in Iraq and Afghanistan.

To prepare the Marines of that era for this challenging new environment, Krulak provided the following guidance:

“There is a critical need for all Marines to prepare themselves mentally and physically for the rigors of combat. Physical preparation has long been ingrained in our culture and Marines are well known for their physical conditioning. Mental preparation needs to receive the same emphasis.”

He stressed the need for Marines to take time to improve tactical decision-making and ordered a two-pronged approach – make wider use of tactical decision games and have regular discussions on warfighting. Krulak also challenged traditional views of training by encouraging the use of commercial video games to improve tactical decision-making when live training opportunities were limited.

Today, Marines still emphasize the need to hone decision-making skills in officer development programs. Successfully completing the leadership reaction course is part of Officer Candidate School while land navigation, where individual decision-making is as important as military orienteering, is still a significant part of The Basic School curriculum at Quantico.

The Marines are not the only service members to recognize the need to continually sharpen mental acuity to prepare for the complex battlefield. Navy SEALs are widely recognized as world-class athletes but they are also some of the most intelligent members of the US military. For years the SEALs have used Keep In Mind exercises to improve an operator’s powers of observation and recall. A decade ago, the SEALs faced the challenge of growing their numbers while not compromising their high standards. Rather than having candidates do more push-ups or flutter kicks, they enlisted the help of top neuroscientists to help improve the cognitive conditioning of future warriors. These scientists found four cognitive pillars which help ensure success: setting goals, mental visualization, positive self-talk and stress control.

The Secretary of the Navy has also recognized the need to improve the cognitive skills of naval officers. Specifically, he tasked the services to [improve problem-solving skills](#) of naval officers, to make wider use of [wargames](#) and to increase the use of [virtual training and simulation systems](#). All of these actions are to help prepare Navy and Marine Corps leadership for a complex and uncertain future, saving time and lives on a future battlefield.

Despite top leadership’s guidance not all naval officers believe cognitive skills are valued in the fleet. During Task Force Innovation we found that many junior officers, fighter pilots being an exception, were discouraged from developing critical thinking and problem solving skills in the operational environment. Instead, the emphasis was placed on enforcing established practices

and following check-lists. In the private sector, workers performing such repetitive functions have been replaced by robots.

Such devaluation demoralizes our junior leaders, and risks worsening their response time in combat. In a future foreshadowed by swarms of micro UAVs, cyber attacks, and even the proliferation of intelligent robots on the battlefield, decentralization of decision-making will be critical for success.

As an institution we must recognize this problem - the navy attracts some of the best young minds our nation has to offer. This is a success, yet their cognitive skills are not valued or developed in the operating forces. Simply sending officers periodically to graduate schools is an insufficient remedy either to encourage the best to stay or to develop needed problem-solving, and life-saving, skills.

As a Marine Officer, I designed several squadron, group/ regiment and wing-level exercises. The guidance I received was usually the same – make the exercise challenging and force leaders to make decisions in a stressful, realistic environment. General Al Gray, Krulak’s Cold War predecessor, was an advocate for “free play” and risk-taking in field training, influencing the Marines of that generation.

“Hot washes” after the exercises were an essential part of the learning environment. Exercise participants were usually advised of the “Rhino-Rules”, that is, have a thick skin and let the spears thrown by others bounce off, in other words, have candid discussions about what worked and more importantly what didn’t work during the exercise; that’s what great organizations do.

In contrast, my first fleet-wide Anti-Terrorism/ Force Protection exercise as a navy civilian was just the opposite of my Marine Corps experience: we were advised to follow a script and make sure there were no surprises! My observation was that large naval exercises were more of a demonstration to prove training had finished. Although history has shown these may reassure allies and capture an adversary’s attention, they are not true learning exercises.

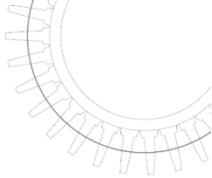
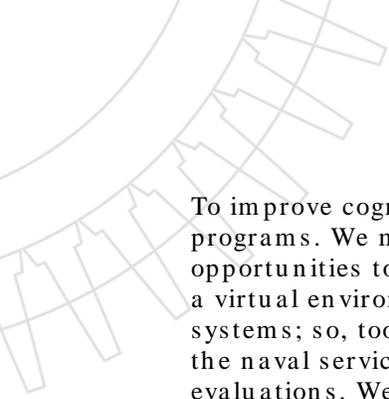
Some may argue that the missions of the navy, focused on commanding ships, submarines and aircraft, are significantly different than those of the Marines or SEALs, which are focused on leading people and operating in a human-centric battle space. Therefore, training the former should also be different. But the future battle space for all naval officers will change significantly over the next few decades and officer development must adapt as well. Just as Commandant Krulak was able to look into the future and urge his Marines to adapt, we should be scanning the horizon today for similar changes and a recent US Army study should provide us with some interesting food for thought.

According to the [report](#), major changes are coming with respect to our ability to see, communicate, think, and decide on the tactical battlefield of 2050. These changes draw upon a shared view that this battlefield will be characterized by the vastly increased presence and reliance on automated processes and decision making; humans with augmented sensing; and information-related and cognitive capabilities.

The study’s authors identified the following 7 interrelated future capabilities that they believe differentiate the battlefield of the future from current capabilities and engagements:

- Augmented humans
- Automated decision-making and autonomous processes
- Misinformation as a weapon
- Micro-targeting
- Large-scale self-organization and collective decision-making
- Cognitive modeling of the opponent
- Ability to understand and cope in a contested, imperfect, information environment

For the naval services to contend with these new realities, we must prepare our future leaders to thrive in this new information- cognitive-centric environment. The first step is to follow the advice of General Krulak and place cognitive fitness on a par with physical fitness.



To improve cognitive fitness we should follow the same structure as physical conditioning programs. We must create local experts to offer cognitive instruction and provide ample opportunities to allow junior officers to exercise decision-making ability; the latter can occur in a virtual environment if needed. Fitness equipment is widely available to condition physical systems; so, too, should simulation or networked gaming to develop cognitive skills. Finally, the naval services include the results of physical fitness tests on officer performance evaluations. We must develop an accurate standard of cognitive development and include those scores on performance evaluations as well.

The information age battle space will be much different from that of the industrial age. We must recognize the need to develop the next generation of warriors with the cognitive skills to dominate the data rich environment of the future. The cognitive warriors of the naval services must be able to apply mental and physical skills with equal acumen. Simply developing and promoting leaders who can follow a checklist will leave us ill-prepared for future challenges.

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Is *Ender's Game* our End Game?

By Robert Kozloski **

Second Lieutenants at The Basic School in the late 1990s were required to read Orson Scott Card's novel *Ender's Game*. At the time, I could not understand why, with the Marine Corps' rich operational history, we were required to read commercial science fiction. Had learning from our own legacy become somehow insufficient?

Years later I came to appreciate the science fiction classic more – not only for the many leadership lessons identified by Ender Wiggin's experience at the story's Battle School, or for its conversion into a [popular film](#) but for the full potential which modeling and simulation in a networked environment holds for preparing for, or even conducting, future military operations.

As Secretary of the Navy Ray Mabus identified in his speech at [Sea-Air Space](#), “New modeling and simulation capabilities allow us to try new concepts without bending steel. They allow us to look at things like asymmetrical concepts without going through the tortuous, sometimes years-long acquisition process.” While modeling and simulation (M&S) offers tremendous advantages in military training and experimentation today, it is difficult to predict their full potential. Could Ender Wiggin's combat experience be a harbinger for military operations in the future?

One group from the Army Research Laboratory recently took a closer look at [Ender's Game](#) in this context and identified several lessons learned:

Lesson One – The Training Spectrum Ranges from Individual to Collective

All military services train their individuals before they train the unit. Ender's time in Battle School was no different. All newcomers (“launchies”) to the school were subjected to classroom instruction and virtual simulations before they were assigned to an army. Once assigned to an army, their platoon leaders worked with them in small units prior to allowing them in the battleroom. Ender, by necessity, put this spectrum aside when training his so-called Dragon Army. He was forced by his instructors to train his army to perform as one team immediately. In this scenario, individual training asked more experienced soldiers to take on the less experienced, instructing them one-on-one [under Ender's guidance](#).

Lesson Two – All But War is Simulation

Army Doctrine Reference Publication 7-1, Training Units and Developing Leaders (U.S. Army, 2012) lists several principles of Army unit training. One is “Train as you will fight” (p. 2-1). A similar concept is codified in the former logo of the U.S. Army's Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI): “All But War is Simulation.”

As Dragon Army's leader, Ender embraced these concepts. His training sessions enforced primary concepts, such as maneuver and marksmanship, which he knew were crucial in the battleroom's games. Ender was trained to view these games as war, honing skills needed for complex command roles. In the end, even “real” war became simulation, as Ender and his commanders did not realize their final battle made them commanders of a real force-on-force action, and not a simulation.

Lesson Three – Perception of Limitations

The training program at the Battle School was very challenging. Yet, critically, it was designed so that the children could challenge the training program itself. Indeed, they had to do so in order to succeed – success was defined as “winning at all costs,” with besting the simulation or

other “players” in the simulated environment as the sole prize. Ender did this on multiple occasions throughout the novel.

For example, in the mind game involving the giant, the player appears to be faced with failure: by design, neither of the options led to a successful conclusion. As part of the training program, Colonel Graff and Major Anderson sought to discover how Ender would deal with the prospect of imminent failure. By killing the giant instead of accepting one of the choices it offered, Ender refused to be limited to failure. This was further confirmation to Graff and Anderson that their search for a brilliant leader was over.

Lesson Four – OPFOR Must Adapt

Early in his time at Battle School, Ender noticed older students playing 3-D games. Since he was still a “launchie” he could not play the game, so he learned by watching others do so. He discovered the older students often learned by playing against Artificial Intelligence (AI) opponents. The AI was not adaptive, which resulted in human players becoming predictable as opponents – accustomed to playing a static OPposing FORce (OPFOR). They solely employed the tactics and strategies required to defeat the AI OPFOR regardless of whether they played against AI or human opponents. Ender used this knowledge against his opponents: he knew how they would react because he knew how the AI would force them to react.

Resolving the issue of non-adaptive, static, AI is not just science fiction, however. “A major disadvantage of non-adaptive game AI is that once a weakness is discovered, nothing stops the human player from exploiting the discovery” (Bakkes, Spronck, & van den Herik, 2009, p. 28). Bakkes, Spronck, and van den Herik proposed a concept known as *opponent modelling* as a framework for machine learning algorithms to develop “case-based adaptive game AI” (p. 28). Had the virtual game been blessed with such a dynamic, adaptive AI OPFOR, Ender may well have faced much tougher human opponents, as they would have been forced to adapt their own game to beat the computer.

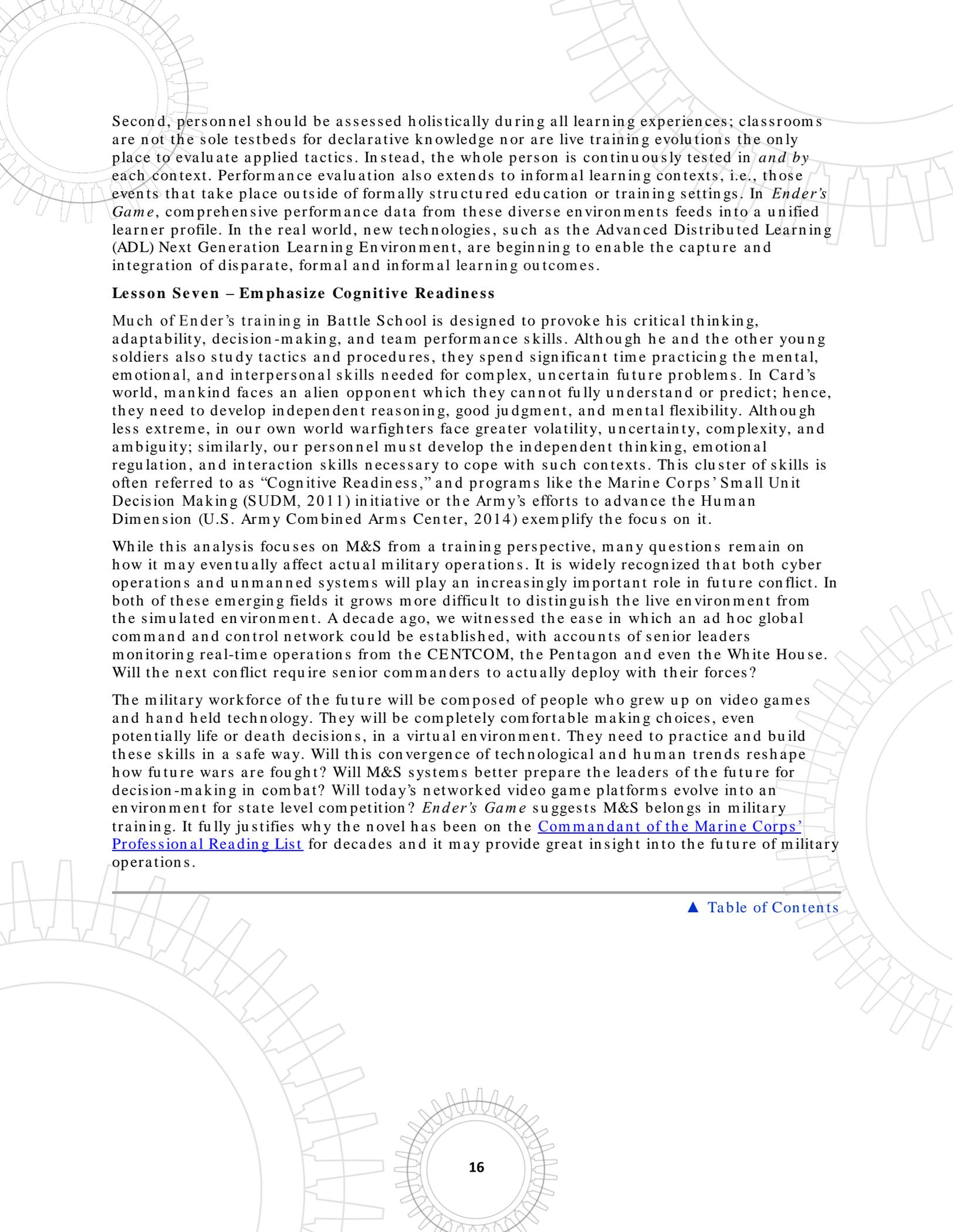
Lesson Five – There is no “One Size Fits All” Training

Anderson’s and Graff’s conversations, which begin each chapter, offer insight into how Ender is progressing through the Battle School. However, their conversation preceding chapter 4 is especially poignant. At the close of chapter 3, Ender has agreed to leave his family and attend Battle School. Anderson and Graff discuss his training regimen, and it is clear that Graff has a plan for how it is to be structured based on data collected from Ender’s observed behaviors and mental patterns. While we are not at the point of embedding technology to read thoughts directly into students’ brains, we do have the capability of gauging the level of knowledge of incoming students via online pre-testing. Knowledge of an incoming class’s strengths and weaknesses can then be used to tailor the courses (Pike & Hosni, 2004). As an example, assume Ender and his fellow “launchies” performed poorly on a pre-test on first aid fundamentals, but all pre-tested well in weapon familiarization. Their weapon familiarization class could be shorted, and the extra time allotted to first aid.

Lesson Six – Fully Blended Learning

In Anderson and Graff’s training regime, all of the separate learning elements inform one another. From the classroom environment, to the individual and collective simulations, and even the social interactions of the soldiers during their free time, in each instance, Ender’s behaviors are evaluated, and his performance influences his subsequent learning experiences. Although the Battle School’s assessment system borders on Orwellian, it highlights two principles which can reasonably apply to real warfighters today.

First, performance in one setting, such as a simulated training experience, should help inform future learning. Although straightforward, most contemporary training programs still treat each event as a stovepipe. At best, participants must complete pass/ fail “gates” to progress, but rarely do the specifics of their past performance directly inform the nature of later learning experiences.



Second, personnel should be assessed holistically during all learning experiences; classrooms are not the sole testbeds for declarative knowledge nor are live training evolutions the only place to evaluate applied tactics. Instead, the whole person is continuously tested in *and by* each context. Performance evaluation also extends to informal learning contexts, i.e., those events that take place outside of formally structured education or training settings. In *Ender's Game*, comprehensive performance data from these diverse environments feeds into a unified learner profile. In the real world, new technologies, such as the Advanced Distributed Learning (ADL) Next Generation Learning Environment, are beginning to enable the capture and integration of disparate, formal and informal learning outcomes.

Lesson Seven – Emphasize Cognitive Readiness

Much of Ender's training in Battle School is designed to provoke his critical thinking, adaptability, decision-making, and team performance skills. Although he and the other young soldiers also study tactics and procedures, they spend significant time practicing the mental, emotional, and interpersonal skills needed for complex, uncertain future problems. In Card's world, mankind faces an alien opponent which they cannot fully understand or predict; hence, they need to develop independent reasoning, good judgment, and mental flexibility. Although less extreme, in our own world warfighters face greater volatility, uncertainty, complexity, and ambiguity; similarly, our personnel must develop the independent thinking, emotional regulation, and interaction skills necessary to cope with such contexts. This cluster of skills is often referred to as "Cognitive Readiness," and programs like the Marine Corps' Small Unit Decision Making (SUDM, 2011) initiative or the Army's efforts to advance the Human Dimension (U.S. Army Combined Arms Center, 2014) exemplify the focus on it.

While this analysis focuses on M&S from a training perspective, many questions remain on how it may eventually affect actual military operations. It is widely recognized that both cyber operations and unmanned systems will play an increasingly important role in future conflict. In both of these emerging fields it grows more difficult to distinguish the live environment from the simulated environment. A decade ago, we witnessed the ease in which an ad hoc global command and control network could be established, with accounts of senior leaders monitoring real-time operations from the CENTCOM, the Pentagon and even the White House. Will the next conflict require senior commanders to actually deploy with their forces?

The military workforce of the future will be composed of people who grew up on video games and hand held technology. They will be completely comfortable making choices, even potentially life or death decisions, in a virtual environment. They need to practice and build these skills in a safe way. Will this convergence of technological and human trends reshape how future wars are fought? Will M&S systems better prepare the leaders of the future for decision-making in combat? Will today's networked video game platforms evolve into an environment for state level competition? *Ender's Game* suggests M&S belongs in military training. It fully justifies why the novel has been on the [Commandant of the Marine Corps' Professional Reading List](#) for decades and it may provide great insight into the future of military operations.

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Can “Sabermetrics” Replace the Officer FITREP?

By Robert Kozloski and Major Armando Martinez **

Major League Baseball is a data-rich environment providing a great example of how analytics can effectively assess and manage talent. As outlined in the book (later movie) Moneyball, the traditional role of the human talent scout, a so-called subject matter expert using highly personal judgment, is being replaced by a statistician who understands baseball. Furthermore, the increasing popularity of fantasy sports provides clear evidence of how analytics are permeating American society, a trend arising in many fields except military personnel systems.

Talent decisions in professional baseball were historically viewed through the eyes of an experienced observer, supported by standard scales of performance: Runs, Hits, and Runs - Batted-In (for hitters) or Wins, Strikeouts, and Earned Run Average (for pitchers). Because of the ease of data collection and analysis, more insightful measures of performance were created to make more informed personnel decisions.

Sabermetrics, named in honor of the Society for American Baseball Research, uses statistical analyses to evaluate, compare and forecast baseball talent. Early use of these non-traditional metrics started in the 1970s, but only became popular this past decade, largely due to advances in information sharing using better quantitative techniques. With more team owners—both real and fantasy—relying on analytics, the value of data-driven insight is readily apparent.

One example of how baseball statistics have evolved can be found in the new “Wins Above Replacement” (WAR) measurement. This method compares an individual player to a “replacement player,” who could be hired easily and (likely) at the league-minimum salary. WAR takes existing metrics and uses them in a complex algorithm to calculate the number of wins an individual player will bring a team, beyond the replacement’s value, by considering contributions on both offense and defense.

Sabermetrics brings objectivity to baseball management through a more robust statistical analysis. Managers can now make personnel decisions not only using the quality of a player, but by assessing how well one fits within the existing talent structure of a team. A team which plays in a hitter-friendly ballpark will target players differently than a team at home in a pitcher-friendly ballpark. A manager is now also more likely to consider the talent surrounding a player—their context within the team—than base a decision solely on the individual player’s skills independently.

Like Major League Baseball, the success of the US military depends upon best using the talent of our outstanding men and women in uniform. No baseball team would stand a chance on the field today if it didn’t incorporate advanced analytics into the clubhouse; the US military must recognize its shortfall in these tools and put data analytics into its game.



Officer Quantitative Rating Score

How the US military measures and uses officer talent is fundamentally broken, particularly in the Navy, where the majority of officers have [lost faith](#) in the current evaluation system. One of the main flaws with our antiquated approach is the over-emphasis on subjective assessments and a lack of clear measures. Such shortfalls could cripple the services, whose “talent scouts” (commanding officers) promote junior officer much like themselves. If the combat environment shifts too quickly, this approach will yield disaster. The naval services, therefore, can learn a great deal from Major League Baseball to resolve this problem.

The first step to creating a data-driven performance system is to define the characteristics desired from naval officers and then develop ways to measure performance. To illustrate the point, the following analysis will use physical fitness, cognitive skills, tactical proficiency and leadership as the variables to calculate the Officer Quantitative Rating Score (OQRS).

Physical Fitness: There are several ways to measure physical fitness. It can easily be appraised with a combination of body composition assessments and fitness tests results. There are other factors which could be used in this algorithm, such as age, sex and deployment time, which can help create a better fitness value. Commercial health monitoring technology, such as the ubiquitous Fitbit type monitor, will eventually be included in this measure.

Cognitive Skills: While cognitive skills may be difficult to quantify, there are a number of component factors which could be measured: standardized tests results, academic performance, professional publications, or practical problem solving tests. Once the data sources are defined, these measures could develop a base “cognitive rating” and officers would work towards improving their ratings over the course of a career.

Tactical Proficiency: This component must be customized for each designator, so that tactical proficiency in a warfighting community could be measured clearly at each skill level from novice to master practitioner. Specific training experience, deployment time and warfare qualifications can all be used to calculate this value.

This variable would also be used to choose between specialist or generalist career paths. Some officers have significant operational experience within their warfare community while others gain operational experience from joint duty assignments. Distinguishing between the two could inform selection decisions for a joint command or senior naval warfare community assignment.

Leadership: Measuring this component is likely the most difficult and contentious. In the past most leadership measures focused on personal accomplishments rather than actually leading teams or organizations. One way to gauge leadership is to establish clearly defined goals, measuring team performance. Beginning each reporting year, officers should be given a set of challenging but achievable goals commensurate with rank, billet and mission. The annual assessment would measure the extent to which goals were accomplished. Additionally, the results of 360 degree performance assessments, to assess leadership behavior, as well as command climate surveys, could feed into this calculation.

Further, types of billets or duty assignments could be categorized and factored into this value. In baseball, a pitcher for the Colorado Rockies is likely to have a higher earned run average than one from a pitcher-friendly home ballpark. This difference can be attributed to the higher altitude of the Rockies’ stadium in Denver, allowing more home runs. Each community manager knows some billets are more demanding than others, so an officer meeting her personal goals at a deployed or high tempo unit would stand out more than one in a less demanding role. Unit assessment reports such as the Defense Readiness Reporting System or Status of Resources and Training System could factor in to this value as well.

Once the OQRS score is calculated, it must be placed into meaningful context. The officer receiving the assessment must be provided the chance to note annual achievements or provide explanation why goals were not met. Similarly, the reporting senior should comment on promotion potential, preferably on a grade-inflation proof scale, and provide insight on the OQRS score for that particular year. Limited resources, for example, may have prevented an



officer from achieving a specific goal. Ideally, the OQRS would be used consistently over an entire career, similar to a lifetime batting average in baseball.

Rather than using this score simply for promotions, as is our current practice, the OQRS could help both the service member to achieve career goals while aiding the institution in managing the actual talent of the workforce, rather than simply putting “butts in seats”.

OQRS scores should be viewable by all officers, to take personnel evaluation ratings out of “the shadows” and make the entire process transparent. The secrecy and back-room deals surrounding the reporting of fitness are holdovers from a bygone era. Officers will know how they stack up against peers and in what areas they need improvement. Top performing officers would welcome such transparency and weaker officers will get the message to improve or get out.

With such data, Detailers, Monitors and command selection boards can make informed decisions about where people “best fit” for a particular position. Senior commanders, similar to a GM in baseball, could request a specific type of officer to fill the immediate organizational needs. For example, if they know a billet demands strong cognitive skills but less leadership, more weight could be assigned to the first variable to identify officers meeting this criterion.

Like professional baseball, the military personnel system is a data rich environment, yet we have failed to take advantage of our existing information and create a truly effective talent management system. Many may argue that expert judgment is the best way to manage our naval officers, simply out of tradition. However, we do not know how to measure the underutilization of officer talent, nor the number of capable people who exit military service each year because the full potential of officers often stays on the bench.

As an institution, we must admit the current system is not working; it can’t be used to build a World Series champion in this new environment. Worse, given the current threat environment we cannot afford to have a “rebuilding year” to resolve this issue. Changing our personnel patterns now may allow us to win our next war. We must explore new data-driven options to measure effectively and use the talent of our naval officers. The sabermetrics approach to talent management in baseball provides an excellent starting point.

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Building the Naval Innovation Network

By Ms. Jane Roberts **

INTRODUCTION

The Naval Innovation Network is a Department of the Navy-wide forum to connect innovators, thought leaders, subject matter experts, mid-level managers and senior leaders to champion, accelerate and promote innovation. Collectively, the group represents a wide range of disciplines, organizations and functional communities around the globe. Through greater collaboration, creativity, experimentation, “intra” preneurship, and diversity of thought, the Naval Innovation Network seeks to actively engage the tremendous untapped intellectual capacity and motivation of our talented workforce to tackling our most complex problems and improving our mission.

VISION

Tactically and practically, the Naval Innovation Network fosters greater social connections between organizations, people, and the innovation community of practice. It will do so by building virtual platforms as well as physical forums, where individuals and teams can share ideas and problems and let the network help. As the Network expands, people will be able to collaborate with others on ideas, brainstorm viable solutions to important problems, try out new technologies and experiment in creative spaces on a much larger scope and scale than ever before. To create an agile and resilient 21st century workforce ready for an increasingly challenging and uncertain future, the Network seeks to complete four major tasks over the next 2 years: crowdsource the DON, incentivize innovation, support innovators locally, and create an environment that institutionalizes innovation.

CROWDSOURCE THE DON

With a workforce of 900,000 Marines, Sailors and civilians in the Department, we have a tremendous opportunity to unleash and unlock the creative talent and energy of a diverse, multi-generational workforce to solve our most difficult challenges. In order to tap into this potential more fully, a DON-level virtual platform called “the Hatch” recently stood up, allowing military and civilians anywhere around the world, on ship and ashore, to leverage their knowledge and skills to build on ideas and solve problems. The Hatch has the ability for individuals, organizations and communities to develop their own “campaigns” to solve vexing problems or get new ideas on untapped areas. Some examples of past and current public campaigns are: Artificial Intelligence/ Robotics, Virtual and Simulated Environments, Open Ideas Forum, Incentives, New Issues 2015 for Reducing Administrative Distractions, and Navy Reserve Policy. There have also been several private campaigns to focus on specific topics for a particular ship or community. Getting feedback from large crowds through crowdsourcing is a relatively fast and easy way to get to the best or most interesting ideas on a wide range of topics. By dramatically increasing the visibility and scalability of concept discussions and proposals, many more people (100x, 1000x, 100,000x) can vote and provide comments to improve an idea. There is tremendous potential in crowdsourcing the DON whether through “the Hatch” sponsored at the Department level, through “Navy Brightwork” to support deckplate innovation sponsored by Naval Warfare Development Command, or through other creative ideation venues available to the Department.

INCENTIVIZE INNOVATION

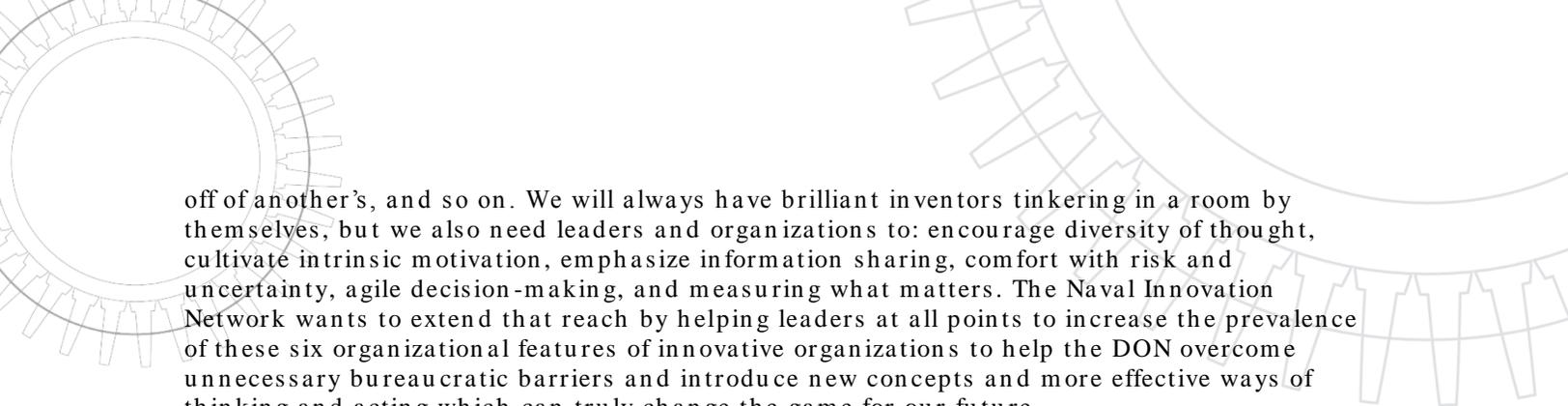
Innovation is not only about creative ideas; it's also doing new things and realizing the benefits from their implementation. The Department is currently developing ways to incentivize even more innovation through annual awards, revamping the current MILCAP/ BENESUGS program, and incorporating non-traditional ways to reward and recognize innovators. First, an ALNAV has just been released to announce the SECNAV's annual Innovation Awards program for 2015. Nomination forms are currently being accepted from now through 31 October for significant innovative achievements in eight distinct categories. Second, work has started on revamping the current MILCAP/ BENESUGS program, including ways to eliminate extraneous administrative layers and accelerate the monetary award process for mature ideas. Third, a group of folks are looking at non-traditional ways to reward and recognize innovators especially designed to appeal to Generation Y and Millennials. Some of the non-monetary awards being considered include: public recognition, training opportunities and education on innovation, additional time and space to develop ideas further, unique access to leaders and subject matter experts to discuss and refine their ideas, and special-access events for innovators. These are just a few of many ideas being discussed.

SUPPORT INNOVATORS LOCALLY

Innovation is robust at the grass-roots level and grows as individuals find other open and creative minds to stimulate a dynamic force for change. The Navy's Athena Project is a prime example of motivated, locally driven innovation which has proven so successful that it has naturally caught on in other places. The idea of "Shark Tank"-like 5-minute pitches to "angel investors" allows participants to generate out-of-the-box possibilities in a fun, friendly, yet competitive atmosphere. The concept of design thinking and accelerator classes to teach a variety of methods for tapping into different ways of problem solving is catching hold in many communities including the Intel community, the CNO's Rapid Innovation Cell (CRIC), and Johns Hopkins Applied Physics Lab (APL). A more formal and deliberate approach to supporting local innovation is the growing trend of identifying and assigning specific points of contact, such as science advisors or lead engineers, to be "Innovation Officers" at local commands. Recently, one Echelon 2 organization stood up a new innovation cell with points of contact at its Echelon 3 commands to bring new ideas forward from that community. A more 21st century technological tool to supporting innovators locally is the concept of the Fab Lab. The Fab Lab is much like a hobby shop for 3-D printing which allows people to design and produce their own 3-D models of objects. Experimentation and prototyping is an important tactic for innovation because it effectively tests a design and incorporates faster, iterative changes to deliver a completed product. If the product needs to be manufactured using different materials, 3-D modeling results in higher quality requirements specifications for a design. As more Fab Labs become available around the country, whether through partnering with local community colleges, military community services, or on ships and in fleet concentration areas, this will be yet another way to support innovators locally. Office of Naval Research also hosts a web-based tool to bring technology needs to the Naval Research Enterprise for rapid response and delivery through a science and technology program called TechSolutions.

CREATE AN ENVIRONMENT THAT INSTITUTIONALIZES INNOVATION

Last, and most importantly, proactive and responsive leadership actions at all levels is absolutely essential to supporting and reinforcing a culture of innovation within your span of influence. Whether you personally consider yourself an innovator or not, you play a vital role in influencing innovation and helping it to develop and grow. While there is definitely a time and place for being effective and efficient, there are also times and places where championing a good idea, giving people time to think, experiment, and test out a new approach, and educating others on how to navigate through a process can yield far greater learning and overall improvement to the larger Naval mission and long-term vision. As the world becomes more complicated and interconnected, success will not always easily be determined by just one person's idea or action, but by the adjacent and collective learning of one person's idea building



off of another's, and so on. We will always have brilliant inventors tinkering in a room by themselves, but we also need leaders and organizations to: encourage diversity of thought, cultivate intrinsic motivation, emphasize information sharing, comfort with risk and uncertainty, agile decision-making, and measuring what matters. The Naval Innovation Network wants to extend that reach by helping leaders at all points to increase the prevalence of these six organizational features of innovative organizations to help the DON overcome unnecessary bureaucratic barriers and introduce new concepts and more effective ways of thinking and acting which can truly change the game for our future.

CONCLUSION

As we enter into the autumn, members of the Naval Innovation Network will be hosting local events and virtual forums and visiting major fleet concentration areas to get the word out and offer additional opportunities for getting involved. We invite you to be a part of our innovation future.

For more information about the Naval Innovation Network, participate in the Hatch, or to find people in your community of interest or local geographical area, contact:
DON_Innovation@navy.mil

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How Can the Department of the Navy Cultivate More Women Innovators?

By Maura Sullivan, Ph.D. **

Coming from the private sector I was struck by the conspicuous lack of female voices participating in SECNAV's Taskforce Innovation (TFI). Women currently constitute less than 10% of The Hatch innovation crowdsourcing community and innovation organizations like the CNO's Rapid Innovation Cell (CRIC) have been overwhelmingly male. The women involved in TFI have provided a disproportionately large contribution in terms of content, commitment, and ability to catalyze larger networks, highlighting the need to cultivate more women innovators. The value of women innovators has been demonstrated in the private sector, where according to a Kauffman Foundation report women technology entrepreneurs achieve a 35 percent better return on investment than male counterparts.

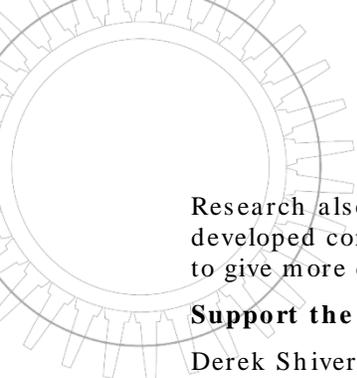
Both in the private sector and the military women have worked to be recognized for their skillsets alone, often by attempting to remove gender from the equation. The Department of the Navy (DON) diversity agenda has largely focused on eliminating differences in perception and opportunity between the genders, such as opening all operation billets and gender-neutral uniforms. The DON may have moved beyond the active intent to exclude or discriminate, but cultural norms still prevent women from fully contributing to activities that take them off the prescribed path.

Scarce numbers increase visibility and scrutiny, and humans are less likely to try things when there is a potential of being threatened. As Sheryl Sandberg and Adam Grant pointed out in a Jan 2015 New York Times op-ed, when male executives speak up, they receive 10% higher competence ratings; when female executives do the same, their ratings from their peers are 14% lower. In male dominated fields men and women are held to a different standard when it comes to proving initial competence. Men are assumed competent at the core functions until proven otherwise, whereas women are forced to spend time proving core competence prior to being allowed to push boundaries. One private sector manifestation of this is the fact that women are often excluded from positions on technology boards because they lack STEM backgrounds, however a significant proportion of the male board members of technology companies also lack STEM backgrounds, but are assumed to be competent.

Innovation requires the ability to question norms, synthesize different views, and collaborate to develop unique and powerful solutions. Diversity is the DNA of innovation, but the current DON focus on diversity is simply about bringing women to the table, not providing the environment to ensure they are included in the conversation. Inclusion is about ensuring diverse voices are heard, recognized, and rewarded. Below are three suggestions for more fully incorporating women innovators throughout the DON.

Create space:

An often cited Hewlett-Packard internal report found men apply for jobs when they meet only 60% of the qualifications, but women will not apply until they meet 100% of them. The fact that women make up less than 1% of writers at the Naval Institute Blog is likely an artifact of this fact. Women are less likely to present ideas in progress in a male dominated environment. Encouraging women to innovate requires creating safe space to develop ideas and experiment. Additionally, creating a sense of community where women can talk openly and take risks without being judged prematurely is critical. Women specific initiatives, such as discussion groups and women in writing week, can create the sense of community and the critical mass necessary to push women innovators into taking risk.



Research also shows that when women come to the table the ideas are more likely to be more developed comprehensive solutions. Innovation programs need to ensure they are not primed to give more consideration to ideas that are brought to the table first.

Support the First Followers:

Derek Shivers gave a TED talk on how the first followers are critical to starting a movement and transforming a lone nut into a leader. In a hierarchical organization followers are generally those that have less authority and influence than their superiors. They may try and get along to preserve career or simply because it is the path of least resistance. Leadership in the innovation space is being the lone nut, a place women are often uncomfortable in that role due to the reasons discussed in this blog post. Good followers are the key to driving innovation. They empower people, remove obstacles, and catalyze implementation. They support good leaders and are willing to actively oppose bad leadership. Valuing, actively encouraging, and rewarding first followers are critical to the success of any innovation agenda and give those outside of the cultural majority a place to engage, refine ideas, and if desired step into leadership positions.

Maximize Strengths:

As an organization the DON spends a significant amount of the manpower effort getting the workforce to a minimum acceptable standard. This was critical in an industrial era military when force structures were optimized for homogeneity and interchangeability. However, research suggests that the most successful individuals capitalize on their innate dominant talents and develop those strengths by adding skills and knowledge. Rethinking who and how people come together to collaborate and solve problems is critical to avoiding group-think, a condition which has created past national security failures. Innovation requires intentionally cultivating views that are outside the cultural norms.

In order to be an innovative organization, the DON needs to embrace the fact that individuals have different strengths and weaknesses and that a model based on interchangeability is not tenable in today's world. There are biological distinctions between the genders, it is a fact, and not something organizational conversation should shy away from. Scientific breakthroughs occur in teams with more women because of increased creativity and fresh approaches and according to research published in Science increasing the collective social sensitivity by adding women increased the collective intelligence of teams. Creating a culture that values individuals and emphasizes organizational constructs that maximize cognitive diversity will allow the DON to maximize the innovative potential of its workforce irrespective of gender.

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Hybrid Warfare and its Implications

**By Robert A. Newson, CAPT USN,
Council on Foreign Relations Military Fellow ****

Clausewitz said, “Every age has its own kind of war, its own limiting conditions, and its own peculiar preconceptions.” Today we face conflict that is hybrid in nature, incremental in execution and savagely violent. The lethality and sophistication of non-state actors, added to their ability to persist within and challenge the modern state is novel to our time. The rise of non-state actors, information technology, and proliferation of advanced weapons gives rise to modern hybrid war, which in the future may challenge us at home. The United States requires, but does not have, a credible strategic-level ability to (1) address incremental, persistent belligerence and (2) interdict and roll back external sponsors of insurgent and separatist movements.

The Growing Threat of Hybrid Warfare

Hybrid warfare has been defined as combining conventional, irregular, and asymmetric means, including persistent manipulation of political and ideological conflict, and can combine special operations and conventional military forces; intelligence agents; political provocateurs; media manipulation and information warfare; economic intimidation; cyber-attacks; use of proxies and surrogates, para-militaries, terrorist, and criminal elements. Wars traditionally have regular and irregular components – this is not new. However, these components previously applied in different areas of operation, as distinct efforts. Modern hybrid warfare combines them simultaneously within a single domain. This vastly increases the complexity and disorder of the conflict and requires an adaptable and versatile whole of society approach – military, whole of government, and non-governmental.

Hybrid warfare places a premium on unconventional warfare (UW)—defined as activities conducted to enable a resistance movement to coerce, disrupt, or overthrow a government. External sponsorship often provides motivation, resources, and support to destabilize international and regional security. Some examples of this strategy include the Russo-Georgian war of August 2008, Russia’s current activities in Ukraine and potential future moves in the Baltics, as well as Iran’s use of surrogates like Hezbollah in Syria and Shiite militias in Iraq. Accordingly, developing a United States capacity for counter-UW is absolutely necessary.

What’s Different About Counter-Unconventional Warfare?

Counter-UW is distinct from counter terrorism (CT) and counter insurgency (COIN). CT operations are short-term, time-sensitive and intelligence-driven, with immediately visible results; i.e., has the kill or capture been achieved or not? Counter-UW, by contrast, is protracted and proactive. The results are expressed in negative terms: what areas do insurgents not control? What opportunities have been denied to them, and what objective has the enemy failed to achieve? Meanwhile, COIN operations contain and defeat an insurgency while simultaneously addressing its root cause. As a result, COIN tends to need a large footprint and high U.S. signature. Future counter-UW, on the other hand, is executed by a smaller force, more narrowly scoped. It has a small footprint, a low signature, and specifically denies an adversary the ability to use surrogates for strategic success. Building upon the lessons from more than a decade of CT and COIN, U.S. special operations forces (SOF) can use this capability to deny adversaries the capacity to employ unconventional warfare for their goals. A combination of Special Operations capabilities is needed: military information support operations (formerly psychological operations); civil affairs; Special Forces (Green Berets),

The page features a background of several large, light-colored gears of varying sizes, some partially visible at the edges. The gears are rendered in a simple line-art style.

Marine Special Operators and SEALs; robust and scalable command and control capacity; and a growing “reach-back” capability in all areas to support operations from the U.S.

More Than Special Operations Forces

While SOF will have the primary counter-UW role within a whole of government effort, hybrid warfare and counter-UW have implications beyond them. China’s pursuit of unrestricted warfare has not yet included surrogates or para-military forces—unless you count the intimidating use of the Chinese Coast Guard—but their UW capabilities should not be discounted. The U.S. should expect more than a conventional fight in any future conflict with Russia, China, Korea, Iran, or Syria. Hybrid warfare, seen now in regional conflicts, will be turned against the U.S. and our military forces. Counter-UW should be in joint and service exercises, as well as operational and contingency plans. Additionally, the military services should explore how to integrate a SOF counter-UW campaign within their broader operations.

Implications

Responding to Gradualism. Global actors have found some success by incrementally—over time—increasing influence over sovereign territory, international waters, or creating prohibited capabilities. Such a strategy achieves strategic goals bit-by-bit while stopping just short of drawing a military response. Responding to gradualism requires presence and commitment as a deterrent tripwire; non-lethal weapons to avoid escalation and miscalculation inherent in lethal action; an aggressive and realistic counter-narrative and information operations campaign, and an ability and methods to de-escalate at every step. In future, this must be integrated holistically.

An Uncertain Path Ahead

Counter-UW requires a whole-of-government approach and a comprehensive, integrated pursuit of political warfare, including economic sanctions, diplomacy, use of surrogates, military and law enforcement support for partner nations, and strategic communication and information operations. The U.S. has not displayed a strategic whole-of-government capacity beyond CT, counter- and counter-proliferation tactical operations run by joint interagency task forces. A considerable effort and strong leadership will be required to create this capacity for the future. This task is so great it may take congressional action to create a national counter-UW capability. Much depends upon national leaders committing to protracted counter-UW operations in sensitive, hostile, and denied environments. Counter-UW requires early and long-term investment. Timely decisions, before a crisis, are needed, a real problem. Since the end of the Cold War the U.S. has rarely invested in developing such long-lead options. To secure the future, it should start now, preparing counter-UW capabilities in Eastern Europe and the Baltics to counter any Russian use of hybrid warfare. It is all too easy for institutional forces to argue counter-UW activities and their preparations will be destabilizing, escalatory, or uncontrollable due to the central role of surrogates. Regardless of the downsides of counter-UW, the alternative—giving adversaries strategic advantage through unopposed use of surrogates and proxies—will always be worse.

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Innovation in Action - Adaptive Force Packages

By Nicholas Malay, NSWC Carderock Division Public Affairs

The Stiletto Maritime Demonstration Program conducted a Capability Demonstration April 13-24, in support of the Chief of Naval Operations (CNO) to assess new concepts for command and control and multi-sensor fusion technologies for small vessels. The demonstration was executed through a partnership with the CNO's Rapid Innovation Cell (CRIC) off the Virginia coast near Joint Expeditionary Base Little Creek-Fort Story, in Virginia Beach, Virginia.

During the two-week demonstration, system developers from private industry assembled their components into rapidly reconfigurable mission packages to perform maritime command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) missions aboard the Stiletto in a realistic maritime environment. The Stiletto program is a maritime demonstration platform that serves as a prototype demonstration tool for industry, government laboratories and academic institutions.

The Stiletto Maritime Demonstration Program is sponsored by the Rapid Reaction Technology Office in the Deputy Assistant Secretary of Defense for Emerging Capability & Prototyping to rapidly evaluate and mature emerging technologies in a realistic maritime environment. Engineers and technicians with specialized expertise in maritime technology from Naval Surface Warfare Center, Carderock Division's (NSWCCD) Norfolk detachment maintain the craft and operate the program.

Stiletto personnel partnered with the CRIC and coordinated with Navy Expeditionary Combat Command (NECC) to create the Adaptive Force Package Littoral Operations Center (AFP LOC), a configuration of maritime rapidly reconfigurable C4ISR mission packages to perform joint and coalition maritime operations.

AFP LOC provides command and control and multi-source sensor fusion for small vessels and auxiliary maritime platforms that typically do not have these organic capabilities on board. Adaptive force packages are essentially the personnel and their associated analytical equipment, which can be tailored to meet the specific needs of a given mission.

AFP LOC has three primary components: infrastructure (e.g., antenna cabling, patch panels and power); backbone (e.g., computer systems, navigation, radar and weapon systems); and sensor packages – which are mission specific and may be hardware or software based. All systems are modular and able to be carried on and set up on the AFP LOC infrastructure in less than 24 hours.

However, vessels typically do not have AFP LOC organic capabilities on board. According to Rob Tutton, NSWCCD engineer and manager of the Stiletto Maritime Demonstration Program, "The electrical and security infrastructure must be built into the vessel in advance, which requires time and funding, but once the infrastructure is installed and approved, then the AFP LOC allows for easy installation and removal with minimal impact to the vessel's normal operations," said Tutton. "I believe this is the true genius behind the AFP LOC that will provide savings and increased capability for the Navy that aligns with the CNO's 'Payloads Over Platforms' concept."

The CRIC's AFP LOC Capability Demonstration coincides with the Secretary of the Navy's establishment of Task Force Innovation (TFI) priorities to ensure emerging operational capabilities, such as adaptive force packages, have a clear and expedient path to the fleet. The task force includes subject matter experts who have been charged with developing a comprehensive innovation agenda for the Navy and Marine Corps.

The objectives were to demonstrate the ability to set up a rapidly reconfigurable operations center on a large surface craft capable of relaying information from other surface and air platforms and demonstrate the ability to communicate and transfer data with a land-based tactical operations center via line of sight radio and satellite networks.

“The C4ISR systems the Navy currently fields onboard ships are expensive, slow to upgrade and install, and nearly impossible to reconfigure for a change in mission,” CRIC Project Lead Lt. Jason Knudson said. “As a result, we only field full C4ISR systems on our carriers, destroyers, amphibious ships and cruisers. We asked the question, ‘How might we make C4ISR mission packages rapidly reconfigurable?’ We are determined to break out of the old model and take advantage of new technologies and platforms of opportunity.”

The program also provided the 25 participating industry partners an opportunity to receive immediate end-user feedback toward increasing technology readiness levels and access to direct operator input.

The Capability Demonstration was unique in that each vendor signed a Cooperative Research and Development Agreement (CRADA) with Carderock Division specifically developed for the Stiletto Maritime Demonstration Program. The Capability Demonstration's requirements led Dr. Joseph Teter, NSWCCD director of technology transfer and Deputy Director Alyssa Littlestone, to develop and execute a new type of limited-purpose CRADA allowing private industry to bring their technology and expertise onto the at-sea demonstration platform. Each agreement facilitates the exchange of the data collected between the Navy and the company. Since this is not a traditional acquisition process, these official agreements were necessary to allow the government and private companies to work together on research and design.

“The vendors were encouraged to work with other vendors to rapidly integrate their individual technologies into a system of systems to overcome capability gaps,” said Tutton.

“At this time, we are forced to take our assets with capability and push them to where we need access. Often, this involves taking a multi-billion dollar investment off station when other platforms are available, but may not have the capability,” Knudson said. “We are saying push out the capability, not the platform. Make it man-portable. Make your platforms plug-and-play ready. By doing this, we can make the CNO’s concept of ‘Payloads Over Platforms’ a reality.”

With Navy Expeditionary Combatant Command and Navy Expeditionary Intelligence Command’s expertise in expeditionary operations, Knudson said he hopes to see NECC and NEIC, among others, operating AFP LOC missions in theater by the end of the year.

Two scenarios were conducted daily to demonstrate how the AFP LOC will help optimize command and control capabilities: a high-value target interdiction scenario and a humanitarian assistance disaster relief scenario. To test rapid reconfigurability, the AFP LOC shifted between these drastically different mission sets within an hour.

In addition to the Stiletto vessel, there was an 11-meter rigid-hulled inflatable boat and other Carderock-owned assets, such as jet skis, that were used as needed depending on the requirements of the demonstration.

“For this demonstration, the CRIC was assessing adaptive force packages while our smaller craft simulated small boat threats, CRIC and Stiletto personnel along with systems developers tracked items of interest from the Stiletto’s Command Information Center,” Tutton said.

The next Stiletto Maritime Demonstration will be in fall 2015.

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Fighting in the Open: The Impact of Ubiquitous Sensors on the Future Maritime Battlespace

By CAPT John Litherland, USN (ret) **

From time immemorial, military forces have concealed their positions and movements from their opponents. Ground forces use terrain, weather, darkness and camouflage; maritime forces, out of sight of land, essentially vanish into the vastness of the ocean space, particularly its depths for undersea forces; and air forces have assiduously developed and deployed a variety of stealth technologies to conceal themselves from adversary sensors. However, the coming Age of the Sensors will largely negate these efforts across virtually every battlespace domain, leaving forces fighting in the equivalent of an open battlefield, in full view. This impending revolution, clearly evident in technology trends, will tilt the finder-hider balance irrevocably in favor of the former, profoundly changing the nature and methods of warfare in ways that the military has yet to even acknowledge or begin to prepare for.

This ubiquitous sensing revolution promises enhanced awareness of physical, social, and cyber environments by combining three technological trends: the proliferation of ever cheaper and more capable sensors into virtually every device and context, large data aggregation and ready access to it using vast cloud-based archives, and cross-spectral data fusion and sense-making algorithms running on ever more powerful processors. All of these trends are accelerating, most at exponential rates. For instance:

- The worldwide total number of sensors has increased by more than three orders of magnitude in the past decade and will soon pass the one trillion mark, or more than 100 sensors for every person on earth. As we move from a “sensor-poor” to a “sensor-rich” world, the individual nodes can become simpler and cheaper, relying on proximity and processing instead of the high gain and selectivity built into today’s exquisite but expensive sensors.
- Sensing capabilities have improved immensely in terms of both cost and performance due to the mass production of electronics. A complete inertial, electronic and satellite navigation system, which would have represented the epitome of military technology a few decades ago, today counts as just one of many sensors, costing only a few dollars’ value in every smartphone, more than 2 billion of which have been manufactured worldwide.
- The worldwide digital data generation rate now exceeds 1 ZB (10^{21} bytes) per year and global storage exceeds 10 ZB, both also having grown by nearly three orders of magnitude in the past decade. Moreover, this data is increasingly accessible due to cloud storage and the communications infrastructure of the Internet.
- The ability to fuse and make sense of unstructured data from disparate sensors and incommensurable formats is only beginning to appear, aided by ongoing growth in computer processing capability and powerful new data reduction algorithms.

At the same time, virtually every military stealth and signature reduction capability being used or developed today, whether in radio-frequency, visible, infrared, or acoustic spectra, appears to be asymptotically approaching some limit or constrained return on further research or investment. Typical signature reductions in these areas over the past decade are less than an order of magnitude, with little outlook for future breakthroughs. Moreover, costs both to develop and maintain these stealth capabilities are extremely high due to their limited applications and exotic materials. Finally, the effects of almost all low-observable technologies are limited to just a small portion of a specific spectrum, or to a limited target aspect, rendering them nearly useless against a sensor threat which is increasingly broadband, multi-spectral, and spatially dispersed.

Obviously the above are global trends, not specific to military technology or scenarios, but their implications are nonetheless clear. No military force operates without creating signature across several spectra, and this information will be increasingly susceptible to gathering by ubiquitous sensors, correlated with other data, and processed into meaningful locating information. Maritime forces, long reliant on the effective cover provided by the oceans' vastness, will inevitably become "visible" from a shore no longer limited by its line of sight. Even undersea forces, operating from what is likely the last bastion of concealment beneath the waves, will eventually succumb to the avalanche of sensors and processing, yielding their much valued stealth.

Surprisingly, given the strength and persistence of these technological trends, little has been done to prepare our maritime forces for the coming fight in the open, newly-visible battlespace. Instead, resources are poured into ever-more exquisite active defenses and limited-return stealth technologies, neither of which will ever restore the tactical security enjoyed when the seas provided natural cover. Unfortunately, like the Emperor in his new clothes, we will likely be surprised to find our nakedness suddenly revealed in the face of our adversaries during some future maritime conflict. Open field fights, where both sides have knowledge of their adversary's location, have historically become symmetrical and bloody slugfests, not our preferred means of fighting nor one which we could sustain for long. In addition, open seas' visibility increasingly offers the adversary the option to wage maritime war from the land, where the inherent asymmetry of unsinkable ground against sinkable ships comes into play. Admiral Nelson's dictum, that "a ship's a fool to fight a fort," remains true even though he never envisioned a "fort" with thousand-mile visibility.

Despite this bleak outlook, the U.S. Navy can take actions to better prepare for and preserve its capabilities for any coming fight. Locating an adversary is but part of the fight; to know one's enemy, one must also be able ascertain his intentions. Maritime forces can deny an adversary this ability by focusing on the following critical concepts:

- **Dispersal** - rather than aggregating in large force elements which are easily tracked and whose intentions can be discerned by location, maritime forces must disperse over as much of the maritime battlespace as possible.
- **Deception** - instead of concealment, future naval forces must focus on targeting the adversary's sensor complex with noise, false targets, and cyber-attacks, across multiple spectra.
- **Range** - when dispersed, maritime forces must be able to create effects at far greater ranges than typical of today's weapons, allowing massing of effects without massing of platforms (a key network-centric warfare concept which the Navy is still struggling to achieve).
- **Speed** - together with range, the speed of both kinetic and non-kinetic effects will be critical to creating tactical surprise for the adversary, even when striking from a known position.

Unless the Navy prepares now to fight in the coming Age of Sensors, it risks becoming as vulnerable, even obsolescent, as the galleys at Lepanto or the battleships at Pearl Harbor were. By taking the steps outlined above, it will remain in the forefront of the globe's maritime forces.

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The Utility of Non-Lethal Force

By Robert Kozloski **

The pre-industrial-age view of military force is captured succinctly in a recent quote by defense scholar Dr. Richard Betts. According to Betts, military force is, “killing people and destroying things for some political purpose”. Unfortunately his simplistic view is shared by many in the Pentagon.

This dated view does not take into consideration many emerging military fields, such as information operations, non-lethal weapons, and directed energy weapons, all of which have the potential to achieve military effects without crossing the lethal threshold. These emerging capabilities should force defense scholars to revisit their view of how a modern military can achieve political outcomes.

Since the end of the Cold War, the United States has attained mixed results using the traditional instruments of national power to achieve policy goals. Because of changes in the geopolitical environment and America’s domestic problems, their application may be even less effective in the future. Innovative thinkers within the defense community must recognize that historic military approaches to exerting national power may not be well suited for the future.

In a recent speech at the Directed Energy Summit, Secretary of the Navy, Ray Mabus, hinted at new vision of military force:

“Directed energy can go beyond its envisioned role as an offensive and defensive tactical tool, and it can become a truly global deterrent. If we do this right, our fleet will employ 300- to 500-kilowatt lasers against over-the-horizon threats. We’ll use railguns. We’ll be able to strike at targets more than 100 miles away. And we will defend our people and our platforms with nonlethal things like high-powered radio frequency systems in every domain.”

This concept of using non-lethal force to accomplish political goals is central to understanding the battle space of the future, where high-casualty rates may be deemed unacceptable in the global court of public opinion. The growing aversion to casualties during interstate conflicts must be a consideration for our defense planners.

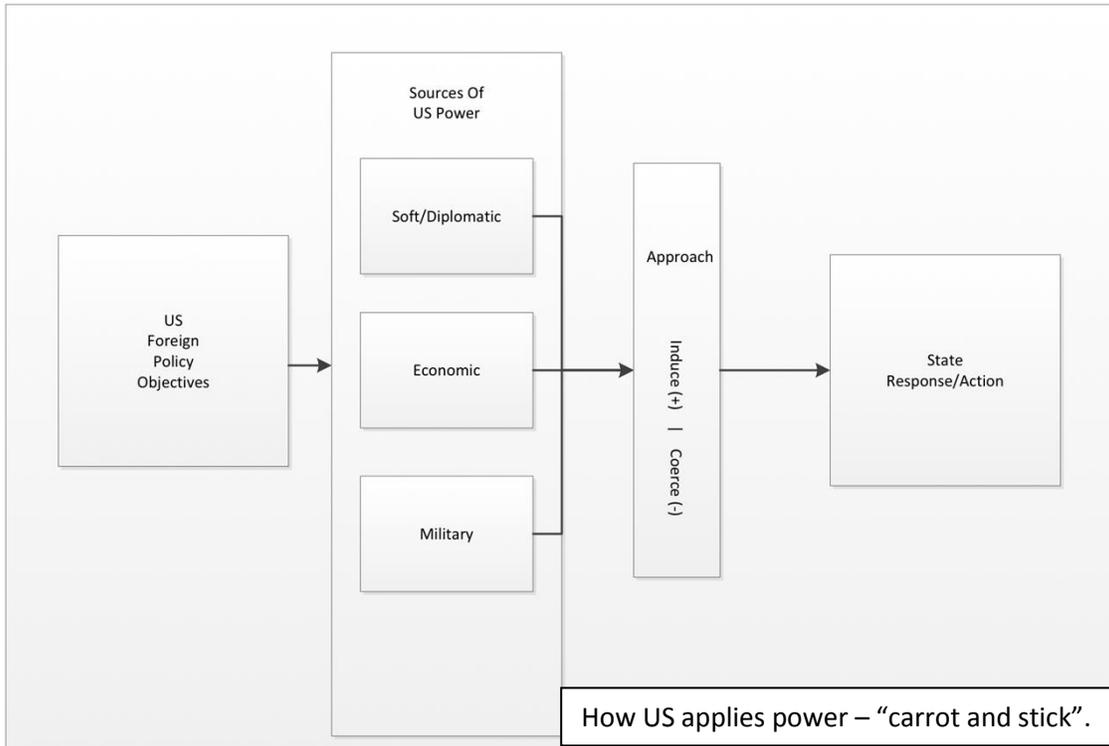
During World War II hardly any Americans objected to the incineration of hundreds of thousands of Japanese civilians, and throughout the Cold War few objected to the principle of killing on a wider scale in retaliation for a Soviet attack. Today, post-Cold War norms and Pentagon lawyers have put those ideas out of bounds and that type of thinking is no longer deemed legitimate.

By the end of the Cold War, most realized the power derived from nuclear weapons had proved so awesome and destructive that their actual application became muscle-bound. Increased lethality and proliferation of technology may result in a similar dilemma for conventional weapons. In the future, the total cost of full-scale war among great power states may be so destructive that conventional military force will become taboo as well. State-level confrontations will have to be resolved through other means.

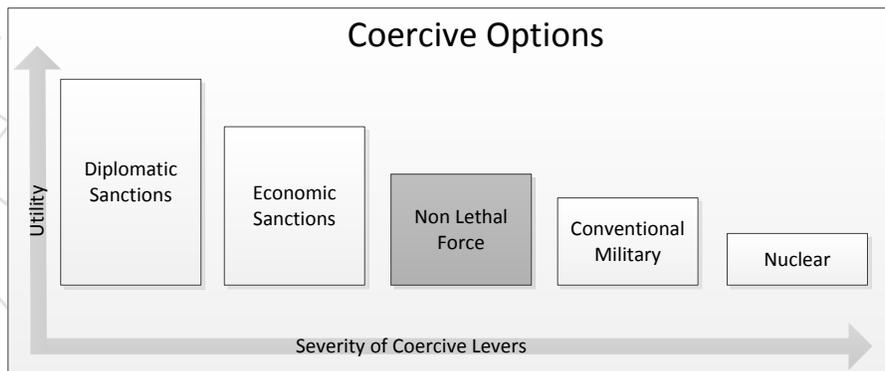
In the geopolitical environment state-level competition over the control of limited resources will not go away. Therefore nations will have to develop new ways to resolve international conflicts. This concept doesn’t appear to be lost on other nations such as, Russia and China, both of whom have advanced modern military concepts designed to avoid military-to-military confrontation. But such thinking is slow to gain support within the United States Military. As

renowned military strategist Colin S. Gray remarked, during irregular conflicts in the future the U.S. armed forces “will need to curb their traditional, indeed cultural, love affair with firepower.”

To understand how nonlethal force could be used on the future battlefield, one must first recognize how the US uses power and influence to achieve political objectives. Briefly, it is done through a traditional carrot and stick model to either induce (carrot) or coerce (stick) a state to take a desired action that produces an outcome favorable to US political interests.



Traditionally, the US military has played an important role in achieving political objectives. However, some experts suggest the United States must rethink its traditional approaches to how it pursues its foreign policy objectives. As Schmidt and Cohen note, “Democratic governments will most likely be tempted to further their national interests through the same combination of defense, diplomacy, and development on which they relied during the Cold War and the decades after. But these traditional tools will not be enough: although it remains uncertain exactly how the spread of technology will change governance, it is clear that old solutions will not work in this new era. The application of non-lethal force will provide new and broader options in the future.



Non-lethal force could be used in a variety of coercion scenarios to deny critical information and resources, to disrupt markets and exchanges, and to disable critical infrastructure. In the future, non-lethal force will provide national leaders other options when coercive action is needed. Options under the lethal threshold will be important to prevent escalation into a full-blown kinetic war.

It is important to consider the full potential of weapon systems of the future and not the current state of technology. As scientists have noted, there is a great deal of trade space between our current engineering practices and the limits of physical laws. The following examples describe how non-lethal force could be applied as a coercive instrument in the future maritime environment.

Electromagnetic blockade. In April 2007, a series of cyber-attacks were conducted against Estonian government websites, media websites, and online banking services. The attacks came the day after a Soviet-era war memorial was removed from the Estonian capital, Tallinn. The attacks continued intermittently for ten days and primarily focused on the financial industry. Ninety-four percent of all financial transactions in Estonia occur online and were crippled during these attacks. The national economy virtually came to a standstill. Similarly, in April 2010, Internet traffic from U.S. federal agencies was unknowingly rerouted to servers in China. Information from the U.S. Senate, all four military services, the Secretary of Defense, and other federal agencies was affected. It can be assumed the United States has similar capabilities to deny communications as well; how and when to apply this form of non-lethal force must be fully considered in national policy debates.

Offshore control enforcement. One strategy currently being discussed for the unwelcome scenario of a military conflict with China is offshore control. At the heart of this strategy is the ability to intercept and divert the supertankers and post-Panamax containers essential to China's economy. Disrupting navigation systems, disabling computers or control systems, or even incapacitating the ship's crew could provide viable options below the use of conventional military force.

Conflict termination. If military tension at sea escalates, the United States may be faced with intervening in small-scale naval skirmishes in support of critical allies. Ship-mounted non-lethal capabilities could be used to terminate or suppress an incident by disabling weapons or communications systems of one or both belligerents. In future state-level conflicts, maintaining regional stability may replace the traditional notion of winning. By reducing casualties by whatever means possible, adversaries may be more acceptable to terms of termination of conflict while minimizing resistance and animosity that destabilizes the situation.

Wide-area denial. Several small sparsely populated islands in the Pacific could be the impetus for military conflict in the future. Most notably the Spratly Island chain and Senkakus are of primary concern. Should these become the object of military occupation, non-lethal force could be used to temporarily prevent occupation or incapacitate the occupiers of the disputed territory.

Despite being a dominant power for the past several decades, the United States has achieved mixed results in attaining political goals through the use of national power. In the future, the traditional instruments of power may prove even less effective for a variety of internal and external factors. The growing aversion to human casualties and the increased lethality of conventional weapon systems may result in strategic paralysis and limit military options available to U.S. policy makers. Emerging non-lethal capabilities in the form of information operations, non-lethal weapons, and directed-energy weapons offer great potential. Non-lethal force will fill a critical gap between sanctions and conventional military force when U.S. political goals require coercive action.

Countering and Exploiting Swarms

By Prof. John Arquilla **
US Naval Postgraduate School, Monterey, CA

In the fifteen years since David Ronfeldt and I wrote our monograph on swarming [i] – a mode of conflict based on simultaneous, omni-directional attacks – it has grown clear that our nation’s active adversaries, and also our potential foes, have become seriously interested in this concept. Clearly, terrorists and insurgents have grown attuned to swarming, as can be seen in their operations in Iraq and Afghanistan – at both the tactical and operational levels. More broadly, “gun swarms” have emerged in varied locales, from the seminal event in Mumbai in 2008 [ii] to the 2013 Westgate Mall attack in Nairobi. And beyond.

Terrorists and insurgents aside, there has also been much ferment in naval thinking about the use of swarms. Indeed, this has become the dominant doctrinal concept of the Iranian Revolutionary Guard Corps Navy, which has about fifty missile and torpedo boats, along with other light coastal craft, all of which train to employ esba (pronounced “ezz’ bah,” like a swarm of bees) tactics. The IRGC Navy also operates from several small islands in the Persian Gulf, from which they can “swarm by fire” with the four types of Chinese knock-off missiles they possess. As to China’s PLA Navy, nearly half of its 500 vessels are missile, torpedo, or gun boats that regularly practice swarm tactics.

For the U.S. Navy, comprised as it is of a relatively small number of high-value vessels, swarms pose a considerable and rising threat. Not just attacks from small boats, but also from aircraft, submarines, and drones that will all be adding their firepower to potential enemy swarms. At present, one American response has been focused on the use of counter-swarms of drones, and perhaps even robots. The Control Architecture for Robotic Agent Command and Sensing (CARACaS) is an important step forward; but much more needs to be considered.

For starters, CARACaS is reliant on a mix of 7- and 11-meter remote-controlled boats. These are probably too big – and still not fast enough – to deal with the most serious threats to larger vessels, so there should be a willingness to consider designing swarms of much smaller craft. Think of USN swarms comprised of large numbers of jet-ski-sized drones or autonomous weapons whose goal is to seek out and destroy incoming swarms with rockets, or by ramming and self-detonating. On the offensive, weapons this small and swift would pose a swarming threat to our adversaries far superior to anything in their arsenals.

With just a little imagination, it would not be hard to see even farther ahead, to the possibility of developing very small undersea swarming systems. These would clear minefields, engage enemy submarines, and so on. Small aerial swarm weapon systems could prove exceptionally useful in dealing with air defense of carrier strike groups. It is even possible to think of using dirigibles as persistent platforms from which USN swarm systems could be launched to support expeditionary forces ashore – or to join in a fleet action at sea, or even serve counter-terrorist missions.

A short Office of Naval Research video of swarms can be seen [here](#)

The swarming concept should also be applied to thinking about the future of amphibious warfare. In the century since the British disaster at Gallipoli, operations from the sea have been declared dead again and again. Yet the Navy and Marines crafted an amphibious doctrine in World War II that neither of the Axis Powers ever figured out how to counter. Now it is time to return to sea-to-land operations – but not to the Overlord paradigm. Instead, a swarming approach to amphibious warfare would look more like the Japanese invasion that led to the

capture of Singapore early in 1942. A force just a third the size of the 100,000+ British Imperial defenders kept infiltrating at many points, using what the Allied theater commander called “bold and skillful” tactics, [iii] to win a most remarkable campaign. A swarming campaign.

World War II provides other good examples of swarms in naval settings, at the tactical level with German Admiral Doenitz’s U-boat wolfpacks attacking convoys, at the strategic level with Admiral Nimitz’s widely spread out submarine campaign that sank 80% of Japanese merchant shipping – and accounted for a third of the sinkings of enemy warships.

The larger point to be drawn from these historical examples is that we should not focus overmuch on remotely controlled and/ or autonomous systems as the sine qua non for conducting swarming operations. Our sailors and Marines can swarm, too. Indeed, the long, rich history of the use of swarms at sea goes all the way back to Salamis in 480 B.C.E., when a smaller Greek force defeated a far larger fleet of Persians and their allies. In the words of Aeschylus, himself a veteran of that battle:

The Greek ships skillfully encircled and attacked them from all sides. [iv]

And some seventeen centuries later, in 1281, swarm tactics once again proved crucial to defeating a seemingly overpowering invader. On this occasion the invaders were the Mongols, who were returning to Japan with a D-Day-sized fleet and landing force – their raid in 1274 had been cut short by worsening weather. Foul weather eventually came as well this second time – the “Divine Wind” that inspired the kamikaze swarms of the Pacific War – but only after seven weeks of hard fighting. The Japanese disrupted the Mongol invasion force during these weeks with sustained swarming operations by their fleet of small boats weaving in and out among the big enemy transports, wreaking havoc among them. As the eminent historian of medieval Japan, George Sansom, put it:

Naval preparations made were confined to the building and equipment of small and easily handled warships . . . In the event, these small craft proved extremely useful. [v]

Sailors and marines have been swarming for many centuries. They should continue to do so, even in this age of intelligent machines. On some occasions, perhaps only the machines will be doing the swarming; on others just people. But my guess is that the great strategic challenge of the future will be to parse the possibilities and find the way to the skillful blending of Sailors, Marines, and intelligent machines.

[i] John Arquilla and David Ronfeldt, *Swarming and the Future of Conflict* (Santa Monica: RAND Corporation, 2000), found at

[http:// www.rand.org/ pubs/ documented_briefings/ DB311.html](http://www.rand.org/pubs/ documented_briefings/ DB311.html), accessed 15 April 2015.

[ii] On the rise of gun swarms see John Arquilla, “The Coming Swarm,” *The New York Times*, 14 February 2009.

[iii] Letter from General Archibald Wavell to Winston Churchill, 11 February 1942.

[iv] From Aeschylus, *The Persians*, Lines 416-417.

[v] George Sansom, *A History of Japan to 1334* (Stanford: Stanford University Press, 1958), p. 447.

Self-Sustaining Ship: Naval Logistics for the Future

**By Vice Adm. Philip H. Cullom,
Deputy Chief of Naval Operations for Fleet Readiness and Logistics**

Keeping the Navy and Marine Corps focused on developing the Fleet's warfighting skills and techniques, as opposed to administrative work, is a crucial innovation goal of the Department of the Navy. A central part of this line of effort is cutting the Service's need for logistics -- the "tail" supporting the "tooth" of their operational capabilities. If liberated from much of the supply chain, both the Navy and Marine Corps could operate more efficiently as well as more securely. The need for much of our current-day information flow, often challenged by adversaries' cyber activities, would also drop dramatically.

This opens the way to the concept of the "self-sustaining" ship: One equipped with a safe energy source, such as a small fusion reactor, producing fungible energy for shipboard use. Fusion power would allow the vessel to operate using seawater as fuel, allowing it limitless range. Its fungible energy can be instantaneously switched, as needed, to propel the ship, power its sensors, and ultimately produce its own weapons, making missiles and gunpowder unneeded. The same fusion energy source provides power to mechanical and electrical systems, as well as for new additive manufacturing processes.

These new manufacturing processes would create 3D printed unmanned ISR/ EW/ Strike persistent vehicles for launch from the ship, tungsten rounds for its fusion-powered rail gun, quality food, on-demand spare parts and materials for shipboard system maintenance, fuel for aircraft, and a slew of iRobots for logistics tasks (e.g., preventative maintenance, food preparation, fuel quality assurance, FOD walk-downs, cleaning/ repair). Such capabilities will enable crews to focus with laser attention on warfighting tasks instead of supply and maintenance issues. Coupled to its inexhaustible fusion power, the ship has longer on-station time through enhanced energy storage and power management, stern flaps, smart dashboards, hybrid electric drive, and hyper-efficient energy technologies. These all provide longer endurance for one-of-a-kind parts not replaceable at sea. The ship is semi-submersible, making it stealthy, survivable, and versatile in many high-threat operating environments.

Making such a leap is not easy. This concept for a "self-sustaining ship" should be created by an advanced acquisition process, in which all platform and related package requirements are considered holistically during the Analysis of Alternatives, akin to our country's space program. There would be no further program requirements added after the Analysis of Alternatives, as such capabilities could be organically developed by the ship's crew. Developing such an independent acquisition process will take much focus by senior leadership of the Department of the Navy, sustained over a long period of time. Yet the payoff could be immense, for with such ships our Fleet would become largely self-sustaining, making redundant the lengthy and expensive logistics umbilical cord, as well as leading America toward ridding itself of dependence on Middle East oil. In that way, our operational advantages would grow continually while remaining affordable to the American taxpayer and generating important political and military advantages.

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Wargaming: Now more than ever . . .

By Sarandis 'Randy' Papadopoulos, Ph.D. **

Imagine a conflict in which war-winning plans, logistics, operational concepts and most of the tactics had been worked out in advance. In this war, how and where to attack the opponent had been theorized, analyzed and rehearsed by existing officers and crews, to the point the navy knew what new equipment it needed to build because it already had worked out how to use it. This did not mean that the winner didn't get surprised on occasion, for war automatically means exposing one's own forces to the rules of chance, but wargames saved time and money.

The victors in this war not only foresaw most of what their opponent could do; it wasn't imaginary. The United States won the 1941 to 1945 campaign against Japan in 44 months. That conflict was not always successful and by no means bloodless—between them, [the World War II U.S. Navy and Marine Corps lost more than 62,000 dead in the Pacific Theatre alone](#). Their losses would have been far worse, however, if the Marine Corps and Navy had not repeatedly wargamed the fight against Japan, practicing how to wage war across the planet's largest ocean. By teaching the Fleet how to plan a fight, wargaming saved time and lives.

From tabletop wargames at the Naval War College, to single-ship drills afloat and Fleet Problems at sea using two-thirds of the pre-1940 Fleet at once, wargames educated and trained the sea services' leaders and operators. Despite their name, these weren't for fun. (At the same time the mathematics of "[game theory](#)" also arose, setting generally applicable practices now used in economics, political science and biology.) The Navy wargames' purpose was to define strategic places to attack, figure out the logistics needed, and employ forces operationally and tactically to maximize U.S. strength as it advanced on Japan. Crucially, these games continued at Newport throughout World War II. [As Fleet Admiral Chester Nimitz noted in 1960:](#)

During the war, the war with Japan had been re-enacted in the game rooms here by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics towards the end of the war; we had not visualized those.

Wargames also helped quickly dismiss some experimental and pricey pre-war Navy ideas, such as [using dirigibles for long-range reconnaissance](#). All these choices took place without paying the cost in combat.

These points were context for the annual [Connections wargaming meeting](#), held at the National Defense University late last month. Its speakers and participants included the Chief of Staff to the Deputy Secretary of Defense, as well as academics from Defense, international scholars and both U.S. and foreign military officers. Those attending had the chance to test a variety of wargames, including the classic 19th-century German *Kriegsspiel*, a tabletop maritime anti-access scenario, a humanitarian relief simulation and a representation of the Syrian Civil War. With the theme "Reinvigorating Wargaming for Innovation," sessions naturally paralleled Navy Department goals to solve problems without throwing massive amounts of cash at them.

One session at Connections, "Fostering Creativity in a Culture of Compliance," made several points showing how the Department of the Navy stepped away from wargaming to solve problems after 2001. Exercises have become ways to certify sea service forces' readiness, not to experiment. Aircraft pilots must be able to fly safely, ships' VBSS teams need to practice boarding operations, submariners have to rehearse firing Tomahawk missiles, and Marines

must be certified for non-combatant evacuations. Imagination, however, takes a back seat during such drills. Experimental decision-driven wargames, drawing upon future scenarios or using past campaigns, develop commanders' good sense in the face of ambiguous facts: they teach judgment.

Even popular culture has employed this idea in wargaming. In the *Star Trek* movie franchise, the [Kobayashi Maru](#) scenario tests *and also builds* the judgment of commanders.

I'm not saying our naval leaders lack common sense. But there's a slightly-hidden trick within innovation: technical competence is not the only way to make innovation occur. Just refining expertise—the technical, repetitive drills of the previous paragraph—can limit thinking. Instead, innovation is about creativity, about taking unexpected ideas and turning them into something useful to change existing practices. As pointed out in a closing Connections session, a good wargame will create a revealing, sometimes startling story in the minds of participants. For example, what if a free play wargame came to the point where the U.S. commander had to choose between losing a war or radically escalating it to win? Wouldn't such a story focus the minds of every service member in the room, asking them to figure out new ways to win?

This is more than simply repeating the line “the enemy gets a vote.” Instead, we should take our cues from the early Naval War College wargamer, William McCarty Little:

Now the great secret of its power lies in the existence of the enemy, a live, vigorous enemy in the next room waiting feverishly to take advantage of any of our mistakes, ever ready to puncture any visionary scheme, to haul us down to earth.

LT McCarty Little wrote [those words](#) about the Naval War College of 1887, and they apply today. Wargaming is about testing and discarding ideas.

What McCarty Little sought was to teach naval leaders to make wise decisions. As a junior officer he had seen the German *Kriegsspiel*, and he wanted U.S. commanders, and their subordinates, to learn their profession without shooting taking place, and without career consequences. Giving the chance to experiment, make mistakes, discard inapt ideas, and recalculate risks, repeatedly, is the essence of wargaming. As McCarty Little [later put it](#) “While we can give an entire forenoon, if necessary, to work out and analyze a five minute critical movement, we can, on the other hand, dispose of a day, or week, or a month in less than an hour.” Such actions, and the time, money and lives they saved, are from where Admiral Nimitz's success stemmed.

Wargames make use of the Navy and Marine Corps's most precious asset—thinking—and create the chance to do so. All that such thinking needs is for local commanders to have some independence to solve problems (meaning a small budget disposable for wargaming) and the virtual reality of a computer or a tabletop wargame. Repetitively confronting difficult problems allows them to work out solutions, after they have disposed of less effective ideas.

Historically, the Department of the Navy has wargamed this way. Marine Corps Commandant Charles C. Krulak sent the same message as the one advocated here in his [April 1997 order](#) “[Military Thinking and Decision Making Exercises.](#)” Freeing up operational commanders to use their time, and small amounts of money, for wargaming is what the Department desperately needs to do. The alternative, reinforced by the program of record and rehearsing to operate in the same way, will be to learn lessons in action, potentially at the cost of more blood spilled. In its place, wargaming is a relatively small investment which will pay off over the long term.

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War in 2030

LT j.g. Kat Dransfield, United States Navy **

Information is entropic, constantly expanding and rearranging itself, and defying efforts to limit its spread. When the amount of data in the world was constrained (largely by the speed at which a small body of literate monks could hand copy religious texts), managing data was relatively straight-forward: its dissemination could be controlled by the laws and norms governing the circulation of material commodities. However, the late 20th and early 21st centuries have seen an exponential increase in the amount and forms of information without a comparable effort on the part of liberal democracies to regulate and manage it. Simultaneously, non-democratic governments and violent non-state actors have been apt to assert hegemony over information systems, often without the consent of system end users.

Today, the omniscience of data implies heavy reliance on it to help us interpret phenomena. However, the incredible amount of information needing processing places a growing cognitive burden on humans. The human brain, even when combined with data processing and analytic technology, can only make use of a fraction of the entire data universe. To complicate matters, adversary efforts to corrupt or manipulate the information environment mandate that the veracity of such information is always in question. Any claim to the truthfulness of information is challenged on the grounds that, first, we have sampled a very small portion of the overall information environment; and second, we can rarely claim to know the pathology of data and what actors may have shaped it without our knowledge.

The result is that, in 2015, it is possible for a leader of a nation state to deny the existence of a military operation through skillful manipulation of the information environment. In 2030, such denials of objective military realities will be commonplace. The availability of data—combined with the power of actors to affect manipulations of it on a massive scale—will make the existence of warfare only subjectively perceptible. Leaders and governments will have the capacity to invent or eclipse entire military operations without challenge to their legitimacy. In an information environment where the truth is ultimately unverifiable, any conflict is potentially both occurring and not happening.

An increasingly chaotic global information environment will require militaries to perform complex manipulations of systems and the data passing through them. In a world where any representation of military action is potentially negated by an equally plausible counter-representation, militaries must deny their enemies such representative capacity. This will necessarily involve both offensive and defensive “data operations” aimed at influencing collective perspective. For example, the kinetic elimination of a cyborg army may be unnecessary if their digital biometric profiles can be seized to simulate their elimination (e.g. their heart rate monitors all indicate 0 beats/min). Similarly, if a ship can be shown to transit a strategic chokepoint, actual execution of the transit may be less important. The victor in the war of 2030 will be the party which best manages and exploits the gap between ocular reality and digital representation. The ability to move weapons systems and personnel successfully, while using data to either affect mass confusion or create a false but convincing digital counter-narrative, will constitute the difference between winning and losing.

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Future Operating Context: Augmented Human Performance

By Scott Cheney-Peters, Dept. of the Navy **

Over the next 20 years the world will see a proliferation of the means to supplement human performance. A parallel rise in their use will impact both the battlefield and supporting military functions from shipyards to watchfloors. Human performance enhancement will come in several forms – wearable, implantable, biological, and chemical. This is not an endorsement of any of these approaches but instead a discussion of developments that might aid our future forces or else emerge among their adversaries.

Wearable

Today's wearable human augmentation devices largely are those that increase situational awareness, such as augmented reality and heads-up displays (HUDs) in helmets, and those for protection, such as armor or gloves. A few like firefighting oxygen tanks and early exoskeletons provide operational benefits by broadening specific human capabilities. Others, such as health monitors and smartwatches' computing power and communications, provide operational benefits by adding new abilities.

The next decades will see these augments improved, joined by those that offer even more capabilities, all combined in integrated wearable systems. Some of these advances will be integrated in exosuits, "composed of some combination of armor, mechanical systems, sensors, communications, interfaces, data displays, weapons, medical systems and power supplies. Exoskeletons are often a central feature of exosuits, bearing and transferring a load to the ground through a frame external to the user."^[i] Exosuits will increase strength and endurance, lower risk of injury, and incorporate a range of operational benefits including immediate medical healing systems. Sailors in the next decades will be able to use the suits for such tasks as damage control, deck and port operations, and performing general shipboard maintenance while Marines are likely to make direct use of them in combat.

Both services will have to contend with the availability of less integrated, but still powerful wearable augmentation capabilities widely available as the result of commercial developments. These will make their way into the hands of the civilian populations the Navy and Marines interact with at sea and ashore, as well as adversaries, which may pose threats.

Implantable

Wearable devices aren't the only means to achieving many of the promised boosts to human performance. Implantable devices do the same more permanently and discreetly, and are sturdier. While most applications to date have focused on prosthetics for missing limbs, restoring capabilities to skilled workers who might otherwise leave the workforce, many of the same technology gains can be applied to improving performance for people without a physical impairment. Furthermore, some of the capabilities of wearable devices can be improved upon using implants, especially those that interact with the human body to achieve effects. These include health monitoring sensors, machines that provide a biological stimulus, and implants that interface with the brain and neural impulses to control external gear – from drones to communication equipment.

Major ethical concerns about the voluntary and reversible nature of such augmentations mean that it is more likely these enhancements will first gain traction in state and non-state forces that do not place as much weight on ethical concerns as our own. Additionally, our personnel system might confront the problem of recruiting from a population whose use of augmentation clashes with policies for use by service members. This is already an issue with chemical and

biological substance use, such as anabolic steroids and human growth hormones, especially when substances are legal but prohibited by policy. On the other hand, the costs of implantable augmentation may mean it's available only to well-funded individuals or organizations.

Biological and Chemical

The same ethical concerns that will bedevil the DoN policies towards implantable devices exist in the realms of biological and chemical supplements. Yet the prevalence of caffeine in the naval forces shows that acceptance of substances to enhance human physical and cognitive performance has long been a matter of degrees. Over the next decades the DoN's policies might not change much from today, or may do so as advances in performance enhancement materialize. The result will depend in large measure on the substances' costs and safety, and the reversibility of their impacts. As with implantable devices, whatever policies are in place in the U.S. military are likely to be more restrictive than those of our least restrictive adversary. This means the future well may hold new dangers for our forces operating among and against those enjoying the benefits of performance enhancement drugs, whether they be to increase strength, endurance, or mental abilities.

Future Operating Considerations

As the above sections indicate, there are actions DoN can take to leverage the maturing technologies of human augmentation, and actions it should take as a matter of diligence. While the DoN can support the research, development, and testing of specific augmentation technologies to ensure it has access to the best equipment and CONOPs for use, ethical considerations will guide its policies for use. The DoN should begin the exploration of ethical implications of future augmentation advances now, to better explain initial positions on use and adoption, while understanding that the level of comfort with any specific technology (and therefore acceptable use) may well evolve over time. At the same time, the DoN should prepare to contend with a future of adversaries and civilians with access to augmentation technologies – exploring the implications and developing ways to mitigate potential disadvantages borne of a reluctance to adopt ethically questionable augmentation practices. For example, a VBSS team might need increased protection operating on a ship whose crew includes individuals willing to greatly augment their strength through chemical or biological substances. While U.S. naval forces may never be willing to go as far as others into the grey areas of augmentation they must nonetheless be ready to deal with those who do.

[i] Cheney-Peters, Scott and Andrew Herr, "Between Iron Man and Aquaman: Exosuit Opportunities in Maritime Operations," CNAS, Jan. 12, 2015, http://www.cnas.org/sites/default/files/publications-pdf/CNAS_IronManAndAquaMan_HerrCheneyPeters.pdf

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A Framework for Understanding two Macro Techno-Revolutions and our Naval Future

By Mark Hagerott, Ph.D., United States Naval Academy **

The use of force in history can be illustrated as a series of changes and extensions to the fundamental nature of war and the demands placed on the warrior: competitors on the battlefield seek to sense the environment; to think/ decide; and then act with greater effect than the adversary.

For most of history, this fundamental process of war was dominated by social-human factors: the human(s) or social group who could mass the most human power and then sense-think/ decide-act (STA) would win. Of course tools were used by humans, but early in history these tools merely enhanced the 'acting', through the stored energy of a bow or catapult. The human dominated the sensing and thinking and most acting, aided on the margin by physical leverage or stored energy.

With time, through a series of what might be called "micro-revolutions" of technological innovation, the human began to create increasingly complex machines to open whole new environments—the open sea became accessible first by the galley and later galleon, but infantry still fought at sea. With the adoption of the gunpowder cannon, wielded by an early technical specialist (the gunnery expert), a new realm of warfare arose, the decisiveness of which centered on the integration of human-machine. The integration of human-machine accelerated and opened new domains of the air and undersea, creating the "Integrated Realm" of human and machine. This realm has dominated warfare at sea the past 200 years, but its dominance is coming to an end. With advances in science and technology, an accumulation of faster processes, coding, and advanced engineering, the likelihood of completely autonomous warfare is now emerging. This offers a battle of systems of systems that move beyond the limits of where integrated human machines can go; beyond speeds at which a human can enter the "S-T-A" process without slowing it and thus ceding a decisive advantage to the enemy.

The three realms of warfare will be defined by more than technology or processing speeds. Due to the influence in democracies of what can be called Policy-Law-Ethics-Norms (PLEN), there will be restraints exerted to varying degrees, depending on the context, on unmanned systems in populated areas of the Earth. While land combat may be constrained by PLEN, the maritime domain will know few limits, and will become subsumed into the realm of machine on machine combat, where the fastest, most lethal mass of machines will dominate. In light of that threat the Navy Department should not slow the movement of resources and talent into the study and development of "Machine Realm" technologies, in all domains of air/ surface/ subsurface.

A second revolution now challenges us for the Machine Realm, is just one of the imminent revolutions. Now, the digital battlefield is also in the wires, air waves, satellite up/ down links, inside the 'Os and 1s' of transistors in the smallest chips, down to the BIOS of our computers, and in the supply chain of the pieces and parts that make up our increasingly 'smart' machines.

Smart machines will become ubiquitous: TWITTER feeds streamed to iPhones will challenge U.S. Marine Corps stability operations in coastal cities; data links communicating between the missile ships protecting a Navy carrier strike group may be targeted as could the navigation algorithms running inside the TRITON unmanned surveillance craft. This information battlespace is depicted in Figure 2, illustrating the concept of the overlay of Cyber warfare across the Three Realms of Social-Human, Integrated, and Machine warfare.

In summary, the Navy faces the historically unprecedented simultaneous confluence of two Macro-Revolutions: the emergence of a new realm of combat, dominated by autonomous Machines; and imminent Cyber battle for any and every smart machine in the Navy.

The challenge going forward is to dominate all three realms—have the best social-human units (e.g., USMC and SEALs, for an example); to the manned machine fleets which currently dominate the fleet/ air/ subsurface forces; the best emerging robotic fleets of machines; finally, the Navy needs the most info-dominant fleets—resilient in defense and most effective in offense, able to penetrate the adversarial machines and networks of the future.

This framework and thesis argues for a balanced Fleet and Marine force across the three realms; to minimize cyber vulnerabilities among manned, unmanned, and human force; but maximize the cyber penetration of our enemies. To this effort we must focus our human capital; doctrine and strategy; resources; research; and ensure adoption by our political leaders of policy and law that do not unduly restrict the navy operating outside human population areas in defense of our nation and allies.

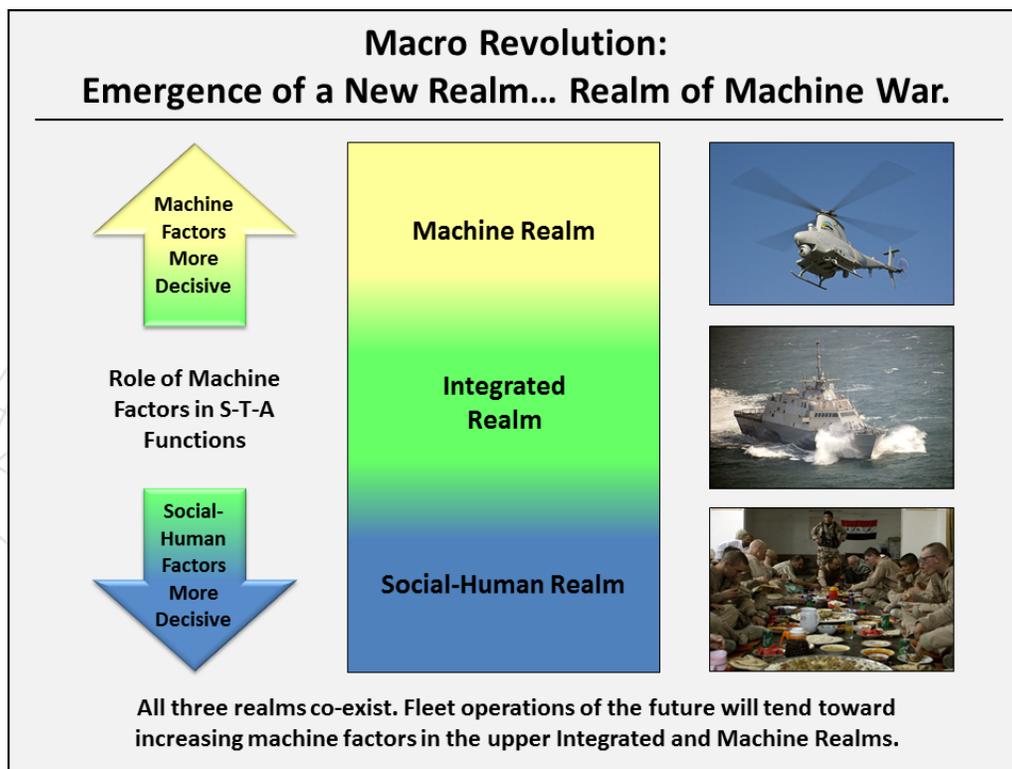


Figure 1: Emergence of the Third Realm of War, dominated by machine on machine combat. [i]

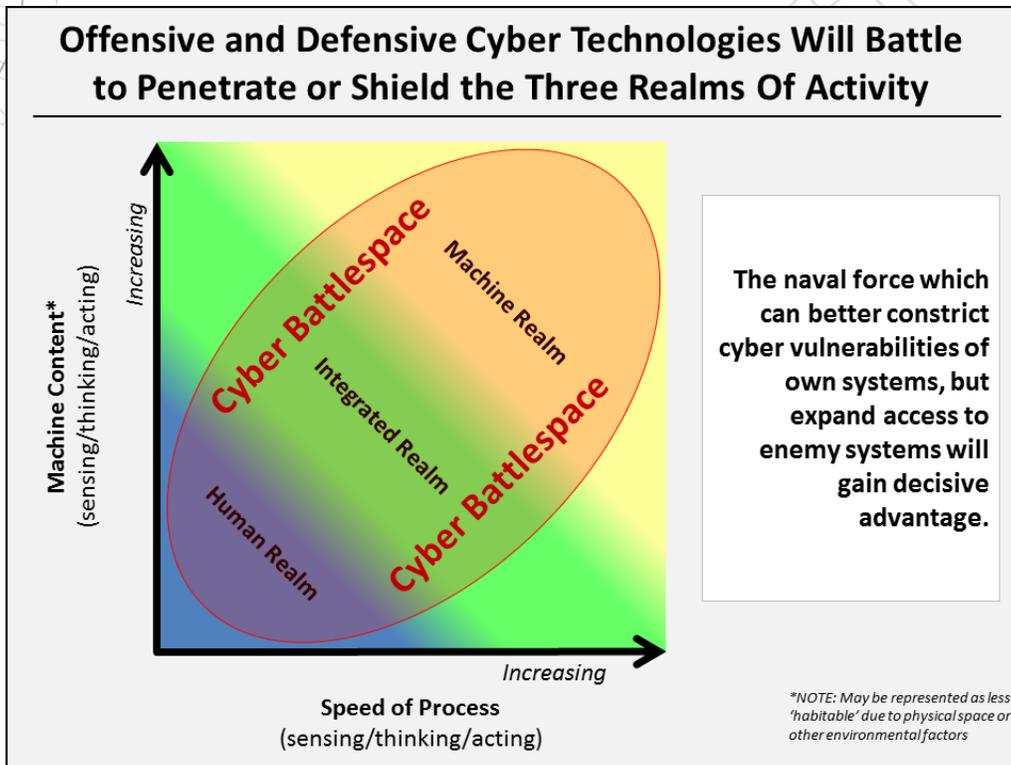


Figure 2: The battle for information dominance in any and all of the Three Realms. [i]

[i] Figures derived from slides submitted by Dr Hagerott.

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Innovating for an Uncertain Future

By Maura Sullivan, Ph.D. **

Prediction is the art of synthesizing past data in order to make decisions for the future. Given the complexity and dynamism of the global security environment, often even well-researched and rigorous predictions are akin to driving while looking in the rearview mirror. Good prediction therefore requires analyzing the structural drivers which underlie trends in order to understand where the future is likely to depart from the past. Innovating for the future consequently requires deconstructing risk and embracing uncertainty.

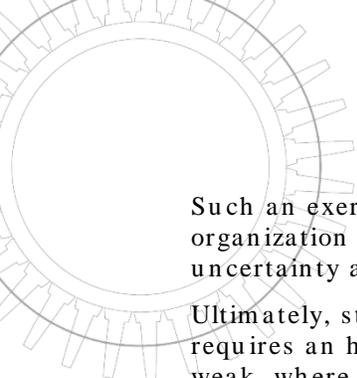
As a term, uncertainty is often used synonymously with increased risk. More precisely, uncertainty is simply the unpredictability of future events or a wide range of potential outcomes which make accurate risk prediction difficult. But an uncertain environment, even one filled with high-impact, low-probability events can present opportunity. An uncertain future becomes such an opportunity space if we are agile enough to respond. In order to build that internal agility, past data can serve as the foundation for preparing the future, but is insufficient on its own. Innovating for the future requires recognizing human and organizational biases, the central value of quantifying risk and uncertainty for use in decision-making, and continually challenging our own assumptions.

The neurochemical traits that gave early humans survival advantages also make us poor judges of risk and uncertainty. Humans are biologically conditioned to overestimate the potential impact of events that occurred recently, of things told to us by trusted sources, or which have the potential to impact us personally. We consistently underestimate uncertainty and overstate the potential impact of things which we feel we have the ability to influence or control. These biological traits explain why crowdsourced answers are often more accurate than the opinions of single experts. Diversity of thought is a key component of innovative organizations and we must make conscious efforts to avoid group-think and cultivate alternative perspectives.

Organizations with a history of success are often loath to stray far from approaches which yielded success in the past. They become delusional about their own market position or organizational strengths and fail to take advantage of opportunities on the horizon. Companies that once dominated a market sector, Kodak and Blockbuster, for example, ended up bankrupt.

Developing confidence in the uncertainty space requires understanding that the distribution or range of potential possible answers is often more important than the answers themselves. Coming to grips with this is not a difficult or resource intensive task; all it requires is the space and permission to think differently and organizational honesty to respond. If done correctly, such assessment will always list things for which the organization is woefully underprepared. In the same way a world-class marathoner cannot be a world-class sprinter, the decisions made intentionally or unintentionally optimize the organization in defined ways, and an organization cannot be world-class unless it is so optimized.

Practically speaking, this means as we prepare for the future we must consider scenarios and wildcard events that play to our current weaknesses, as well as to our strengths. Recent history has shown us that potential adversaries rarely challenge our strengths head on. But once the uncertainty space itself is understood, risk can be quantified. Assigning rough probabilities to the structures underlying both positive and negative scenarios can help to create an initial framework for understanding risk. Then, in order to reduce complexity, first treat the component pieces as independent parts, and only then add correlation assumptions.



Such an exercise will create a map of the future risk and opportunity space, which gives the organization a common currency with which to trade and discuss risk, even in the face of uncertainty and complexity.

Ultimately, strategy is about what you choose not to do and innovating for an uncertain future requires an honest discussion and the ability to make conscious decisions about where to be weak, where to be strong, and how to be adaptable and resilient. Employing methods, such as the ones discussed here, can build resilience in the face of asymmetric and unpredictable threats to Department of the Navy and to the United States.

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What Ifs?

By Scott Cheney-Peters **

Questions can say a lot, sometimes more than their answers. Usually, they explain something about the questioner – his or her line of thinking, how well they've grasped a subject, and how confident they are that they won't be mocked for speaking up. At the same time questions say something about leadership. They tell us how well a leader has fostered an environment in which folks are comfortable asking questions. And posing questions is important, especially the question "What if?"

What Ifs play an important, and recognized, part in naval planning. They illustrate blind spots and flaws in everything from tactics to campaign plans, and their asking is institutionalized through the use of red-teaming and red cells. *What Ifs* help our Sailors, Marines, and civilians practice operational risk management while carrying out the most mundane evolutions. Yet *What Ifs* need not be narrowly utilized. As proactive questions, *What Ifs* can point the way to the benefits in new approaches just as usefully as they can highlight the unknowns and dangers in current methods. By asking them, our naval forces have the chance to peer through the possibilities and second-order implications, in prospect, and to chart a course towards a more advantageous future. They can create new avenues of research and study, generate original thoughts for experimentation and wargaming, and lead to entirely novel operational concepts. Only a small fraction of the *What Ifs* posed will come to pass, and many of their assumptions will not hold true. But the insights gained from them and the fruits of the initiative taken will leave the DON better prepared for the uncertainties of the future than a future in which the *What Ifs* went unasked.

Mike Myatt, a business expert, echoes this view, noting that great leaders aggressively pursue *What Ifs* – both as asker and the asked – because the "status quo is mediocrity's best friend." Static thinking is the best short cut to obsolescence. As the Secretary of the Navy stressed recently, innovation is about the unpredictable interaction of people, ideas, and information. Simply asking *What Ifs* is a great way to get all people to think differently about the future, helping make them less defensive about current practices and lowering resistance to the process of identifying completely new ideas.

As a military organization, the Department of the Navy understandably places a premium on the unhesitating support for the chain of command. In moments of crisis, adherence to this bedrock principle can be the literal difference between life and death, victory and defeat. Yet the DON must ensure a balance between obedience and the equal need for discussion, dissent, and *What Ifs*. This dividing line again points to the role of leadership. Instead of shooting down divergent views and diverse perspectives, leaders need to actively solicit, encourage, and incentivize the sharing of creative ideas and concerns – even those not yet fully formed. A table full of nodding heads can be one of the most perilous environments for a leader to confront.

Good leaders also know that it's best, whenever possible, to have these frank conversations before the crisis or contingency erupts. This openness goes beyond formal contingency planning. Every member of our workforce must have access to the outlets and forums that allow them to ask the big questions and think broader thoughts without fear of reprimand and in an environment where they know they'll be heard. And there is no bigger question than *What If?*

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The Indirect Approach

By Sarandis "Randy" Papadopoulos, Ph.D. **

Less than a week into the war, the mid-Atlantic fleet action began between U.S. and German forces. After the opening gunfire, the American line, although outnumbered 18 to 9, had crippled or sunk several ships and seemed set to win due to better position and firepower. Suddenly, the Imperial German zeppelin formation broke through the cloud cover, unleashing a swarm of single-seat "dragonfly" attack craft to sink the battlewagon *USS Susquehanna*. In quick succession all the U.S. Navy ships were sunk by these new aerial weapons. A day later, the German airships cruised over New York, the city unwarned of the naval defeat. Despite being told to surrender, its residents refused to do so, shot back, and destroyed a zeppelin. Retaliating, the Germans wrecked the city center with bullets and bombs until it capitulated, scoring a crucial victory over the American republic. Over the next year airships and small aircraft destroyed the global economy prompting a new dark age.

The foregoing summarizes the actions of [The War in the Air](#), which British futurist H.G. Wells first penned in 1907. His imaginative combat portrayals showed the promise as well as the threat offered by air warfare a century ago. The potential of aircraft—vehicles just four years old when Wells wrote his novel—stood foremost, defeating state-of-the-art weapons, dreadnought battleships, and violently cowing a major city's civilian population. The book also posits how small aircraft built globally in workshops decentralize violence, favoring the offensive over any type of defense. That last point prefigured the thoughts of British military thinker Captain B. H. Liddell Hart, a World War I veteran, and creator of a strategy he labelled "[the indirect approach](#)." First published in 1929, the indirect approach sought to explain the potential of a less-linear strategy. A product of his personal experience as a junior officer in the blood-soaked 1914-1918 stalemate in France and Belgium, Liddell Hart summarized the theory as:

In strategy the longest way round is often the shortest way there; a direct approach to the object exhausts the attacker and hardens the resistance by compression, whereas an indirect approach loosens the defender's hold by upsetting his balance.

This was not a means of victory in war by avoiding combat, akin to Sun Tzu's recommendation to win wars without fighting. Instead, the [indirect approach](#) suggested attacking where or how an opponent isn't strongest, where military power is attenuated either by distance or a lack of preparation, to gain a means for disrupting defensive measures. For H.G. Wells, it meant using home-built aircraft to wreck armies, navies and nations by exploiting their vulnerability. Today, the indirect approach is another way of explaining and highlighting potential U.S. vulnerabilities to a cyber-attack.

In our world the role of cyber-capabilities are key. Beyond their value to consumers and other users of data devices, much of the globe's money travels over the Internet every day. Such transactions are invisible to us, reflecting the smallness information has in the physical world, which also explains its speed. Just as the dragonfly attack craft destroyed the fictional *USS Susquehanna*, however, being small does not mean something cannot hurt us. Small attacks can also severely damage the civilian economy, even paralyze it, by targeting the data of the public. These mean that for the U.S. government, attacks on the internet are a principal threat to national security.

Here's how: while the Internet is just 20 years old, all nations use it to manage information; even [terror groups use it to transmit their messages](#). In the world's departments and ministries of defense, personnel, intelligence, operations and logistics systems run on the 'net. For them,

information has become crucial to tracking service-members' careers, targeting assailants, command and control in the field and keeping friendly forces supplied. The problem is that these sinew bundles, moving the muscles of military organizations at the speed of light, can be leveraged for their information by enemies. Especially in today's world of networked computers, it is trivial to target and manipulate information, just as H.G. Wells showed the offensive's advantages over the defensive. These considerations make information a prime objective for those employing the indirect approach.

It's not that the U.S. Government doesn't understand this problem. Legions of experts have written (and less often read) rafts of [studies of our cyber-vulnerabilities](#). And, following the reports' recommendations, well-meaning officials layer ever-deeper methods with which to protect systems from attack, thereby creating processes (certifications, passwords, encryption) to fence off networks and make information harder to get for authorized users. But these approaches put the cart before the horse—a metaphor more from H.G. Wells's day than our own, if you'll forgive me—protecting the systems, not the data they hold.

Recall the indirect approach is a strategy which shifts balances to favor the attacker. Given the United States and its allies field a small number of Internet-based systems, relative to the number of potential attackers, we play on a field tilted against us. Al Qaeda or self-styled Islamic State hackers can, for relatively small investments in people and internet access, strike the information systems which are the linchpins of our armed services. They are independent of geography (the 'net is global) and, in many cases, the attackers are of deniable origin, making them harder to fend off. They can also throw many more hackers against our few systems than we can field in terms of network defenders. We're seeing the decentralization of military power, in the form of cyber warfare conducted guerrilla-style, which H.G. Wells anticipated.

Okay, a critic might say, let's do all our military business on separate, that is, classified domains. Bluntly, there's no refuge there, however. Western militaries use the internet for day-to-day work all the time. And there's a wider consequence to an indirect approach to cyber, as well, which H.G. Wells considered: a civilian economy can only take so much punishment and keep working. Three weeks of closed banks brought the country of Greece politically to its knees; what would happen if the ATMs of the Western world completely stopped working due to a cyber-attack? If coupled to attacks by swarms of drones, the impact would worsen. Could the U.S. military function if its service members, their dependents, civilian employees, industrial suppliers, international partners and political leaders all couldn't pay their bills at once and [faced harassment in their daily lives](#)?

A solution comes to mind. The first is to recall that the offensive advantage of the indirect approach cuts both ways. Invigorating the US and allied offensive cyber capability would certainly serve to deter states wishing to protect their own use of the internet, and deny terrorists access to it for their criminal purposes. Also, the economies of states which threaten our way of life can be targeted, too. And finally, the control systems for these systems must be identified quickly online and neutralized at the source. The better defense on a small scale is a good offense.

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Extricating DON Information

LT j.g. Kat Dransfield & Maura Sullivan. Ph.D. **

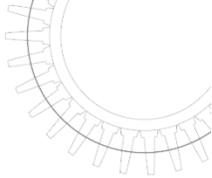
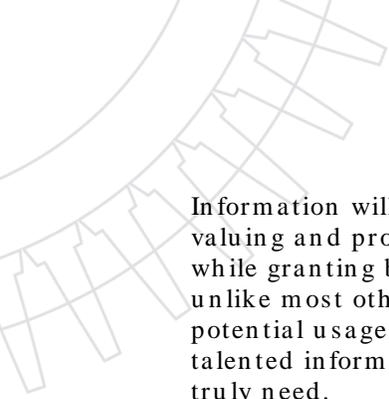
Cutting edge organizations have the ability to harness the power of their data, match it in context, and evolve it into actionable knowledge. From helping to model the dispersion of deadly diseases, to allowing us to manage our personal finances, the integration of data into decision-making processes enhances our ability to interpret and interact with the world. The flood of data made available to us recently, proliferated by digital technologies, is revolutionizing how we make decisions.

However, while data in isolation may be neutral, any benefit or harm to individuals, organizations, economies, and societies is highly contingent on the ways in which it is applied. Optimal uses of data allow us to identify patterns and trends, confirm or refute our assumptions, and validate our actions. Conversely, when improperly managed, data can distort, obfuscate, and confuse. The DON, without the tools, processes, and skilled workforce needed to store, share, synthesize, and protect information, finds itself increasingly overwhelmed by the terabytes it collects. Rather than using it effectively, we find ourselves always swimming upstream against a data current that is constantly growing in scope and complexity.

Data can be thought to travel through the pipes, collection tanks, and valves which make up an organization's IT infrastructure. In the best case scenario, it flows freely through the system, with the right controls so that users can access and utilize it securely and quickly. If we compare a healthy data ecosystem to the primary cooling loop of a nuclear reactor, then the Navy's IT infrastructure has the fluid flow equivalent to the 19th century Paris sewer system before Baron Haussmann. By creating a system lacking the right protocols, controls, and "clean" pipes for data sharing, the DON has created an information ecology characterized by stagnant cesspools, unpatchable leaks, and corrosive run-off. The quintessential and current examples of this are the DON's email and shared drive systems, which create infinite and insuperable problems with version control, leaks, bottlenecking, and searchability. The Department's current IT infrastructure and associated governance and certification structures all but ensure that all DON data is equally valuable and none of it is useful.

We live in a world where the outcomes of conflicts are increasingly contingent on information capability as much as a state's industrial or demographic capacity. In the 21st century, effectively managing information is at least as important, perhaps even more vital, than the number of bullets and ships a country can apply to a particular scenario. The ability to evolve the DON's or an enemy's data into high value knowledge, by applying the right skillsets and analytic tools, is what will allow the DON to manage the conflicts of the future and keep the country safe.

Any organization that wants to compete in the 21st century must learn to value data intrinsically, not view it as a component of IT and sensing systems. One of the major roadblocks keeping us from modernizing how we think about data and IT is the system-centric funding model. Computers and networks are not intrinsically valuable; what's on them is what is. Moving from a vulnerability-reduction approach for systems to a data-centric method means allocating money for algorithms, data projects, and "Software as a Service," independent of any funding for an IT system, platform, or service contract. Just as JP5 fuels our aircraft, data is the raw material needed to propel decision-making; it must be paid for and governed in a way that reflects that truth.



Information will be the central enabler of 21st century national security. Mastering it requires valuing and protecting only very select and very specific parts of the ocean of data we collect, while granting broadest access to the balance of our data. Such an approach recognizes that unlike most other DON assets, value determinations within the marketplace are based on potential usage of data rather than its mere existence. With the proper systems, managed by talented information professionals, we can assess, interpret and exploit the information we truly need.

Effectively influencing the conflicts of the future hinges on the DON's ability to first, recognize the value of its data, and second, funding the right tools and skillsets to use it.

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