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Space as a War-fighting Domain

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For the past 70 years, the US Air Force has consistently delivered a war-fighting advantage in support of vital national interests. Our service grew from the vision of early Airmen who recognized the potential of a new war-fighting domain and exploited emerging technology to make it a reality. We developed the capabilities to gain and maintain air superiority, securing the high ground to protect US forces and defeat adversaries. These advantages were not a given; they were bought with the blood, sacrifice, and ingenuity of American Airmen. In 1982, the Air Force established the Air Force Space Command (AFSPC) to operationalize and normalize space operations, recognizing the intersection of a growing reliance and increased vulnerability of the space domain. More recently, the USAF has led a decades-long effort to exploit space by integrating it into joint war fighting.

For example, in 1991, when coalition forces resoundingly defeated the Iraqi forces in Operation Desert Storm, the nation saw firsthand the power of integrating operations in air and space. Even though the global positioning system (GPS) was not fully operational, it delivered navigational precision to great effect. When Iraqi SCUD missiles posed a significant threat to coalition forces, innovative Airmen found a way to enhance the data from our strategic missile warning satellites to locate missiles and warn of incoming attacks. Finally, strategic intelligence, surveillance, and reconnaissance satellites provided valuable situational awareness to battlefield commanders engaged across vast operational distances.

After Desert Storm, the Air Force accelerated the integration work. We envisioned and formed joint space support teams that traveled forward to educate theater commanders on space. We activated a space division at the Air Force Weapons School to grow a cadre of space weapons officers finely trained in the art of employing weapons effects from and through space. Finally, we created a joint space operations center to provide command and control (C2) of the department's space forces.

As a result of Air Force leadership in this critical domain, space capabilities became a virtually seamless part of all military operations, providing a great strategic and operational advantage for the nation and our allies. Our national security space program is the envy of the world; today, there is nothing we do as a joint force that is not enabled by space capabilities. Space systems allow us to mass and concentrate fires while reducing collateral damage, network, and C2, synchronize widely dispersed and disaggregated forces, and extend our operational reach, all while compressing the time it takes to deliver decisive combat effects on a global scale. Space capabilities clearly fuel both our American way of life and the American way of war. They significantly sharpen the Air Force's global vigilance, global reach, and global power!

The Imperative—Winning a War that Extends to Space

As an Air Force, we take great pride in our ability to always be there. However, that assured ability to exploit the advantages of the space domain is no longer a given. Today, we cannot take space for granted. Our potential adversaries have had a front-row seat to observe and learn from the many successes we have achieved by integrating space effects into joint war fighting. Unfortunately, they are rapidly developing the capabilities and doctrine, tactics, techniques, and procedures to deny us that advantage.

In the future, our potential adversaries will have the capability to hold every one of our critically important national security satellites at risk. In his 2016 Posture Statement, the chairman of the Joint Chiefs of Staff reported that Russia is modernizing its counterspace capabilities to defeat a wide range of US space-based capabilities, while seeking to secure freedom of action in, through, and from the space domain. Similarly, as the Office of the Secretary of Defense reported to Congress in 2016, China continues to pursue a diverse and capable range of counterspace capabilities designed to diminish, degrade, and disrupt an adversary's space capabilities. These targeted capabilities are the same capabilities the US relies on to underpin our global reach and unmatched global power.

The US does not want to see a war that extends to space because nobody wins that war. We will continue to seek ways to prevent that from happening; at the same time we cannot ignore the capabilities and stated intent of potential adversaries. The best way to prevent war from extending to space is: to prepare for that possibility, deter aggressive action in space, and if deterrence fails, be ready to fight and win. US national security depends on our ability to do so, and the Air Force is leading the way toward that end.

Ensuring the Future by Understanding Space is a War-fighting Domain

Until recently, the consensus among senior policy makers assumed a future of unimpeded action in space. To change this legacy perspective, the Defense Department and the intelligence community actively educated key stakeholders and collectively built an agreement around a new, threat-informed narrative. In a close partnership with the National Reconnaissance Office (NRO), the Air Force developed a space architecture and concept of operations to successfully operate in today's contested environment. This new space war-fighting construct is based on the reality that the control of space provides a military advantage and, therefore, it is a contested war-fighting domain. Like other bottom-up, innovative, joint war-fighting constructs, this concept must align operational activities to higher-level policy and strategy to be most effective in achieving its desired ends.

In the December 2017 National Security Strategy, the US articulated that the unfettered access to—and freedom to operate in—space are vital interests. We must backstop this pronouncement with capabilities designed to protect and defend the domain. Hence, it is equally critical that current space system requirements and acquisition processes enable expedited, effective development, and fielding of capabilities that outpace our rapidly advancing adversaries. As recommended by the Commission to Access United States National Security Space Management and Organization (the Rumsfeld Commission), the Air Force aligned space acquisition and operations together under AFSPC in 2001. This alignment has proved vital to our success. However, we must further streamline acquisition to meet the speed of need. This streamlining will require action to eliminate the inertia of outdated bureaucratic processes and perspectives.

Integrating space capabilities through our unified command plan structure from US Strategic Command (USSTRATCOM) into geographic combatant commands (GCC) has served our nation's war fighters well. On 1 December 2017, USSTRATCOM strengthened this structure with the establishment of the joint force space component commander. This new four-star level component command elevates the C2 of joint space forces to create parity with other component commanders found in GCCs for air, land, and sea. This elevation best postures the joint force to sustain the tremendous integration of space effects into joint war fighting, while also fortifying and balancing command relationships to fight and win should a war extend to space. One component to orchestrating joint and whole-of-government operations and activities for space superiority is the relatively new National Space Defense Center (NSDC). In partnership with USSTRATCOM, the intelligence community, and the NRO, the Air Force maintains the NSDC. This center is designed to ensure space su-

periority for the joint force and the nation. Additionally, the NSDC staff innovates, experiments, and tests new space C2 tools, methods, and procedures necessary to fly, fight, and win a war in space. This operations center is rapidly helping us better understand how to link all space stakeholders to better defend space capabilities.

As we train and equip Airmen to deter and win a war that may extend to space, we must also acknowledge that successful war-fighting concepts incorporate proven, multidomain principles of war such as maneuver, security, and offense. Similar to successful war-fighting conceptual frameworks of the past such as Air-Land Battle, a construct to fight a war that extends to space must blunt aggression, seize the initiative, and terminate a conflict on terms favorable to US national interests. Communicating and resourcing this strategy only strengthens our deterrent position. The nation and our war fighters deserve nothing less. Our sacred promise must be to ensure our sons and daughters remain the best-equipped Soldiers, Sailors, Marines, and Airmen on the battlefield.

Gen Douglas MacArthur famously said, "The history of the failure of war can almost be summed up in two words: too late. Too late in comprehending the deadly purpose of a potential enemy. Too late in realizing the mortal danger. Too late in preparedness." We must heed these words today. Protecting and defending our space capabilities is a national imperative. Just as the Air Force has done in the past 70 years, now is the time to unlock the ferocious and disruptive ingenuity of our Airmen. We must continue to rapidly evolve war-fighting operational concepts and simultaneously organize, train, and equip Airmen to ensure our ability to deter adversaries from extending a war to space, and if necessary, to win decisively. Ceding the high ground is not an American way of war—not then, not now, not ever. ✪

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Col Gregory J. Gagnon, USAF

Colonel Gagnon (BA, Saint Michael's College; MS, Naval Postgraduate School; MS, Air Command and Staff College; MS, National War College) currently serves as the director of the Commander's Action Group, Headquarters AFSPC, Peterson AFB. In this capacity, he is directly responsible to the commander for executive engagements, legislative affairs, strategy, speeches, and civic engagements. Colonel Gagnon is a career intelligence officer with an extensive background in intelligence, surveillance, and reconnaissance and cyberspace operations. He previously commanded the 495th Expeditionary Intelligence Squadron and the 94th Intelligence Squadron. Colonel Gagnon is a fully-qualified joint staff officer with staff tours at US Strategic Command and Pacific Air Forces. Before his current assignment, Colonel Gagnon commanded the US Air Force's only offensive cyberspace operations group—the 67th Cyberspace Operations Group.

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The Coming Revolution in Military Space Professionalism

Dr. Brent Ziarnick

Introduction

Many recent events are coalescing to form a critical mass of energy that will soon give birth to the first true generation of military space professionals in history. Space professional development has been a major concern for the DOD, especially the Air Force since the *2001 Space Commission Report*, and a great deal of outstanding work has been accomplished, but three individual but mutually supporting events in 2017 promise to allow the space cadre to flower into full fruition and produce the military space professionals the nation needs. These events are the publication of President Donald J. Trump's new *National Security Strategy*, Rep. Mike Rogers (R-AL) and Rep. Jim Cooper's (D-TN) crusade to form a US Space Corps, and Air Force

Space Command (AFSPC) commander Gen Jay Raymond's execution of his Space Warfighting Construct (SWC), especially its Space Mission Force element originally conceived by US Strategic Command commander Gen John Hyten. The independent actions of these five men have combined to place military space personnel, especially its officer corps, in a position analogous in modern history only to US Navy officer corps of the 1890s—a group of highly skilled operators on the verge of attaining the heights of comprehensive professionalism.

Professionalism

To understand professionalism, it is first necessary to define the term and determine if that definition is sufficient for its task. The USAF defined a *space professional* in 2004 as a person "skilled and knowledgeable in the development, application and integration of space concepts, doctrine and capabilities to achieve national security objectives."[1] For almost two decades, the Air Force has attempted to build space professionals under that definition, and great strides have been made. Strict requirements for the professional development of the space cadre, in addition to the rigors of USAF professional military education (PME), have made today's space cadre perhaps the most skilled and knowledgeable at their job in the history of the Air Force.

However, in the recent congressional debates regarding Rogers and Cooper's drive to establish a Space Corps, Air Force leaders did not—by some accounts—comport themselves as well as expected in discussions with Congress. Rogers and others asked questions about the ramifications of advances in commercial space and other space subjects often encountered in today's news, and the responses by USAF officials were not satisfactory enough for Rogers and Cooper to drop their call for a Space Corps. The rank and file USAF space cadre responded to the national debate with overwhelming and deafening public silence. Arguably, at least in the open sources media, the USAF and the space cadre's performance did not assuage Congress' worries that something was very wrong with military space.

Perhaps some reason for the space cadre's lackluster performance may be found in the Air Force's definition of *space professionalism*. By way of comparison, naval historian Ronald Spector defined *professionalism* "as the process by which an occupational group acquires or develops a specialized, theoretical body of knowledge related to its area of expertise, develops a heightened feeling of group identity which is usually accompanied by the emergence of professional associations and journals, and takes on a body of rules and standards which regulate its relationship to the public."[2] This definition is much more expansive than the definition used by the Air Force space cadre.

Reviewing the USAF space professional development program (SPDP) through Spector's lens is revealing. The SPDP certainly attempted to develop a heightened feel of group identity by identifying the members of the Air Force space profession and adjusting the space occupational badge from the smaller, nonrated space and missile badge to the modern "spings," a much larger badge with prestige of place equal to rated badges like pilot and navigator wings, and even look indistinguishable from wings at a distance.[3] The *High Frontier Journal*, published quarterly by AFSPC

from the summer of 2004 to August 2011, encouraged further professionalism, although the Air Force major command effort did not prove as resilient or intellectually stimulating as private military professional associations such as the US Naval Institute and its *Proceedings* journal or the Air Force Association have been. Arguably, the rules and standards regulating the space cadre's relationship to the public is accounted for sufficiently by the simple fact that the space cadre are military personnel. The USAF SPDP accomplished many of Spector's requirements for a profession—save one.

The SPDP focused on skills and training and was successful in those areas, but in many ways it did not prove equally successful in developing a specialized, theoretical body of knowledge related to its area of expertise. SPDP schools, such as Space 200 and 300, imparted much deeper instruction into the execution of space power, and advanced courses developed experts across the many space systems fielded by the Air Force. Consequently, the USAF SPDP has trained skilled operators to expertly serve the joint war fighter. However, time for theory and professional reflection in the SPDP was always lacking. Program courses were invariably a short few weeks and long days. Theoretical knowledge on space power is intangible and, by military necessity, was discarded as more pressing training matters impinged on the limited time for the SPDP in the space cadre member's career.

In the short term, discarding theory may have been the only responsible decision available, but perhaps the long-term consequences of that decision have revealed themselves in the Space Corps debate. Just as a master electrician may be able to perfectly wire a five-star hotel but would generally not be able to discuss the pros and cons of a superconducting power grid effectively, the USAF space cadre may be excellent at providing military space support to the joint war fighter but may also be susceptible to be completely nonplussed by space questions that differ significantly from their day-to-day activities. Without a theory that coalesces the myriad skills of the space cadre into a coherent and complete system of specialized knowledge of space operations, as Spector advises is necessary for professionalism, perhaps the space cadre will never be able to act as consummate professionals. Fortunately, a new front in the revolution into space professionalism will soon be in progress.

Setting the Stage for Revolution

Circumstances are providing an almost perfect setting from which true space professionals will emerge because they are providing essential elements to the space cadre that have, until now, been absent. First, the new *NSS* published in December 2017 provides a much needed national vision and direction to fuel the revolution of military space professionalism. Pillar III of the *NSS* is to "Preserve Peace through Strength." In Pillar III's section on space,, the *NSS* states that the "United States considers unfettered access to and freedom to operate in space to be a vital interest." Further, the *NSS* describes three "priority actions" for the US in space, two of which directly interest the military space cadre. First, the *NSS* directs that the nation must "advance space as a priority domain" and charges the National Space Council (NSpC) to "develop a strategy that integrates all space sectors to support in-

novation and leadership in space." Additionally, the *NSS* also directs the government to "promote space commerce," charging the government space programs to partner with US commercial space entities to "improve the resiliency of our space architecture" and, very interestingly, to "consider extending national security protections to our private sector partners as needed."[4] All of these pronouncements are very important. The *NSS* stresses the importance of the NSpC in national-level space strategy (in which the military space effort will have a significant role) and places emphasis on the military missions of ensuring access and freedom to operate in space and potentially defending space commerce. Of note, these missions were only achieved by the US in the sea domain when the Navy achieved professional status in the early twentieth century.

The second event driving the emergence of true space professionalism is Rogers and Cooper's efforts to establish a US Space Corps, which culminated in the 2018 National Defense Authorization Act (NDAA). Rogers opened his public campaign to reform national security space in an address to the 2017 Space Symposium in Colorado Springs, Colorado in early April. In his remarks, the congressman addressed many perceived flaws in the current system, including what he saw as a lack of promotions among space professionals in the Air Force, paltry space education, and career management, a bloated and confused space bureaucracy with a distinct lack of accountability, and inadequate funding for space programs.[5] Of specific interest to space professionalism, Rogers called for a single person dedicated to "leading [the military space] effort who wakes up every day and thinks about how to have the best military space program in the world. This leader must have the authority to make things happen and will be accountable for success." Rogers continued, arguing that "space needs to be put on par with the other domains of conflict" and that:

> there must be a clearly identified cadre of space professionals who are trained, promoted, and sustained as space experts. Air Force leaders have talked about normalizing space and treating space as a warfighting domain. All other domains of air, land, and sea have established cultures, professions, and identifiers. Now it's time for space to have the same. Because at the end of the day, we all know it comes down to people.[6]

Rogers and Cooper intended to make these changes and others by including a provision in the House version of the 2018 NDAA mandating the creation of a US Space Corps under the Department of the Air Force with the space authorities necessary to enact Rogers' change agenda. While the measure easily passed the House, the proposed service was highly controversial in the Senate and was opposed by President Trump, Defense Secretary James Mattis, Air Force Secretary Heather Wilson, and Air Force Chief of Staff Gen David Goldfein. Ultimately, the Space Corps proposal was dropped in the final NDAA, but Rogers and Cooper gained many concessions in negotiation with the Senate. Among other changes it made to national security space, Rogers has claimed the NDAA made AFSPC the sole authority for "organizing, training, and equipping all space forces within the Air Force," rather than the Air Force itself, although this interpretation has been challenged. Rogers and Cooper, seemingly losing the fight to authorize the Space Corps to its Senate opponents, nonetheless claimed that the NDAA "refashioned AFSPC similar to the Air Corps Act of 1926, which established the Army Air Corps."[7] It is an interesting

irony that the Air Corps Act itself was mostly a gutted version of Maj Gen Mason Patrick's proposal to reorganize the Air Service under a Marine Corps-type model that did little more than change its name to the Army Air Corps to increase its apparent prestige. Meanwhile, its 2017 counterpart grants AFSPC most (certainly not all) of the authorities of a Marine Corps-like independent organization but did not grant the "space service" a more prestigious name.[8] Important to professionalism, the NDAA may have confirmed the top military space professional—the single uniformed person to worry about the military space program Rogers originally wanted—by extending the commander of AFSPC to a six-year term armed with a dramatically increased set of responsibilities and authorities.

General Raymond, the current commander of AFSPC, can be considered the biggest winner of the 2018 NDAA. With a six-year term, he will have the longest tenure of any AFSPC commander and has been charged with managing AFSPC's expanded organize, train, and equip role, and has also been granted operational command of all US military space forces as the first-ever US Strategic Command joint force space component commander, among other changes. Speaking of the NDAA, General Raymond said, "It will help us get where we need to go. I always talk about having a foot on the accelerator. But I don't just want to have a foot on the accelerator. I want to run laps around our competitors."[9]

General Raymond intends to run those laps by pursuing the SWC, an effort designed to prepare AFSPC to both fight through and prevail in a space conflict, the third and most important of the three events driving space professionalism. Built on the previous work of the former AFSPC commander, General Hyten, the construct is comprised of six interconnected efforts: the Space Enterprise Vision, a joint AFSPC/National Reconnaissance Office pathway to develop a resilient space enterprise that can both deter and prevail in a space conflict; a set of space warfighting concepts of operation for space situational awareness, command and control, and other operations, that will determine how AFSPC will fight and ensure success against a thinking adversary; resilient architectures; enterprise agility; and partnerships with civilian and allied space programs; and the Space Mission Force (SMF), the human capital strategy for the SWC, which intends to revolutionize the development of space operations crews (the heart of the space cadre) with advanced training scenarios on employing their space systems in and through an operationally degraded environment.[10]

While the *NSS* and the NDAA provide critical support, from the SMF will emerge the seeds of the revolution in space professionalism. General Hyten's *Space Mission Force* white paper, dated 29 June 2016, outlines the SMF well. General Hyten envisioned the SMF to be an "advanced training and force presentation model that prepares our space forces to meet the challenges of today's space domain." In response to adversary development of space control capabilities, US "space forces must demonstrate their ability to react to a thinking adversary and operate as warfighters in [the modern space] environment and not simply provide space services." The watchword for General Hyten's SMF is *training*. Hyten emphasizes pushing space crews to their limits and beyond through both continuation training—maintaining and enhancing foundational skills—and advanced training,—designed to teach crews how to overcome new and emerging counterspace threats. In addition, the

general also recommends participation in wargames to "enhance understanding of future warfighting concepts."[11] General Hyten's vision is unparalleled in scope and importance in the development of space professionalism. However, one word in conspicuously absent in the document—*education*.

General Raymond's invaluable contribution to the SMF through his SWC concept, besides his intense focus on executing the SMF in the tactical space units, is his recognition that education must be a part of the SMF concept for it to be truly complete. While there much debate over exact differences, for SMF purposes it's helpful to differentiate the terms by assuming training is about imparting skills and education illuminates theory. Using these definitions, we can see how the 2004 definition of space professionalism did not specifically mention education into theory as a goal of the program, although it did mention doctrine and concepts, without a solid grounding in theory both items are often brittle and transitory and cannot impart lasting professionalism. Spector's definition posits that the space professional development program since 2001 has not achieved true professionalism because it has focused on training but not education, skills but not theory, and consequently has not yet developed the specialized, theoretical body of knowledge related to its area of expertise required of true professionalism. However, General Raymond has identified and corrected this oversight. Fortunately, history provides a wonderful example of how a military organization can use education to crest the final hill before winning the title of professional.

Lessons from the Navy

In many ways, the state of the military space care of 2018 is similar to the state of the military sea cadre of the late 1800s. To historian Elting E. Morison, officers of the US Navy in 1890, while gentlemanly, were anything but professional. He explained:

> In all, nobody really quite knew why there was a Navy at this period. The definition of what a Navy was supposed to do and how it was supposed to do it was not clear. There was no naval doctrine. There were no strategic ideas and there were very few tactical rules except the rules of thumb. In strategy the highest thought was that you existed to protect the coastline.

As Morison describes it, "Naval society was run by faith and habit," and little else. There were individuals who made interesting advances in navigation, in steam engineering, and in gunnery, among many others, but they were without any unifying significance that a naval officer could identify. However, all that changed beginning about 1890 when that habit began to be supplanted by the first real theory in naval history.[12]

The theory was found in Adm Alfred Thayer Mahan's *The Influence of Sea Power upon History*, and it was based on then-Captain Mahan's lectures he presented to classes of the Naval War College. He had developed the theory that allowed the Navy to become professionalized, but he did not professionalize the Navy. The man who professionalized the Navy was rather Adm Stephen Bleecker Luce, naval reformer and founder of the Naval War College. Admiral Luce spent the majority of his career increasing the professionalism of the Navy by instituting advanced training

for both officers and enlisted personnel. He wrote the first book on sailing, *Seamanship*, for midshipmen as an instructor at the Naval Academy in 1863. By the early 1880s, his training ship system was bringing the newly-skilled Navy to the edge of professionalism, but Admiral Luce knew that one last requirement remained—the scientific study of war. Therefore, he devoted the rest of his life to the nurturing of the Naval War College.

Admiral Luce's vision was to establish an institution where officers could concentrate on the highest levels of their profession—war. With the heightened training across the service and the naval officer corps edging closer to professionalism in the late-nineteenth century, many officers decided to take advanced study in various arts: geology, ornithology, engineering, and astronomy. These were fine so far as they went, Admiral Luce believed, but they did little to advance the Navy. He thought that this increase in education was due to officers becoming bored with naval life and seeking education wherever they could find it—and it wasn't in the Navy. Why not, then, provide a way for the naval officer to study the naval profession instead of borrowing professionalism from another field? Thus, he founded the Naval War College so the naval officer could study his profession proper.

As its first president, Admiral Luce also instilled the institution's intellectual academic philosophy. He believed that naval officers using inductive reasoning, thinking about specific events to infer broad generalizations and then comparing these generalizations with tested principles from military strategy, could begin to develop a science of naval warfare.[13] With this science of naval warfare, seemingly isolated technological advances in naval warfare, such as new optics, wireless communication, steel hulls, and steam engines, could investigated from a common vantage to assess their utility in naval warfare.

Luce considered "science" the collection of data linked by a generalized theory and accepted principles through the use of inductive reasoning. Citing an example that would be familiar to the modern space cadre, he explained, "while Tycho Brahe himself knew not the real value of his own work [compiling a comprehensive set of astronomical and planetary observations], [Johannes] Kepler, generalizing from the great mass of observations, was led to the discovery of those three great laws [Kepler's laws of planetary motion] which won for him the proud title of 'Legislator of the Heavens' and opened the way for the final generalizations of [Isaac] Newton."[14] Admiral Luce then expounded how a similar science can be erected around naval warfare:

> Now, naval history abounds in materials whereon to erect a science. . . and it is [the Naval War College's] present purpose to build up with these materials the science of naval warfare. We are far from saying that the various problems of war may be treated as rigorously as those of one of the physical sciences; but there is no question that the naval battles of the past furnish a mass of facts amply sufficient for the formulation of laws and principles which, once established, would raise maritime war to the level of science. Having established our principles by the inductive process, we may then resort to the deductive method of applying those principles to such a changed condition of the art of war as may be imposed by later inventions or the introduction of novel devices.[15]

However, Admiral Luce noted that nineteenth-century science rarely emerged from whole cloth and often the generalizations required for imposing order on data

often came from a different field of study. But where can one start to look for general principles, and how might principles be best tested for truth? He called his preferred system the "comparative method" and offered:

> naval tactics, using that word in its more extended sense, becomes scientific only through *comparative* tactics. For, having no authoritative treatise on the art of naval warfare under steam, having no recognized tactical order of battle, being deficient even in the terminology of steam tactics, we must, perforce, resort to the well-known rules of the military art with a view to their application to the military movements of a fleet, and, from the well-recognized methods of disposing troops for battle, ascertain the principles which should govern fleet formation. Thus, from the known, we may arrive at something like a clear understanding of what is now mere conjecture. *It is by this means alone that we can raise naval warfare from the empirical stage to the dignity of a science* (emphasis in original).[16]

Admiral Luce concludes his description of the Naval War College's scientific philosophy with a final charge, "Inspired by the example of the warlike Greeks, and knowing ourselves to be on the road that leads to the establishment of the science of naval warfare under steam, let us confidently look for that master mind who will lay the foundations of that science, and do for it what Jomini has done for the military science."[17] Admiral Mahan eventually became that master mind, but he would not have been found had Admiral Luce not lighted the path of discovery so successfully.

Can the same path light the way to develop a similar science for the military space cadre and lead them to true professionalism? General Hyten seems to think so. His *Space Mission Force* white paper states, "As we define and implement the SMF, AFSPC will adopt proven principles of operational art from other domains and apply them to space. We will tailor these proven methods, principles and terms to account for our unique domain and apply them."[18] What else is this than another restatement of Admiral Luce's comparative method? General Raymond has taken AFSPC a dramatic and important step further, by creating a dedicated program for education in space warfare.

The Schriever Scholars Program

The task of developing a science of space warfare has fallen to Air University (AU), just as it successfully developed a science of air warfare almost 80 years earlier. AU was selected not only because of its history, but also because it had the right infrastructure with which to form such an effort. That effort, the Schriever Scholars Program (SSP) curriculum at Air Command and Staff College (ACSC)—beginning in July 2018—is the nation's first academic year-long, degree granting, PME program that will provide Development Education and Joint Professional Military Education (JPME) credit with a focus on military space issues. As one of the three "concentrations" available at ACSC, SSP graduates will be awarded an accredited Master of Military Operational Art and Science (MMOAS) degree as well as JPME Level I and in-residence Intermediate Developmental Education (IDE) credit, as all ACSC graduates receive. SSP's sister concentrations include the highly successful and competitive Multi-Domain Operational Strategist (MDOS) program and the School of Advanced Nuclear and Deterrence Studies (SANDS). Among them, SSP is unique.

The MDOS program has existed at ACSC for many years and SANDS, while new to ACSC, has existed as an independent school since 2015 devoted to the study of a classic field—nuclear deterrence. SSP, on the other hand, was personally directed by General Raymond to offer selected students an intensive, year-long curriculum devoted to the study the science of space war.

SSP students will come from many different background but with one common interest—space power. The initial class of SSP students will be one ACSC seminar—13 students. More than half of the students will be AFSPC-selected core space operations officers. Since SSP is intended to be a capstone space-centric experience, space operator students are highly encouraged to be graduates of Space 200 and 300, the critical space education courses managed by the National Security Space Institute (NSSI). SSP is intended to allot students the maximum amount of time to think about the science of space warfare. Only the NSSI's rich space education will enable SSP students to be wholly armed to take advantage of its opportunity.

To add richness to the experience, one Army and one sea service (Navy or Marine Corps) students will also be chosen by SSP faculty to attend to offer their joint opinions on the subject of space power. The remaining student positions will be filled by acquisitions, engineering, science, or intelligence officers with space experience. All students will have appropriate security clearances for the course, and capable of advancing the science of space warfare.

As Admiral Luce demanded of naval officers, SSP requires budding military space professionals "to study their profession proper—war—in a far more thorough manner" than has ever been "heretofore attempted, and to bring the investigation of the various problems of modern" space warfare "the scientific methods adopted" in the other professions.[19] Just like the early NWC, SSP applies the comparative method to turn space warfare into a true science. Their experience from the SMF training efforts, as well as their own background operating in the contested space domain, will provide the empirical "grist" from which SSP students and faculty, utilizing the comparative method, will develop the science of space warfare through comparing the facts of space operations to the sciences developed for terrestrial warfare, including its land, sea, and air branches, to discover the principles necessary to build the science of space warfare. The SSP curriculum is specifically designed to engender and advance that lofty goal.

The Schriever Scholars Program Curriculum

To ensure that the Schriever Scholars become true war fighters, the SSP curriculum takes advantage of the inherent strengths of the Warfighting component of the ACSC core curriculum: War Theory, International Security I and II, and Joint Warfighting. These courses, which span all four terms (or quarters) of the academic year, are intended to fulfill the DOD's mission to "provide combat-credible military forces needed to deter war and protect the security of our nation."[20] These courses form the backbone of the profession of arms by asking fundamental questions, beginning with what constitutes war (War Theory), then proceeding to why wars occur (Inter-

national Studies I), through how wars are fought (International Studies II), and ending with how wars are planned (Joint Warfare).[21]

To arm the Schriever Scholars with the space domain-specific understanding with which to ponder the science of space warfare, the SSP takes three separate approaches. First is the SSP's dedicated Spacepower component. Spacepower I explores the capabilities and limitations of space power through a comprehensive review of space-centric military and technology theory, as well as the history of the US space program. Spacepower II prepares the Schriever Scholars for the Joint Warfighting capstone course by adding both modern space power history and forming a space-centric view of establishing space superiority before successful integration can take place.

The second approach to develop space domain expertise is a series of SSP core courses that replaces ACSC's regular elective curriculum. Schriever Scholars take a specialized Space Horizons course that interprets space power from a holistic national perspective, including the civil space program and emphasizing the impact of commercial companies and visions of classic space power as critical drivers of space innovation. The second specialty course, Space as a Contested Domain, is a classified elective in which the students will study current documents and the history and lessons learned from modern space operations to found their own concept of the science of space warfare on the firmest foundations possible. Lastly, the Schriever Scholars will engage in a number of research trips, both individually and as a group (to be determined), to explore the state of space power in the field.

The End of the Beginning of Space Professionalism

When they have displayed the theoretical competence to advance both the science of space warfare and apply that science to the practical considerations of joint multidomain operational planning and problems of national space power, SSP students will have proven themselves worthy of being called SSP graduates. As ACSC in-residence graduates, they will receive their MMOAS graduate degrees, JPME Level 1 certification, and credit for IDE in-residence. As SSP graduates, their follow-on assignments will be personally managed by the AFSPC director of operations (A2/3/6) through each officer's specialty development teams. Moreover, as SSP graduates, they will be uniquely suited to educate others in the science of space warfare, and to further their personal mastery of the subject. Collectively, they will become the first true military space professional class, armed with the theoretical understanding of the science of space warfare and ready to apply it to the pressing needs of the nation in the twenty-first century.

However, like the Navy more than a century earlier, becoming a military space professional will not require attendance at SSP. Indeed, not every space operator ACSC student (perhaps not even the majority) will be required to attend SSP and will instead complete the general ACSC curriculum, where they will take advantage of one of the most rigorous airpower curricula available. Rather, the science of space warfare that SSP aims to develop will become Spector's "specialized, theoretical body of knowledge" related to the space cadre's area of expertise required to elevate today's space cadre into space professionals. SSP graduates may be the founders of

comprehensive military space professionalism and the first scientists of space warfare, but they will not be the only ones. The fully-developed military space professional class will far surpass the tiny halls and scant graduates of the SSP program and spread across AFSPC, the USAF, DOD, and perhaps across the US. SSP and its graduates may, like Adm Stephen Bleecker Luce and Adm Alfred Thayer Mahan for the sea, drop the first stone into the pond of comprehensive space professionalism, but the wave made by the first generation of true space professionals will ripple far beyond the USAF, the DOD, or the nation.

Armed with a science of space warfare, the fully-equipped Air Force space professionals will be able to overcome all challenges the nation faces in space. Adversary aggression in the space domain will be thwarted and deterred. Enlightened government and military actions toward the burgeoning commercial space industry will maximally secure both US security and economic interests in space. Senior leaders will be able to assuage congressional concerns authoritatively and decisively. American leadership in all aspects of the space domain will excel.

The men and women at the forefront of the revolution in space professionalism sparked by the vision of President Trump and the efforts of Congressmen Rogers and Cooper and Generals Hyten and Raymond may help lead the world to unprecedented prosperity through space guarded by a thorough knowledge of how to defend that prosperity from all aggression. The impact of space professionals on America's national development will meet or perhaps even exceed that of their terrestrial brethren. But to do so first requires that they understand the specialized, theoretical knowledge that is unique to their profession. The great men who have galvanized the revolution have done their job. It is now up to the US space cadre to finish the task. The Air Force, the nation, and the world need complete space professionalism now! ✪

Notes

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Improving How the Air Force Develops High-Potential Officers

Maj Steven T. Nolan Jr., USAF
Dr. Robert E. Overstreet

Unlike industry where a company can bring in senior leaders at any time, USAF senior leaders are a product of more than 20 continuous years of deliberate career development. Therefore, young officers who are thought to have the potential for senior leadership must be identified early in their careers and vectored to the right opportunities. How these officers are identified, assessed, and developed is not well understood by most of the USAF.

Every officer's performance is continually assessed and documented to provide a means of stratification within squadrons, groups, wings, and so forth. Officer Performance Reports (OPR) and Training Reports (TR) track these assessments, the verbiage used, and awards achieved, and stratification among peers serve as a "reliable,

long-term, cumulative record of performance and promotion potential." Once an officer accumulates the requisite years of service to compete for the rank of major and above, a Promotion Recommendation Form (PRF) summarizes the highlights of that officer's career and communicates "performance-based potential."[1]

The term *potential* is an important distinction because the word is not synonymous with *performance*. In fact, high performance is often mistaken for high potential.[2] The difference between the two does not mean that performance and potential are mutually exclusive. While most high-potential (HiPo) employees are also high-performing, the opposite is not always true. Although it may seem an innocent mistake to confuse the two descriptions, Andre Lavoie, the chief executive officer of ClearCompany, stated that "not being able to distinguish between performance and potential will make it difficult for employers to identify, develop and retain talent."[3] Furthermore, Lavoie claims that there is a cost associated with not delineating between the two. According to the Korn-Ferry Institute, the cost of misidentifying a HiPo employee is three-fold.[4] First, misidentification leads to pushing employees into roles that they are not qualified for or do not desire, which in the USAF may jeopardize the mission and damage an officer's career. Second, misidentification leads to mediocre performance, which may lead to a decrease in organizational morale and an increase in employee turnover. Third, misidentification leads to employees losing faith in the human resources (HR) department (the Air Force Personnel Center for the USAF), which is the perceived owner of the organization's talent.[5]

The implications of successfully identifying potential can have positive strategic military effects as outlined in the *USAF Strategic Master Plan* (*SMP*), *Human Capital Annex* (*HCA*). The HCA is one of four annexes to the SMP that translates goals and objectives required to achieve USAF strategy into initiatives and priorities. Under the "Talent Management" section, the HCA states "the detailed, personal management of the small subset of Airmen who possess those ever-shifting skills, special experiences, and high potential will enable the strategic agility the Air Force of the future demands."[6] Although the USAF references the word *potential* in numerous documents, no characteristics or attributes are explicitly stated to aid personnel directorates in synchronizing their efforts to achieve the strategic guidance outlined in the HCA.

Consequently, the problem faced by the USAF is that there is an incomplete understanding of how to differentiate HiPo company grade officers (CGO). Therefore, the purpose of this study is to improve the way the USAF identifies, assesses, and develops HiPo officers. To that end, we drew upon multiple data sources, such as scholarly journals, magazine articles, talent management case studies, webinars, and textbooks to fully immerse the researchers in the case. Once immersed, we conducted semistructured interviews to assess the perceived or realized differences between an officer's performance and their future potential. What follows is a brief review of the literature, a discussion of our methodology, and our analysis, which leads to our seven recommendations for the USAF:

1. Establish a formal definition of HiPo officers.
2. Evaluate officers against institutional competencies.
3. Adopt a simple, executable model to evaluate potential.

4. Increase the roles and responsibilities given to CGOs.
5. Development teams (DT) must have the power to utilize the assignment process as a means to deliberately develop officers.
6. Replace below-the-zone (BPZ)/in-the-promotion zone (IPZ)/above-the-promotion zone (APZ) promotions with promotion windows.
7. Allow DT notes, vectors, and Airman Development Plan (ADP) comments in the management-level review (MLR) and Central Selection Board (CSB) process.

Literature Review

The researchers noticed significant, similar descriptions of a HiPo employee. Utilizing Nvivo's Word Cloud tool, we populated the program with various "high-potential" articles and reports focusing on specific characteristics describing HiPo employees. Scholarly articles were equally weighted, and multiple instances of the same word were ignored to avoid skewing the query. As shown in the figure, results highlighted an emphasis on an individual's drive, learning, agility, and leadership, which were also coincidental with Dr. Rob Silzer and Dr. Allen A. Church's findings in their 2010 corporate survey.[7] In the survey, organizations' top three HiPo identification factors were leadership competencies, past performance, and career aspiration. Other factors considered were adaptability, commitment, experiences, mobility, and learning ability.[8]

Figure. Common descriptors of high-performing individuals

While the factors of HiPos are valuable in increasing the prediction probability of a person's future potential, most people inquire: "potential for what?" The question is valid and is best explained by viewing potential in three different time frames: past-looking, near-term, and long-term. Past-looking definitions are best suited for static, nonrapidly changing environments as future roles are similar to past or current positions. Only 10 percent of organizations identify HiPos in this manner. Near-term potential involves looking one to two jobs in the future and matches a person with a function. Approximately 25 percent of companies define potential this way and categorize potential by level or strategic position.[9] Projecting long-term potential means identifying ambiguous future roles for HiPos and is associated with potential by breadth or by role.[10] Depending on the organization, one or all three definitions categorize different talent groups.

Silzer and Church discovered organizations cluster HiPo talent into four, "band-level" designations.[11] The purpose of categorizing this way ensures a company maintains an appropriate talent level throughout the organization while maximizing its strategic competitive advantage. The four levels are: top potential (senior-level potential), turn potential (next-level potential), grow potential (the same level but expanded), and mastery potential (same work, same level).

Senior executives play a significant role in an organization's HiPo solicitation and nomination process. Typically conducted on an annual basis, the process is top-down driven. Managers at all levels can nominate candidates based on the organizational definition and categorization of HiPos. As a nominee's "package" travels through the organizational hierarchy, higher-level managers assess, approve, or remove prospective HiPos, providing senior leaders a calibrated list of candidates. Additionally, organizations leverage advanced data collection technologies, capturing a candidate's background information, which bolsters a wide array of assessment tools.[12] Current tools in use are leadership competency surveys, 360-degree interviews, practical competency measures, career background interviews, cognitive ability tests, personality inventories, assessment centers, or individual assessments. Depending on the organization, collected data is either used to make initial HiPo decisions or serve as an assessment tool for individuals already accepted as a HiPo talent. If an organization uses the data for the latter, it is intended to facilitate an individual's development.

Once identified as a HiPo talent, organizations begin preparing individuals for future leadership roles through systematic development. Irrespective of the transparency of HiPo designation, senior leaders continuously review and discuss developmental opportunities for HiPo employees. Examples of deliberate development include but are not limited to formal leadership programs, access to coaches or mentors, in-depth executive assessments, career planning, distinctive work assignments (projects, task forces, or temporary assignments), or executive education courses.[13]

Although companies execute an exhaustive process for identifying HiPo talent, research shows 5–20 percent of initially labeled HiPos do not succeed during the developmental process.[14] This failure may be a result of misidentifying HiPo talent or a sign of an inefficient developmental process. In either case, the research is clear HiPo identification is an inexact science.

Air Force Pamphlet (AFPAM) 36-2506: *You and Your Promotions—The Air Force Officer Promotion Program* outlines and communicates the timeline, procedures, and criteria used for officer promotion. Additionally, the document serves as a baseline for the USAF talent management processes and practices that facilitate the service's ability to distinguish the performance and potential of its officers. The seven major distinguishing criteria for officer evaluations are job performance, leadership, professional qualities, breadth and depth of experience, job responsibility, academic and professional military education, and specific achievements. The USAF evaluates every officer's relative potential and refers to the grading process as the whole-person concept, which is now called "Whole Airman Factors."[15]

The USAF defines potential as "performance-based" and uses numerous forms to create a "cumulative record of performance and promotion potential based on that performance."[16] It is then fair to assess that USAF HiPo talent is categorized by record.[17] This type of talent categorization best suits organizations in nonrapidly changing environments, or when future roles are similar to the past positions; only a minority of organizations identify HiPos in this manner.[18] Moreover, categorizing talent "by record" is incongruent with the USAF's current strategic guidance.

In 2015, Gen Mark A. Welsh III, then the USAF Chief of Staff, emphasized two strategic imperatives: agility and inclusiveness. He stated, "we must commit to changing those things that stand between us and our ability to rapidly adapt."[19] Moreover, the *Air Force's SMP/HCA* parlayed this sentiment into its "Talent Management" section. One deliverable was for the USAF to "ensure an institutional HR system capable of rapidly recognizing and adapting to the changing environment."[20] This statement insinuates certain changes must occur for the USAF to identify its "small subset of Airmen who possess those ever-shifting skills, special experiences, and high potential."[21] Currently, the only conduits for capturing potential are through the OPR, PRF, TR, and Letter of Evaluation documents, as well as vetting through DTs, MLRs, and CSBs.

One major component embedded in OPRs and PRFs is the extensive use of stratifications differentiating officers among each other. Accompanying the stratification is the push line, whereby the rater communicates an officer's potential for future leadership roles. However, the rater's assessment of future potential is restricted due to limits on the rater's competency to judge requirements for service at higher levels beyond the rater's own experience, notwithstanding the limited scope of communicating potential, the lack of a numerical figure, introduction of a percentage, or numerator greater than one indicates a lesser caliber of an officer. Additionally, there is an implied distribution of stratified officers. Nevertheless, it is arduous to determine where the numerical tiering occurs. Furthermore, the second and third-level stratifications are confusing. What is the difference between "one of my best officers" and "top 10% in the wing?" It seems to imply that "one of my best officers" is less than 10 percent of top officers, but greater than an "outstanding" officer.

The USAF also describes 8 institutional competencies (IC) and 25 subcompetencies.[22] ICs are "the foundation for developing professional military education programs," and those programs "allow Airmen to understand and *possibly* demonstrate the desired IC proficiencies."[23] Additionally, ICs are intended to "create the appropriate strategies, policies, and processes required to prepare all Airmen with the

necessary leadership expertise to accomplish assigned airpower missions."[24] Furthermore, the explicitly stated purpose of ICs is to "set behavioral standards of leadership for all levels," and ICs are "observable, measurable patterns of knowledge, skills, abilities, behaviors, and other characteristics needed to perform institutional of occupational functions successfully."[25] Observations and measurements are divided into five distinct levels: basic, intermediate, proficient, skilled, and advanced. Each measurement corresponds to various pay grades and applies to both enlisted and officer personnel, as well as civil servants. In many instances, there is an expectation for enlisted, officer, and civil servants to demonstrate the same level of proficiency. In any case, it stands to reason these competencies are intended for inclusion in an officer's performance evaluation to gauge their developmental progress as well as assess their future potential.

Methodology

An intrinsic case study design was used to better understand the characteristics or attributes of a HiPo CGO and how the USAF can better identify, assess, and develop them. Emerging themes, from senior leader interviews, served as the units of analysis for this article. As themes emerged, the researchers coded and tracked the data with Nvivo qualitative research software.

We invited 18 USAF senior leaders to participate in the study, and 14 senior leaders accepted (77.7-percent response rate). These 14 senior leaders had an average of 28 years of service and had DT, MLR, or CSB experience, as well as multiple command tours. In total, ten general officers and four colonels with flying, maintenance, special operations, or cyber experience were interviewed to gain their perspectives on HiPo officers.

We conducted semistructured interviews in person, over the phone, and via email. The medium used was entirely dependent on the participant, their location, and their schedule. The semistructured format is well suited for situations where a researcher may only get one opportunity to interview an individual.[26] Furthermore, Dr. H. Russell Bernard, an anthropology professor at the University of Florida, states "semi-structured interviewing works very well in projects where you are dealing with high-level bureaucrats and elite members of a community—people who are accustomed to the efficient use of their time."[27] We requested each participant's permission to record the interview, and all agreed.

At the conclusion of each interview, we created a denaturalized transcript of the audio file, reviewed notes, and wrote an interview summary to capture themes or keywords and phrases. Denaturalized transcription captures a verbatim depiction of speech, but is not concerned with every utterance.[28] Naturalized transcription, by comparison, analyzes the idiosyncrasies of speech patterns, body movements, and other nonverbal activity which sociologists Dr. Ian Hutchby and Dr. Robin Wooffitt refer to as talk-in-interaction.[29] Therefore, denaturalized transcription was deemed sufficient in capturing the substance, essence, and meaning of the participant's thoughts.

Qualitative data analysis is an ongoing, continuous endeavor conducted throughout the research process.[30] Unlike quantitative research, the researcher collects and

analyzes data simultaneously. The iterative process aids the researcher in organizing their findings for the final report. We used Dr. John W. Creswell's data analysis spiral as a guide to flow through interview data.[31] The data analysis spiral contains the following steps: organize, peruse, classify, and synthesize.

To classify the data, we used codes (that is, tags or labels) for assigning units of meaning to the descriptive or inferential information compiled during a study. Codes are usually "attached to chunks of varying size—words, phrases, sentences or whole paragraphs."[32] Codes help answer several questions such as what is happening, what does this say, and what is the participant conveying? We started with four major coding categories: high-performance officer indicators, HiPo officer indicators, personnel management system processes, and process improvement ideas. These codes were directly related to the central and investigative questions. As the study progressed, we used Nvivo's qualitative research software to track and manage codes. Finally, we implemented Tesch's eight-step coding process to discover emerging themes systematically.[33]

As recommended by Creswell, to ensure reliability and validity of our study we implemented two strategies: triangulation and member checking.[34] Triangulation involves analyzing different data sources to justify themes. During the data analysis phase, we cross-referenced with private industry HiPo employee studies. The purpose of comparing the two was to uncover similar themes in industry. The intent was to link ideas, discover implemented enterprise solutions and how they may relate to the research study. Member checking is a process where the researcher solicits participants' feedback on the interpretations and credibility of the findings. At the conclusion of the study, we conducted follow-up interviews, discussed major themes, and provided an opportunity for participants to analyze the findings critically. The participant comments served as another check on the viability of the researcher's interpretations.[35]

Data Analysis

The primary research data comprised of senior leader interviews with an exhaustive literature review serving as the secondary data source. In total, the researcher referenced or cited 175 scholarly articles, textbooks, and talent management case studies. The literature review enabled the researcher to orient, compare, and help analyze interview data. The 14 interviews totaled more than 12 hours of audio, which equated to 193 pages of transcripts. The medium used for interviews varied with the preponderance conducted via telephone. In all cases, the conversations were recorded using Apple's Voice Memo application or the TapeACall application. Once completed, all audio files were transcribed using denaturalized techniques and Wreally Transcribe software. The researcher concluded the interview process when "data saturation" was achieved.

After all the interviews, the researchers generated 15 codes. Utilizing Nvivo's word frequency query, word cloud, and word tree function, we identified four broad categories and nine subcategories. The four categories were HiPo Indicators, High-Performance Indicators, Perceived Issues, and Recommendations. The eight subcategories were organizational perspectives, categories of potential, HiPo nomination,

HiPo assessment, HiPo development, board issues, system problems, and process problems. As with other HiPo talent case studies, there was an overlap in how participants defined an officer's performance versus their potential. The major task was parsing the difference between the two definitions. Our analysis uncovered the top three HiPo indicators, the USAF's perspective of HiPo officers, and how the participants nominate, assess, and develop HiPo officers.

The top three indicators of HiPo talent, as described by interview participants, were sustained performance, continuous learning, and demonstrative leadership skills. Sustained performance was identified as a major indicator of an officer's future performance as the promotion system is designed to reward such behaviors. A sustained performance methodology is best suited for static, nonrapidly changing environments as future roles are similar to the past or current positions.[36] Furthermore, one senior leader identified this as a problem. While "officers can perform well at one level, that does not indicate they will be successful in future roles."

Continuous learning was another HiPo identifier mentioned by participants. In some instances, participants stated HiPo officers were "life-long learners" while others described them as "inquisitive, reflective, or continuously seeking feedback." The commonality among all the responses was that HiPo officers are not satisfied with their current state. They are always trying to better themselves and others. The focus beyond individual needs and desires embodies the third HiPo indicator which is leadership. All participants mentioned highly-developed leadership skills as a HiPo officer indicator. When combined, these HiPo officer indicators closely resemble industry standards. By comparison, the top indications of HiPo talent in the private sector are drive, learning, agility, and leadership. This discovery indicates that industry best practices may provide pragmatic solutions in the USAF's HiPo officer identification process.

The majority of participants stated stratifications were a means of communicating an officer's potential. Stratifications reside on the fifth and ninth line of an OPR, as well as the bottom line of a PRF. Just as various psychological, communication, and advertising studies indicate last impressions dramatically influence evaluations, so, too, is the placement of stratifications on these official documents.[37] In most instances, participants stated stratifications served as both a current performance and future potential for performance indicator. However, a few participants reported they believed stratifications to be an indicator of only current performance. In any case, when asked how they evaluated records while working on a DT, MLR, or CSB, stratifications were mentioned as a way of differentiating the promotion potential, in all instances. Several of the participants explicitly tempered stratifications with the officers "full body of work."

As commanders, the participants stated their intention of pushing HiPo officers to different jobs or assignments as a means of communicating their potential. In some instances, the other jobs were in the form of challenging projects which received "higher visibility" from senior leaders. A few of the participants stated the purpose of these actions was to highlight the officer's potential based on their knowledge of how the system works. While pushing officers into closer proximity of senior leaders is a way of communicating an officer's potential, the also act serves as a means of assessment. Just as stated in the HiPo assessment process, senior

leaders use "stretch" assignments to challenge officers outside of their core competency. The purpose of a "stretch" assignment is to take HiPo employees out of their normal day-to-day activities and make them accountable for something more strategic in nature.[38]

Beyond stretch assignments, the majority of participants stated coaching, mentoring, and senior leader feedback was a means to develop HiPo officers. Although some may argue coaching, mentoring, and feedback should not be reserved solely for a select group of individuals, multiple studies and articles recommend deliberately investing more resources towards these efforts.[39] The key term, both from previous studies and participants, was the perceived and realized value of deliberately conducting all three activities commensurate with an officer's or employee's talent level.

Most participants stated the boarding process was extremely efficient given the volume of records requiring review. However, 10 of the 14 participants identified several issues with the system or process. One senior leader claimed the most difficult portion of a board was the amount of "homework required, before arrival." In this instance, the participant was discussing a DT and believed that some of the work accomplished on-site should be achieved beforehand. Additionally, several participants mentioned the difference in scoring outcomes when contrasting a DT to a CSB. Although the "population size and makeup the officer is competing with is different, there are times where the scores between the groups are significantly different."

It is important to note that the DT, MLR, and CSB boards do not share scores or information among each other. The only way for DTs to notice a scoring discrepancy is by analyzing promotion results and comparing them to their vector. As an example, if a DT issues an officer a Joint Chiefs of Staff (JCS) vector, they are signaling two things. First, the officer is among the top tier of their community and, second, the officer should be considered for a JCS job opportunity. However, if the CSB does not promote or the officer is not selected for an intermediate developmental education (IDE) opportunity, the DT knows there is a delta between their score and the CSB. This problem may be identified in the reverse order as well. Assume an officer was promoted and was a school select the previous year. The proceeding DT knows this individual did not receive a strong vector and when scoring the records, determined the officer was outside of the top 20 percent of their functional area. In both instances, the DT must reconcile the difference.

There is a tendency to promote familiarity and preference over objective criteria of the service's needs for the future. To be clear, we are not suggesting board members ignore Secretary of the Air Force or commander guidance deliberately when scoring records. We posit that there is a possibility that board members bring their values into the process which is in line with interview responses and Leader-Member Exchange (LMX) theory. LMX theory describes the give-and-take relationship between leaders and their subordinates.[40] In-group members share common value systems while out-group members have little in common with the leader. Research also reveals work units are differentiated through LMX relationships approximately 90 percent of the time. Therefore, the researcher's finding is not uncommon, should be expected, and was reaffirmed in another participant's similar sentiment.

Another senior leader believed "a person's real strength and leadership are not found in a paper record, which is clearly where the rubber meets the road." As the

paper record contains numerous accomplishments during an officer's career, the current system views the accumulation of accomplishments as an analogous metric for talent. Several referred to certain accomplishments as "career milestones." Half of the participants explicitly identified Squadron Officer School (SOS) Distinguished Graduate (DG) as one of these milestones while the other half referenced all awards received from training or development programs as such. While the preponderance of the participants agreed that DG awards were indicative of demonstrating "excellent performance, relative to their peers," 5 of the 14 participants claimed SOS DG was disproportionately weighted.

Although formal training awards constitute one significant discriminator in an officer's records, stratifications on OPRs and PRFs were another issue raised by participants. One cannot overemphasize the value and importance of stratifications. From a commander's perspective, an officer stratification indicates potential. However, one participant rhetorically asked, "Do you think stratifications mean the same thing to all commanders?" The participant went on to say "determining how thinly we slice the stratification is an important distinction." The "thinness" of a stratification describes the specificity of a relevant peer group (for example, "number 1 of 10 2008 instructor-pilot captains" versus "number 1 of 10 captains"). This last statement alludes to the lack of codified or universal way of crafting an officer stratification, which may lead to issues in the boarding process.

Recommendations

The results of this study offer insight into how the USAF delineates an officer's current performance from their future potential. Additionally, the findings illuminate the scope and depth the USAF defines talent at the strategic, operational, and individual level. Based on the literature review and interview data, we provide seven recommendations to improve how the USAF identifies, assesses, and develops HiPo officers.

1. Establish a formal definition of high-potential officers.

This definition must capture the "ever-shifting skills, special experiences, and high potential, which enable the strategic agility the Air Force of the future demands."[41] AFI 36-2406 states potential is "performance-based" and uses numerous forms to create a "cumulative record of performance and promotion potential based on that performance."[42] Air Force Reserve Command Instruction 36-2640 uses the acronym "HP" to mean "high-potential" and says an individual has met a command screening board or on the key personnel list.[43] Headquarters Air Force Air Staff guidance outlines indicators of potential as being a DG from a commissioning source, formal training program, PME, IDE, SDE, high-level OPR stratification, BPZ selection, and other objective criteria. However, all of these areas may not be valid indicators of potential. In fact, research and private industry agree that drive, ability to learn, leadership, and other leadership competencies and skills, are the top signs of HiPo employees. The researcher found the senior leaders interviewed agreed with this conclusion. Consequently, questions left outstanding are what skills

should the USAF measure and how should they measure them? These questions lead to our second recommendation.

2. Evaluate officers against institutional competencies in AFMAN 36-2647.

The purpose of institutional competencies is to "set behavioral standards of leadership for all levels," and to do that they must be "observable, measurable patterns of knowledge, skills, abilities, behaviors, and other characteristics needed to perform institutional and occupational functions successfully."[44] Therefore, these criteria require inculcation into every officer's records. Some may argue this recommendation is too cumbersome and difficult to manage given the current documentation used to evaluate officers—which may be true. However, assuming institutional competencies properly align with the HCA, it is crucial that the USAF act on this recommendation.

3. Adopt a simple, executable model to evaluate the potential of all company grade officers.

Organizations considered to have "best practices" in the field of talent management, use models to identify and assess their employees' potential. Models are available to gauge an employee's future potential. They measure the probability an individual can successfully take on greater roles and responsibilities, in both breadth and depth, as leaders in their organization. These models are an excellent template to use for deliberately and methodically identifying and assessing HiPo CGOs.

4. Increase the roles and responsibilities given to company grade officers.

If the purpose of a HiPo officer program is to identify future leaders, then the assessment process must include leadership challenges that truly test the capability of an officer. These "tests" must be monitored and tracked beyond a stratification or push line. The literature does not include any instances where companies distilled the performance of an individual, or their potential to perform in the future, into one singular number relative to their peers. In fact, the best talent management companies use multiple sources to identify and assess HiPo employees. These sources include an objective assessment of budget management, project impact on business performance, as well as peer, subordinate, and supervisor feedback. The USAF must achieve this level of fidelity of an officer's capability to accurately assess their potential for future leadership roles. The information captured must then be monitored and maintained by a central talent management entity. Currently, force development offices are best aligned to serve this function while DTs are best suited to carry out the annual assessment and development of the HiPo talent pool. Unfortunately, DTs lack the authority to be as effective as intended, which leads to the fifth recommendation.

5. Developmental teams must have the power to utilize the assignment process as a means to deliberately develop officers.

Although DTs must identify "the education, training, and experiences appropriate for officers," the only outputs they provide are assignment vectors and career feedback.[45] The Air Force Personnel Center is the only organization with authority to generate assignments. DTs must be able to pair their developmental strategies with officer assignments. Moreover, the movement of personnel in industry does not happen serendipitously—especially for someone singled out as a HiPo. The assignment and development of a HiPo is a very deliberate process. Employees move to locations where the job experience is intended to prepare them for future roles in the organization. Furthermore, the USAF should consider deliberately placing CGOs with mentors that can facilitate further professional development.

6. Replace BPZ/IPZ/APZ promotions with promotion windows.

Presently, BPZ boards do not follow a similar construct as IPZ and APZ boards. The "Definitely Promote" (DP) allocation rate is 10 percent for BPZ promotions to lieutenant colonel and 15 percent to colonel. Comparatively, IPZ and APZ "DP" rates are 40 and 20 percent, respectively.[46] These DP allotment caps are intended to ensure only "the most qualified records are endorsed" and provide a greater chance that "a significant number of officers receiving "Promote" recommendations" are promoted as well.[47] Although the USAF can promote to their allotted "DP" rate, they seldom do so.[48] Furthermore, the BPZ records scoring is dissimilar to the IPZ and APZ process. First, BPZ scoring starts with an up/down, yes or no vote, which determines which records are considered "Exceptionally Well Qualified."[49] Then, the board scores only those records.

While there are processes in place to calibrate BPZ selects with IPZ selects, a few senior leaders mentioned, with one directly stating, the process was "purely a square-filling exercise." The participant went on to say BPZ boards "look for the markers that stand out (that is, PME DG, what school an individual attended, and the amount of number one stratifications received). These boards look at past career milestones or achievements as analogs for promotion criteria, whereas the IPZ board at least attempts to determine an individual's ability to serve in the next grade." The leader who was interviewed understood the quota system, but he did not understand why the process was different. Likewise, we postulate that HiPo talent or promotion potential is indifferent to year groups.

As such, the researcher proposes an alternative to the current promotion construct by creating promotion windows which look similar to the BPZ timeline but alters the quota system and mentality. The main difference between the two methods is that anyone who is eligible for promotion to lieutenant colonel or colonel would see the same board and be vetted the same exact way. This modification allows for equitability and transparency in the process.

7. Allow developmental team notes, vectors, and Airman Developmental Plan comments in management-level review and Central Selection Board process.

DTs have much more flexibility and latitude when reviewing officer records. According to the senior leaders interviewed, the amount of time spent on each record varies from board to board. However, DTs typically spend eight minutes on a record, while MLRs and CSBs spend two minutes or less per record. Additionally, DTs are allowed to discuss individuals openly and are not bound to the rigid scoring process the MLR and CSB must follow. The reason for this difference is attributable to their respective outputs. An MLR board allocates additional DP recommendations, which provides a demonstrable positive effect on promotion rates, while the CSB promotes individuals. By comparison, DTs offer assignment vectors and feedback, with no formal authority. Still, DTs view the same records, develop a similar rank-ordered officer list, but have the luxury of reviewing an officer's ADP as well. When combined with the functional experience of their career field, the rich data source provides a more robust means to assess the potential of an officer. Why would we not use this information when determining who to promote?

Some may argue this would provide an undue influence on subsequent boards. Our counterpoint is how does the DT support for promotion differ from an MLR DP recommendation? In the end, it is just information, and each board must independently evaluate the future potential of an officer to serve in greater roles and responsibilities. Nevertheless, DTs are best situated to know and understand the officers they evaluate. Therefore, we recommend the results of DTs be packaged and included for MLRs and CSBs to consider. A few ideas offered for consideration are providing: percentiles of officer's standing within their respective community, outplacement vectors, DT notes on individuals, or a DT rank-ordered officer list, which is intended to serve as a comparative analysis tool after a board convenes.

Summary

The USAF faces several challenges in the coming years—whether it is the retention of personnel or fiscal constraints. The current operating environment dictates a fresh look at the various ways the USAF conducts business. Therefore, it is imperative that the USAF effectively identify, assess, and develop its top talent to succeed in future military conflicts. While it seems this article's focus is strictly on top-tier talent, the criteria used to assess applies to all Airmen. Currently, the USAF's definition of talent is not clear. Its personnel system requires simplicity and transparency. By capitalizing on the outlined recommendations, the USAF can leverage its greatest asset—its people. ✪

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Intercontinental Ballistic Missiles and Their Role in Future Nuclear Forces

Dr. Dennis Evans
Dr. Jonathan Schwalbe

The DOD started the B-21 program for maintaining the bomber force, the *Columbia*-class ship, submersible, ballistic, and nuclear missile submarine (SSBN) program for the SSBN force, and the B61-12 program for maintaining nuclear bombs, and these programs have been under way for several years.[1] By contrast, intercontinental ballistic missiles (ICBM) recapitalization—in the form of the Ground-based Strategic Deterrent (GBSD) program—was not funded until fiscal year 2016. Details are currently lacking on program cost, missile characteristics, basing mode, and the planned size of the ICBM force in 2040. However, with a 2016

start and typical development times for large missiles, it is likely that the ICBM force will drop below the planned New Strategic Arms Reduction Treaty (START)-level of 400 missiles for some period in the 2030s even if the long-term goal is a force of 400 missiles or more. Similarly, the department has just started a program—the Long-range Standoff (LRSO) cruise missile program—for maintaining the air-launched cruise missile element of the triad. The DOD has expended almost no funding on either the ICBM program or the LRSO program to date. Moreover, providing full funding for these two programs in the 2020s—in competition with the B-21 bomber, F-35 fighter, KC-46 tanker, T-X trainer, and various satellites—will be challenging. Of the two relatively nascent programs, the GBSD will almost certainly involve much larger amounts of funding than the LRSO. Hence, although the recent *Nuclear Posture Review* (*NPR*) endorsed the GBSD program, the high cost of this program makes it likely that discussions on the future of the ICBM force will continue for several more years.[2]

This assessment presents technical analyses to help inform decisions on whether to retain an ICBM force beyond about 2035 and—if ICBMs will be retained—what characteristics would be desirable in a future ICBM force. This report also identifies policy issues that decision makers need to consider before making large acquisition choices or deciding on new treaties for nuclear weapons.

If the nation decides to retain ICBMs in the 2040s and beyond, the answers to three key questions will largely drive the desired force size and characteristics, although several other metrics (cost, in-flight survivability, payload, and so forth) also are relevant:

1. How survivable will future ICBMs need to be against a large and advanced attack? This question is discussed below, along with various options for improving ICBM survivability.
2. To what degree will future ICBMs need to reach Asian targets further than Russia, especially without flying over Russia? Techniques for achieving such a capability are discussed below in the section that discusses target coverage.
3. To what extent will future ICBMs need to balance lethality and collateral damage? In the future, high levels of collateral damage may be less acceptable than was the case during the Cold War, so it may be important to have accurate delivery options for low-yield weapons.

Also, it is important to compare entire strategic force structures, with variable numbers of ICBMs and other systems, and variable characteristics, instead of focusing purely on missile force structure and features. Finally, if the decision is to abandon the ICBM force by 2040, the nation needs to decide whether to procure more bombers, transatmospheric vehicles, SSBNs, nuclear cruise missiles, or something else (such as missile defense) to provide elements essential to future strategic forces in the absence of ICBMs. This study considered additional SSBNs as a compensation measure for eliminating or reducing ICBMs (in the section on force structure options).

Survivability against a Large Preemptive Counterforce Attack

When initially deployed, US silo-based ICBMs were highly survivable because of the poor accuracy of Soviet ballistic missiles in the 1960s and early 1970s.[3] However, Soviet/Russian missile accuracy has improved greatly in the last 40 years and will likely continue to do so in the future. So the US ICBM force may not be very survivable against a Russian attack in 2030 or beyond unless the US strategy is to rely on launching ICBMs based on warning of Russian missile launches. No other nation is likely to have a force with the number and accuracy of nuclear weapons needed to threaten US silo-based ICBMs in 2030, although China has the resources and technology to pose a threat by perhaps 2035 if Chinese leaders choose to expand their arsenal.[4]

The primary approaches to improving ICBM survivability are harder silos and mobile ICBMs. Launch-on-warning could also improve survivability relative to riding out an attack, but no meaningful discussion of this topic is possible in an unclassified forum. Also, launch-on-warning—if implemented successfully—would contribute to the initial retaliatory strike against the country that attacked the US but would not increase the number of US nuclear weapons available days or weeks after the initial foreign attack.

For a force of 400 or more ICBMs, harder silos would have substantial benefits in the next decade or two but could be vulnerable to credible future improvements in foreign missile accuracy. However, in a much smaller ICBM force of perhaps 150 silos, harder silos would be less likely to produce major benefits against a large and accurate attack because of the enemy's ability to aim multiple, accurate, high-yield weapons at each silo. The benefits of a silo-based ICBM force increase at least in a linear manner—and possibly faster—as a function of force size, whereas the overall costs of an ICBM force rise in a slower-than-linear manner. The slower increase is because research and development costs are largely independent of force size, as are the costs associated with annual flight tests of the missiles. Figure 1 illustrates a quantitative example of this dependency on force size. Suppose that an attacker wants to be sure that no more than 20 ICBM silos survive the attack, independent of the size of the US ICBM force. Suppose further that each attacking re-entry vehicle has a 70 percent single-shot kill probability. (The figure of 70 percent is notional but subjectively reasonable.) The figure shows the price to attack, as a function of the size of the ICBM force, for destroying all but 20 of the ICBM silos. The number of ICBM silos is parametrically varied from 100–800. Such an increase in the number of ICBM silos increases the price to attack by a factor of nearly 17 (and to a number much more than US or Russian forces under New START).[5] If the first 200–400 attacking re-entry vehicles had a high single-shot kill probability, and all subsequent reentry vehicles had a much lower single-shot kill probability, the price to attack would grow more than indicated in figure 1.

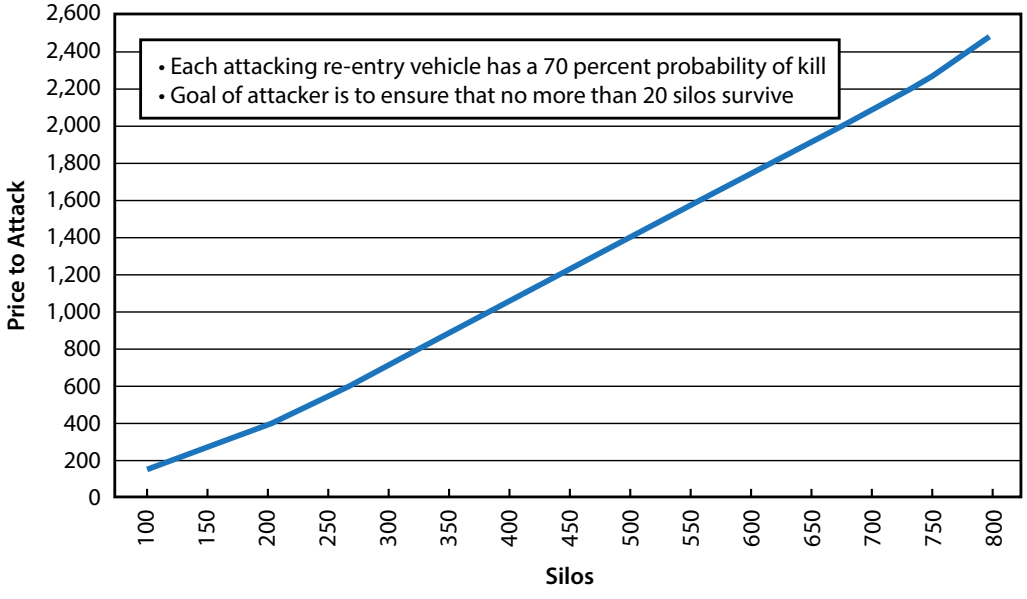

Figure 1. Enemy price to attack as a function of the number of US ICBM silos

Mobile ICBMs deployed in the field (outside of their garrisons) should be highly survivable unless the enemy can detect and track deployed ICBMs in real time. If the enemy had this capability, then mobile ICBMs would have poor survivability because they are soft targets. The survival rate for mobile ICBMs in the process of deploying from garrison under attack could vary widely—from poor to outstanding—depending on multiple factors that have uncertain values, including:

- The number of US garrisons (Unlike the case with silo-based ICBMs, the adversary's "price to attack" depends on the number of US garrisons, not the number of US missiles. Hence, the number of warheads available for saturating the operating area around each US garrison would be (M/N), where N is the number of US garrisons, and the number of enemy weapons available for attacking the garrisons is M.)
- How long it takes for the ICBM garrisons to receive warning of an incoming attack
- How quickly the ICBM launcher vehicles can leave the garrison once an alarm sounds
- Whether the ICBM launcher vehicles are limited to operating on roads
- The road geometry around the garrisons (multiaxis; spoke versus being limited to traveling in one of two directions on a single road)
- The top speed of the ICBM launcher vehicles
- The hardness of the ICBM launcher vehicles

The survivability of ICBMs is only part of the issue. Ensuring the survivability of an adequate portion of the overall nuclear force is a broader goal. SSBNs at sea are likely to be highly survivable for the next decade at least, whereas SSBNs in port are vulnerable even to a small nuclear attack by weapons of moderate accuracy. Also, SSBNs at dock are vulnerable to conventional cruise missiles. Bombers on maximum nuclear alert should be relatively survivable against a preemptive attack, but bombers are unlikely to be on nuclear alert, except in a severe and protracted crisis. As with SSBNs in port, bombers that are not on alert are quite vulnerable to a small nuclear attack by weapons that do not have state-of-the-art accuracy. Improved ballistic missile defense might be able to help with bomber and SSBN survivability against small attacks. Cruise missile defense at bomber and SSBN bases would also be beneficial because Russia has nuclear and conventional submarine-launched cruise missiles. Keeping one bomber base on nuclear alert at all times would be another useful measure.

Target Coverage

The survivability of the nuclear force is not, by itself, sufficient. Surviving nuclear weapons must be able to reach potential adversaries. The ability to do this depends on weapon range, in-flight survivability, and the extent to which overflight of countries other than the adversary is acceptable. No detailed discussion of in-flight survivability is possible in an unclassified setting, although ICBMs and SLBMs would be highly survivable unless the adversary has advanced ballistic missile defenses, such as, possibly, the defensive system around Moscow.

ICBMs provide good coverage of Russia from the current bases without having to fly over any other country, except Canada. When ICBMs were initially deployed in the 1960s, this was all they were designed to do, but the future world may require coverage of additional countries. As shown in figure 2, ICBMs at the current bases cannot reach much of Asia without flying over Russia. If ICBMs need to reach potential non-Russian adversaries without flying over Russia, there are three basic approaches: adding bases in Hawaii (or Guam) and Cape Canaveral, Florida,[6] providing a capability for maneuvers to divert around Russia, or building an ultra-long-range ICBM that flies a trajectory over the southern hemisphere and approaches some targets from the south. All three of these approaches are expensive, and the latter two are technically risky. Figure 3 depicts the impact of adding two more ICBM bases in Hawaii and Cape Canaveral.

By contrast, SSBNs and bombers are more capable of reaching various countries without having to fly over Russia. Therefore, it may be reasonable to accept this limitation in future ICBMs and rely on bombers, SSBNs, and possible future nonstrategic nuclear systems for non-Russian targets.

Reaching regions in white or gray over Asia and the Indian Ocean requires an overflight of Russia. Results shown do not include any shadowing due to the small Russian enclaves in Kaliningrad and Crimea. The red ring in North America bounds the region containing the US bases. Missile range is varied parametrically.

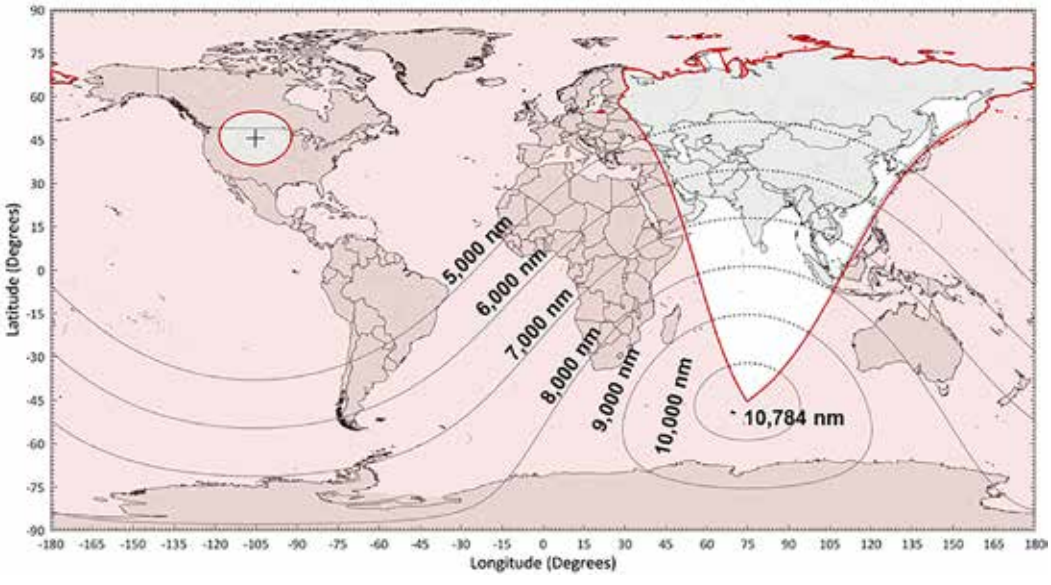

Figure 2. Target coverage from current ICBM bases without flying over Russia

Reaching regions in white or gray over Asia and the Indian Ocean requires an overflight of Russia. The ICBM has a notional range of 8,000 nautical miles. Varying the ICBM range parametrically would make this figure too cluttered. Results shown do not include any shadowing due to the Russian enclaves in Crimea and Kaliningrad.

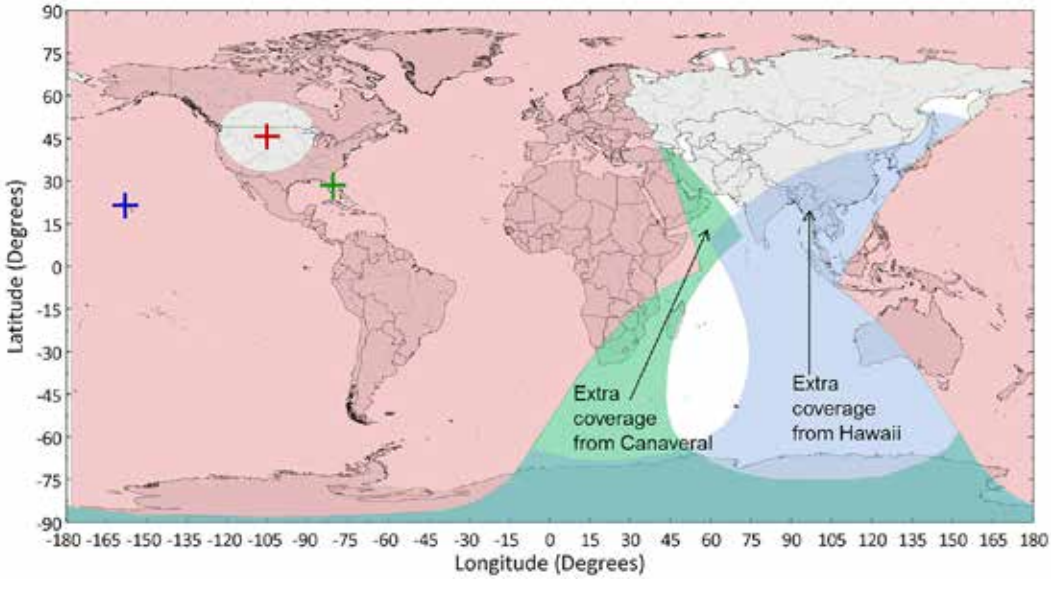

Figure 3. Target coverage with extra bases without flying over Russia

Weapon Lethality and Collateral Damage

In addition to the various factors previously discussed, it also is important for a US weapon to demonstrate a high probability of destroying its intended target. It may also be helpful to minimize the number of civilian casualties resulting from each US strike, both for moral reasons and to enhance deterrence by giving an adversary more reason to think that the US would use nuclear weapons if sufficiently provoked. For example, if the US could not destroy a target without inflicting civilian casualties that are grossly excessive in relation to any military goal, then an enemy might not believe that the US would conduct such an attack and would, therefore, not be deterred.[7] Prompt casualties depend on the population density around the target, weapon yield, height of burst, and (for a ground burst) wind direction. Lethality depends on accuracy, yield, and the ability to control the height of burst, with accuracy being the most important factor. Figures 4–5 illustrate this phenomenon and show that accurate, low-yield weapons can achieve high lethality against the vast majority of targets. (The two figures are not closely keyed to the actual hardness of real targets, although 21 pounds per square inch is near the upper limit for a small building.) Although these figures do not explicitly calculate collateral damage, it would often be possible to combine very high effectiveness with relatively low civilian casualties—at least if the targets are outside urban areas.

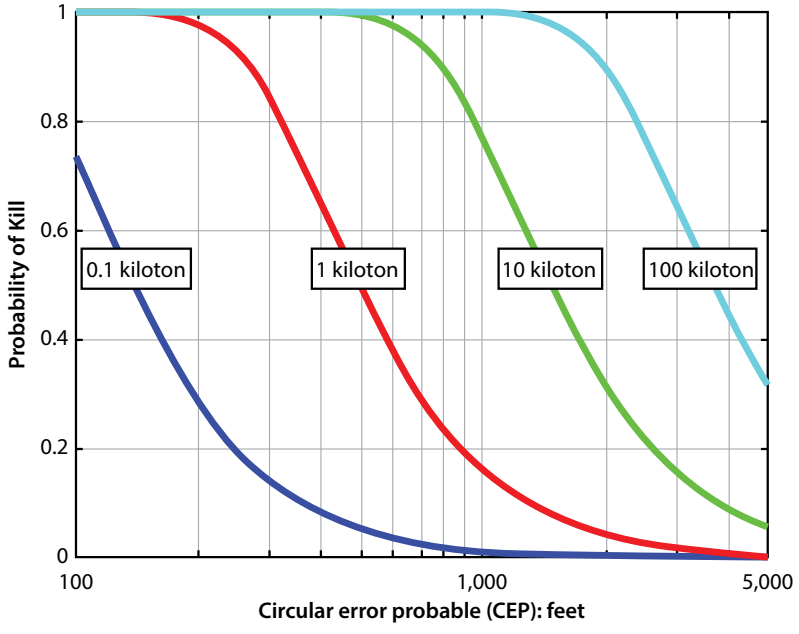

Figure 4. The probability of kill versus circular error probable (CEP) for a 21-pound per square-inch target

Note: X-axis=accuracy of the weapon, as measured by a CEP. Y-axis=probability of destroying the target. Each curve represents a warhead of the indicated yield (range of 0.1–100 kilotons) with a reliability of 100 percent.

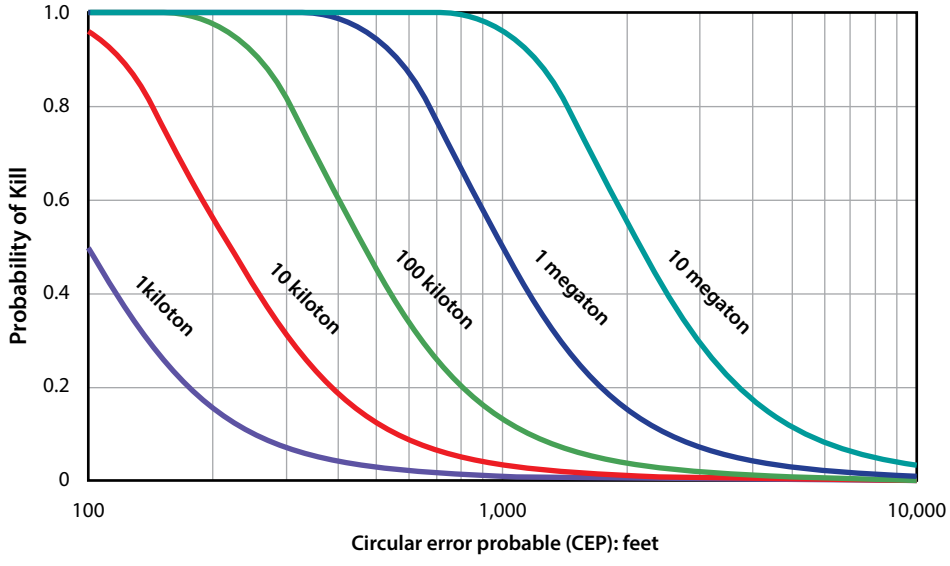

Figure 5. The probability of kill versus CEP for a 4,000-pound per square-inch target

Note: Curves for yields ranging from 1 kiloton to 10 megatons, with one curve for each yield and a reliability of 100 percent.

However, it should be noted that ICBMs and SLBMs might not always be the preferred weapons in cases where there is a need to maximize the ratio of lethality to collateral damage. It would likely be easier to achieve a CEP (a measure of accuracy) of perhaps 30 to 150 feet in a guided bomb or a cruise missile than in a long-range ballistic missile, although the ballistic missiles would have significant advantages in speed of response and in-flight survivability.

Force Structure Options

When making decisions on future nuclear forces, it is not sufficient to consider the performance of individual triad legs; it is necessary to compare plausible complete force structures. Consequently, we examined seven triads (with 150–510 ICBMs and 8–12 SSBNs) and four bomber-SSBN dyads (with 10–18 SSBNs) in the context of a major nuclear war against an adversary with a large and fairly accurate inventory of nuclear weapons. (We also examined a much smaller attack of 50–100 re-entry vehicles. This is less than the number of US ICBMs in any of the triads, so this small notional attack was limited to SSBN bases, bomber bases, and other non-ICBM targets.) For simplicity, we designed all forces to comply with New START limits, although the New START Treaty will expire in 2021, absent an agreement to extend it. Some of the forces, in fact, are well below New START limits and would likely comply with the limits in any plausible successor treaty.

The forces chosen span a reasonable set of ICBM-SSBN trades. It would also be desirable to evaluate trades between bombers and ballistic missiles, but such trades were not considered because of uncertainty about weapon loads for the B-21

bomber and about the number of LRSO cruise missiles carried by the B-2 and the B-52. (It is necessary to know how many bomber *weapons* survive a preemptive enemy attack and successfully penetrate any defenses en route to the weapon launch point, not simply the number of bombers.) Hence, all forces considered have 60 deployed nuclear-capable bombers, although it would be possible to deploy a much larger number of bombers in the dyads and the triad with only 150 ICBMs without exceeding any New START limits.[8]

The table lists the 11 forces that were studied by the Johns Hopkins University Applied Physics Laboratory (JHU/APL). Two force structures in the table include more than 12 SSBNs. These extra SSBNs would not be available until after 2042 unless the US accelerated procurement of the *Columbia*-class SSBNs. By contrast, all of the ICBM options could be available by 2040. The primary metric for comparing these forces was survivability against a counterforce attack. All options provide good target coverage and timeliness. Comparisons on other metrics would be more illuminating if the forces varied the number of bombers but are less relevant to trades between ICBMs and SLBMs.

Table. Force structure options (60 bombers in all cases)

Force options	*ICBMs*	*SSBNs*	*Accountability versus actual warheads*	*Delivery vehicles*
0[a]	0	10	860/1,280	220
1[a]	0	12	1,020/1,440	252
2[a]	0	14	1,180/1,600	284
3[a]	0	18	1,500/1,920	348
4[b]	400	12	1,420/1,840	652
5[c]	510	8	1,550/1,970	698
6[c]	480	10	1,550/1,970	700
7[c]	400	12	1,550/1,970	652
8[c]	448	12	1,550/1,970	700
9[c]	150	12	1,550/1,970	402
10[d]	148	12	1,468/1,888	700

Source: JHU/APL

a Bomber-SSBN dyads

b Single-warhead ICBMs in current silos and launch control centers

c New ICBMs in new, harder silos and new, harder launch control centers. Some ICBMs carry multiple warheads, but are consistent with New START limits. Options 4–8 have 1–3 warheads per missile. Option 9 has a larger missile with up to 5 warheads.

d Mobile single-warhead ICBMs

Our modeling suggests that a triad is better than a dyad, at least of similar or lesser cost, according to most metrics. However, the triad–dyad choice depends on which characteristics are more important to decision makers, or specifically:

- Relative to triads of similar procurement cost, bomber-SSBN dyads may perform well regarding the number of surviving US weapons if the US forces are on maximum alert at the time of a large and accurate nuclear attack.[9]
- Triads, by contrast, perform considerably better than bomber-SSBN dyads of similar cost regarding the number of surviving US weapons if the US forces are in a day-to-day posture at the time of a large and accurate enemy attack. Dyads could be improved to some extent by having a higher day-to-day alert level for both bombers and SSBNs, but this would come at a cost and could interfere with prompt bomber availability for conventional missions.
- Triads invariably perform better than dyads in terms of the price to attack imposed on the enemy, the ratio of surviving US weapons to remaining enemy weapons after a large enemy first strike, and survivability against a small nuclear attack (without regard for the alert status of US forces at the time of the small enemy attack).
- Additional metrics such as target coverage, lethality, collateral damage, and in-flight survivability are important for the nuclear force as a whole but are not very helpful for selecting between ICBMs and SLBMs/SSBNs. Such metrics would, however, come into play in any attempt to evaluate trades between bombers and ballistic missiles.

Finally, it is also important to consider sensitivity to changes in threats and assumptions. For example, the bomber-SSBN dyads and the very expensive triad with mobile ICBMs are sensitive to improvements in an enemy's ability to detect and track mobile ICBMs, SSBNs at sea, or both, whereas silo-based ICBMs are not sensitive to such improvements but are quite sensitive to improvements in enemy missile accuracy.

Conclusions and Observations

Russia is modernizing its nuclear forces, and additional US investment will be needed to ensure parity with Russia if parity is deemed to be essential. Parity includes considerations of force size and also survivability, target coverage, and the variety of capabilities provided (yield, accuracy, reliability, the speed of response, and so forth). Parity considerations could be limited to strategic nuclear weapons, or they could be extended to include nonstrategic nuclear weapons, where Russia has a large advantage.

Analysis indicates that a well-designed triad is superior to a bomber-SSBN dyad in terms of the post-exchange balance of weapons after an enemy counterforce attack, survivability against a small enemy attack, and the price to attack imposed on a foreign great nuclear power. Under some conditions, by contrast, a dyad can be comparable to a well-designed triad regarding the number of US weapons that would survive a counterforce first strike.

US ICBMs at the current bases provide good coverage of Russia, but ICBMs would have to fly over Russia to reach other countries in Asia. (This is a purely technical

observation; the authors take no position on the likelihood that an ICBM overflight of Russia would be permitted.)

The benefits of the ICBM force increase linearly or faster as a function of the ICBM force size, whereas total ICBM costs increase in a slower-than-linear manner as a function of the ICBM force size. Hence, it would be desirable to retain all three ICBM bases and at least 400 ICBMs. For example, it would be possible to have a force of 448 ICBMs, in conjunction with 12 *Columbia*-class SSBNs and 60 deployed nuclear bombers, without violating New START limits.

It may also be important to consider US nuclear needs—both strategic and nonstrategic—for adversaries other than Russia. Deterrence of geographically small adversaries poses special challenges (due to fallout propagation from high-yield ground bursts), which would be necessary for negating underground targets.

These conclusions are derived from physics-based analyses, and they should be integrated with deterrence theory and policy considerations to provide the best input to major investment decisions. In particular, decisions on the future of the ICBM force depend in large part on policy questions that physics-based modeling can help inform. Key policy questions include the following:

1. What level of threatened retaliation against which potential adversaries is adequate to support US deterrence strategy?
2. How should the US think about Russia in the future, including issues of overflight and future treaties?
3. How much is the nation willing to invest in its nuclear force?
4. How survivable should ICBMs be against a large and advanced attack?
5. How important is it to deplete an adversary's nuclear stockpile in an exchange to influence the post-exchange balance of weapons?
6. Under what conditions might the nation select a bomber–SSBN dyad?

This analysis focused on strategic nuclear forces, especially ballistic missiles. Russia is also devoting considerable effort to developing and producing accurate, low-yield nonstrategic nuclear weapons. The US does not have any development programs for similar weapons, except for the B61-12 bomb for the F-35A, the B-2, and, eventually, the B-21. Russian use of such weapons could have military advantages that might negate US/North Atlantic Treaty Organization superiority in conventional weapons and/or force the US into a disproportionate response. Additional analyses are warranted on nonstrategic nuclear weapons, including considerations on the extent to which the LRSO cruise missile could compensate for Russian advantages in nonstrategic nuclear weapons.

The value of the analyses conducted by JHU/APL derives from a focus on physics-based modeling, a subset of quantitative analysis that relies on first-principle calculations of variables such as weapons' survivability, lethality, and ability to reach targets. Although the work performed in this study cannot answer critical policy questions, quantitative modeling assists decision makers by providing the discernment to answer some policy questions and to render policy objectives more quantifiable. This

synergistic process of quantitative modeling and policy refinement would naturally enhance acquisition decisions, force structure decisions, future versions of the *NPR* and similar studies, and future arms control negotiations. ✪

Notes

1. Jeremiah Gertler, "Air Force B-21 Raider Long-Range Strike Bomber," *Congressional Research Service* (CRS), 7 June 2017, https://fas.org/sgp/crs/weapons/R44463.pdf; Ronald O'Rourke, "New *Columbia*-Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress," *CRS*, 12 May 2017, https://fas.org/sgp/crs/weapons/R41129.pdf; and Amy F. Woolf, "U.S. Strategic Nuclear Forces: Background, Developments, and Issues for Congress," *CRS*, 10 February 2017, https://fas.org/sgp/crs/nuke/RL33640.pdf.

2. The future of the long-range stand-off cruise missile (LRSO) program is a major issue in its own right, even though the amount of funding involved would likely be 5–10 times lower than for the ground-based strategic deterrent program.

3. Dietrich Schroeer, *Science, Technology, and the Nuclear Arms Race* (Hoboken, NJ: John Wiley and Sons, 1984), 143–49.

4. Eric Heginbotham et al., *China's Evolving Nuclear Deterrent* (Washington, DC: RAND Corporation, 2017), https://www.rand.org/pubs/research_reports/RR1628.html.

5. This faster-than-linear increase in the enemy's price to attack occurs because—as the number of US intercontinental ballistic missiles (ICBM) grows—the enemy has to destroy a steadily higher percentage of the US ICBMs to hold the number of surviving US ICBMs to 20 or fewer. If the US forces consisted of only 66 ICBMs, the enemy would have to destroy only 70 percent of the US ICBMs to hold the number of survivors down to 20. With a single-shot probability of kill of at least 70 percent for the enemy missiles, this would require only one enemy missile per US silo. With 800 US ICBMs, the enemy would have to destroy 97.5 percent of the US silos. With a single-shot probability of kill of 70 percent for the enemy missiles, this would require three enemy missiles for every US silo and a fourth enemy missile for some silos.

6. A base on the west coast would not provide much additional coverage of countries in Asia without flying over Russia. A base in Guam would provide additional coverage than the base in Hawaii, that is assumed in figure 3, but at the expense of greater vulnerability to attack.

7. The Law of Armed Conflict forbids the use of weapons or tactics that cause noncombatant casualties that are disproportionate to the military objective achieved. *Disproportionate* is, of course, a subjective term, but an accurate, low-yield nuclear weapon would appear to be more compliant with this provision than an inaccurate, high-yield weapon, especially if there were a large number of civilians relatively close to the target. Similarly, the use of an inaccurate conventional missile (such as the Iraqi Scuds from Operation Desert Storm) would be permitted against an isolated military base but not against a military target in a city.

8. The programs for the *Columbia*-class nuclear-powered, ballistic missile-carrying submarine (SSBN) and the B-21 bomber have been underway for several years, and there is a consensus on the need for SSBNs in the nuclear mission (due to their survivability when at sea) and the need for a new, more survivable bomber in the conventional mission. Moreover, the cost savings from making the B-21 "conventional only" would be a small fraction of the total cost associated with the B-21, so it is not likely that the B-21 will lack nuclear capability (at least within the confines of New Strategic Arms Reduction Treaty [START] limits and counting rules). Hence, we did not consider bomber-ICBM or SSBN-ICBM dyads.

9. There are at least two ways to improve the survivability of a bomber-SSBN dyad: defenses against small attacks (ballistic or cruise missiles) and a day-to-day enhanced alert posture that keeps the maximum possible number of SSBNs at sea continuously and keeps one bomber base on ground alert at all times. This statement does not account for the costs associated with either defenses against small attacks or an enhanced alert posture for the bomber-SSBN dyad. The comparison of forces on maximum alert is based on the assumption of a lengthy crisis that naturally gave the dyad time to get all operational bombers on ground alert and to get all SSBNs to sea (exclusive of SSBNs in long-term

maintenance). If one were to include costs for defenses against small attacks and additional operating costs for an enhanced alert posture, then a bomber-SSBN dyad might be more expensive than a triad of comparable overall utility.

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Using Auxiliary Forces to Accomplish Strategic Objectives

Lt Col Jeremy K. Hodges, USAF

This article argues that the utilization of auxiliary forces, specifically the Civil Air Patrol (CAP), should be maximized to complete domestic, noncombat missions to reduce defense costs and free military resources to perform those duties that can only be accomplished by uniformed service members. The CAP gives the nation an opportunity to explore other ways volunteer auxiliary organizations can secure national interests. The CAP serves as the volunteer USAF Auxiliary, codified in US law for the public good.

Senior government officials determine national security strategic objectives to direct the application of national resources to best protect citizens and national sovereignty. The national military strategy cascades from national security strategic objectives and informs the process of organizing, training, and equipping military forces. Service–strategic documents (that is, Air Force) and lower-level instructions provide a cohesive policy for how military departments contribute to the accomplishment of national security strategic objectives.

The purpose of this article is to evaluate the CAP as a model for accomplishing national-level objectives using auxiliary forces. This article will present the main US national security strategic objectives, including defense objectives and priority missions, and will examine the legal framework allowing the CAP to perform domestic, noncombat missions as the official USAF Auxiliary. The conclusion will be evident that using auxiliary forces is a cost-effective way of accomplishing national-level objectives.

Foundational Strategic Guidance

In this section, the US *National Security Strategy* (*NSS*), *National Military Strategy* (*NMS*), US Air Force Strategy, statutes, and other foundational documents are presented to frame security and defense policies. The purpose is to familiarize the reader with the leading themes that apply of auxiliary forces toward the accomplishment of national security strategic objectives.

National Security Strategy

The most recent *NSS* was published in 2017.[1] The *NSS* describes a changed security perspective that puts "America First" by being "safe, prosperous, and free at home" to have "strength, confidence, and will to lead abroad."[2] The *NSS* further delineates four pillars that objectives are derived from to structure the application of American resources to secure the nation: protect the American people, the homeland, and the American way of life; promote American prosperity, preserve peace through strength; and advance American influence.[3] The objectives are outlined in each area below.

National Security Strategic Objectives

Protect American People, the Homeland, and American Way of Life

1. Secure US borders and territory
2. Pursue threats to their source
3. Keep America safe in the cyber era
4. Promote American resilience

Promote American Prosperity

1. Rejuvenate the domestic economy
2. Promote free, fair, and reciprocal economic relationships
3. Lead in research, technology, invention, and innovation
4. Promote and protect the US national security innovation base
5. Embrace energy dominance

Preserve Peace through Strength

1. Renew America's competitive advantages
2. Renew capabilities
3. Diplomacy and statecraft

Advance American Influence

1. Encourage aspiring partners
2. Achieve better outcomes in multilateral forums
3. Champion American values[4]

National Military Strategy. The Joint Chiefs of Staff (JCS) provides the US *NMS* to outline the military's contribution to national security. The *NMS* follows from the *NSS* by providing guidance on how military forces are employed to protect national interests. The key factors accounted for in the strategic environment are globalization, diffusion of technology, and demographic shifts.[5] Within the military environment, the *NMS* aims to position military capability against states and violent extremist organizations that threaten the US.[6] A challenge exists of sustaining a flexible military capable of meeting large state actors or small violent extremist cells while integrating the military strategy into the overall security strategic objectives.

Aligned under the four pillars in the *NSS*, the JCS derives six national security interests and three national military objectives. The national security interests are "the survival of the nation; the prevention of catastrophic attack against US territory; the security of the global economic system; the security, confidence, and reliability of our allies; the protection of American citizens abroad; and the preservation and extension of universal values."[7] The three national military objectives are then integrated "to deter, deny, and defeat state adversaries; to disrupt, degrade, and defeat violent extremist organizations; and to strengthen our global network of allies and partners."[8] Organizing these elements under the previous headings can show where the *NMS* fits into the scheme of security strategic objectives.

National Security Strategic Objectives and Security Interests

In addition to the first national security strategic objective of protecting the American people, the *NMS* also includes the survival of the nation and the prevention of a catastrophic attack against US territory. The other three objectives also involve the following under *NMS*:

- Promoting American prosperity—the security of the global economic system
- Preserving peace through strength—the security, confidence, and reliability of our allies and the protection of American citizens abroad
- Advancing American influence—the preservation and extension of universal values[9]

Following from the national military objectives, "to deter, deny, and defeat state adversaries; to disrupt, degrade, and defeat violent extremist organizations; and to strengthen our global network of allies and partners," the *NMS* presents 12 prioritized missions for US military commanders, as described below.

Joint Force Prioritized Missions

- Maintain a secure and effective nuclear deterrent.
- Provide for military defense of the homeland.
- Defeat an adversary.
- Provide a global, stabilizing presence.

- Combat terrorism.
- Counter weapons of mass destruction.
- Deny an adversary's objectives.
- Respond to crisis and conduct limited contingency operations.
- Conduct military engagement and security cooperation.
- Conduct stability and counterinsurgency operations.
- Provide support to civil authorities.
- Conduct humanitarian assistance and disaster response.[10]

As the joint force prioritized missions for the US military suggest, operations are on a spectrum ranging from humanitarian support to war. Each service—Army, Navy (including Marines), and Air Force—then is required to integrate in a way that accomplishes the priority mission set. The following section will focus specifically on the Air Force's role in accomplishing these priority missions.

USAF priorities and missions. The Air Force, comprised of active duty, Guard, Reserve, and auxiliary forces, possesses capabilities to operate in air, space, and cyberspace. The USAF strategy's five strategic vectors are to:

1. Provide effective 21st-Century deterrence;
2. Maintain a robust and flexible global intelligence, surveillance, and reconnaissance capability;
3. Ensure a full-spectrum capable, high-end focused force;
4. Pursue a multidomain approach to our five core missions, and;
5. Continue the pursuit of game-changing technologies.[11]

Pursuing these vectors with all components of the service, the USAF accomplishes five core missions in support of the *NMS*: air and space superiority, global strike, rapid global mobility, integrated intelligence, surveillance, and reconnaissance; and command and control (C2).[12] The following section will focus on how the CAP, as the official auxiliary, aligns with USAF priorities and missions.

Civil Air Patrol (USAF Auxiliary)

Established by law in Titles 10 and 36 of *United States Code*, the CAP is a federally-chartered nonprofit corporation for the public good to, among other things, "assist the Department of the Air Force in fulfilling its noncombat programs and missions,"[13] and as the Air Force's official auxiliary, to carry out missions assigned by the Secretary of the Air Force.[14] The CAP is organized under a volunteer, dual-hatted, national commander and chief executive officer who reports to an 11-member board of governors. Currently, the CAP is comprised of approximately 60,000 members, organized in 1,535 units, in 52 state wings, in 8 regions. The corporation owns more than 500 Cessna aircraft and more than 900 vehicles. Annually, the CAP ex-

ecutes a budget of approximately $50,000,000 while accomplishing emergency services, aerospace education, and cadet programs. The majority of the CAP's funding comes from the Air Force's total obligation authority in procurement and operations appropriations.[15] In its corporate and auxiliary statuses, the organization conducts approximately 100,000 flying hours per year.[16]

The CAP aligned its priorities with the USAF priorities for a concerted approach to accomplishing the Air Force mission and the CAP's civic responsibilities. Three DOD mission themes support the alignment of the CAP's priorities: to defend the homeland and provide support to civil authorities; conduct humanitarian, disaster relief, and other operations; and operate effectively in cyberspace and space.[17] CAP's priorities are the following:

1. Obtain and sustain required CAP funding.
2. Maximize CAP resources/skill sets to meet emerging mission areas.
3. Enhance awareness of CAP's contributions and capabilities.
4. Develop "dynamic Americans and aerospace leaders" through the Cadet Program.
5. Expand aerospace education/science, technology, engineering, and math education outreach initiatives to meet America's future national defense workforce requirements.
6. Achieve institutional excellence.
7. Value the service of CAP members.[18]

Synopsis of Strategic Path

CAP priorities and missions trace back to the *NSS*. As a federally-chartered corporation and the official USAF Auxiliary, the CAP uniquely contributes to the security of the nation.[19]

Emergency Services

As the USAF Auxiliary, the CAP conducts a variety of noncombat missions under the umbrella of "emergency services." These operations broadly include: search and rescue (S&R); disaster relief and humanitarian services; Air Force support; and counterdrug operations.[20] Conducting emergency services as the auxiliary, CAP contributes to at least three joint force missions outlined in the *NMS*: it provides for the military defense of the homeland, provides support to civil authorities, and conducts humanitarian assistance and disaster response. Furthermore, the emergency services mission contributes to the pillar of "Protect the American People, the Homeland, and the American Way of Life," as outlined in the *NSS*.[21]

Aerospace Education

The CAP is a leading organization in the educational development of Americans through its internal and external aerospace education programs. Internal education

opportunities for members ensure the development of a professional and educated auxiliary force. External programs provide outreach to thousands of students in education programs throughout the US.[22] Relating this mission area to the strategic framework, the national pillar of promoting American prosperity in the *NSS* is the best fit. Aerospace education specifically addresses the needs to develop "research, technology, invention, and innovation," ensuring that the population continues to prosper.

Cadet Programs

Of CAP's almost 60,000 members, about half are cadets ages 12–21.[23] Cadets in the CAP develop ethical and moral leadership through a myriad of educational activities that use aviation as a cornerstone.[24] Cadets are even trained to participate with supervision as ground teams for S&R and disaster relief operations. Enriching and sustainable cadet programs contribute to the *NSS* by bolstering the "advance of American influence" among Americans, specifically "championing American values."

Evaluation of United States Air Force Auxiliary Utilization

Utilization of the CAP as the USAF Auxiliary makes a significant contribution to national security strategic objectives. The first major theme that supports this is the legal framework that allows the nonprofit corporation to receive federal appropriations and operate under the Secretary of the Air Force (SECAF). Organization, evaluation, and fiscal management are overseen by the USAF to ensure that the CAP maintains its capability to perform Air Force-assigned missions.[25]

Being a federally-chartered nonprofit corporation guarantees the existence of CAP to perform emergency services, aerospace education, and cadet programs for the US. Coupling this charter with a legally established role as the USAF Auxiliary allows for the DOD to utilize an unpaid professional volunteer force to accomplish those inherently noncombat missions often requested of the military to support the homeland. Under the United States Northern Command, the Air Forces Northern component operationally tasks the CAP in its auxiliary capacity to perform S&R, disaster relief and humanitarian services, Air Force support, and counterdrug operations.[26]

Noncombat Air Force-assigned missions are those that have been requested as support to another federal agency, are determined to have a federal interest by the Air Force, are directed by the USAF, or as determined by the SECAF.[27] Air Force instruction outlines the following mission areas as those that currently qualify for assignment by the USAF to the CAP: homeland security operations, S&R/disaster relief, law enforcement support, drug interdiction activities, combat training support, range and airspace surveys, orientation flights, light airlift, public affairs support, communications, training, support of Air Force organizational functions, and incident facility activities.[28] An example of support to another agency would be to provide aerial observation and imagery of a land area after a natural disaster for the Federal Emergency Management Agency (FEMA). A request determined to have federal interest could be a US state along the US–Canada border requesting assistance

assessing snow melt in the Red River Basin. USAF approval officials can direct certain types of training, transport, and aircraft fleet management missions as Air Force-assigned as well.

The ability for the CAP to perform these missions as the USAF Auxiliary primarily is based on the professional credentialing required in other aspects of aviation law.[29] Internal mission-specific training within the organization ensures that each CAP wing is capable of performing missions for the Air Force. USAF and CAP evaluation teams inspect the compliance of CAP wings in order to certify them for operational use, audit expenditure of federal funds, and ensure proper disposition of equipment procured with federal funds.

Funding for CAP comes through federal appropriations used for aircraft and vehicle procurement in addition to organization and maintenance funding. The procurement strategy for CAP aircraft includes expending appropriated funds on a mostly standardized fleet of Cessna aircraft. With a baseline of 541 aircraft and a service life of 8,000 flying hours, CAP aircraft should generally be replaced approximately every 30 years. The CAP has approximately 900 general-purpose vehicles used mostly for transport and search and rescue that are replaced approximately every 10 years.

The CAP organization is made up of approximately 60,000 volunteers in more than 1,500 units in the US, Puerto Rico, and the Virgin Islands. Funding for organizational activities include federal appropriations for a small paid staff, aircraft maintenance, training, supplies, some operational mission costs, and other associated organizational costs. Generally, the CAP budget is divided as 70 percent toward emergency services, 20 percent for cadet programs, and 10 percent for aerospace education. In addition to federal funding that provides for organization and equipment, when acting as the USAF Auxiliary, the CAP is funded (exception: counterdrug operations) for operational costs, such as travel and fuel costs, by the supported federal agency. These costs are typically 1/10th the cost of contractor costs for similar support and up to 1/40th the cost of an active military unit to perform the same service.[30]

Themes of Effective Auxiliary Utilization

Legal authority, national civilian credentialing, leadership, national organization, federal oversight and regulations, integration into policy, and proper federal funding are the leading themes for employing the CAP as the effective USAF Auxiliary to accomplish national security strategic objectives. Recent history reflects the tremendous value of the CAP in its auxiliary role. In CAP's citation accompanying the Air Force Organizational Excellence Award, it was credited with flying more than 2,500 hours of search and rescue missions, resulting in 272 lives saved.[31] In assisting the Air Force's response efforts during Hurricane Sandy, CAP aircrews from 21 states flew 696 sorties and provided 158,000 geotagged images to FEMA.[32] From 2012–2016 alone, the CAP flew more than 34,000 hours in auxiliary status, saving more than an estimated $200,000,000 when compared to using uniformed service members and military platforms.[33]

How should auxiliary forces like the CAP be utilized and expanded to meet national-level objectives? To begin, a national need must be identified for a particular capability that could be fulfilled by professionally credentialed volunteers. The purpose of government is primarily to provide for those public domains that are otherwise unprofitable to the private sector, including defense and security, infrastructure, governance and economic regulation, environmental protection, and (to an extent) healthcare and education, among others. National institutions or federal agencies are charged with the responsibility for these areas in order to safeguard US national interests. In the US, federal departments such as defense, commerce, education, health and human services, and state have broad responsibility for these strategic interests.

Because these departments receive federal appropriations for their missions, alignment with national professional credentialing organizations (such as the CAP) could be accomplished to integrate an auxiliary force of volunteers to perform industry services. Joint leadership and management oversight committees would be required to ensure that the priorities and missions of the volunteer organization align with the specified department, and that federal monies are expended on approved activities and equipment. Billions of dollars could be saved through oversight, administration, personnel benefits, and the like by having just a percentage of the work of these agencies accomplished by volunteers.

Volunteer organizations responsible for a portion of the national objectives must be aligned with a partner federal agency and organized on a national level. Regional or state chapters, with officers and leadership, applying consistent rules, regulations, processes, and procedures, will ensure uniformity of quality and capability to accomplish activities tied to national objectives. The US strategic interests are not specifically of a military nature, and as a result, can be accomplished by those willing and unpaid professional volunteers once they are nationally integrated and credentialed. Retaining federal oversight keeps checks and balances in place to ensure that organizational activities are in step with national policy.

Recommendations and Conclusion

The effectiveness of the CAP to contribute to the accomplishment of national security strategic objectives as the USAF Auxiliary is cause to explore what other ways that volunteer auxiliary organizations can secure national interests. The major recommendation is that those activities that can be accomplished by auxiliary forces should be. Even a 1-percent cost savings at the national level may be incentive enough for governments to apply legality, credentialing, oversight, leadership, and funding for volunteer organizations charged with accomplishing federally-assigned missions. Federal departments should take the initiative to explore and align with national volunteer organizations to optimize the utilization of auxiliary members in order to free federal resources and funding. ✪

Notes

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14. CAP, Title 10, *US Code,* ch. 909, (2000), http://uscode.house.gov/view.xhtml?req=granuleid%3AUSC-prelim-title10-chapter909&edition=prelim.
15. The CAP Corporation is a program within the Air Force Corporate Structure and competes internally for Air Force funding as part of the submission to the president's budget each year for aircraft procurement, operations and maintenance, and other procurement appropriations. Under Title 10, funds appropriated to the CAP are exclusively for the use of CAP. The Air Force reviews and approves CAP's annual budget request and ensures that appropriations funding is executed according to the approved budget request.
16. CAP National Headquarters, *National Civil Air Patrol Annual Report to Congress* (Maxwell AFB, AL: CAP, 2016), https://www.gocivilairpatrol.com/media/cms/NationalCAP2017HR_412A38C3816D9.pdf.
17. CAP, *2014–15 Strategic Plan* (Maxwell AFB, AL: CAP, 2014), 2.
18. Ibid., 3–11.
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23. CAP, *Annual Report to Congress*.
24. CAP, "Cadet Programs," 30 March 2018, https://www.gocivilairpatrol.com/programs/cadets/.
25. As the USAF Auxiliary, the CAP is the only Department of Defense auxiliary utilized to accomplish missions during peacetime. The merchant Marine may be employed as an auxiliary to assist the US Navy in times of war.
26. Certain Title 10 legal protections are afforded to CAP members operating in auxiliary status.
27. Air Force Instruction 10-2701, *Organization and Function of the Civil Air Patrol*, 15 January 2016, 13.
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Strategic Foresight Methods in the Public and Private Sectors

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When talking to a person about the future, it can often seem ambiguous and unpredictable. What is the future? What can we expect from it? Some might inquire about predicting the future. The reality is that predictions are impossible to make with perfect confidence; as a result, very few individuals in futurology will use the term. Instead, *forecasting* is the term of choice. Partially, it removes the stigma around predicting the future, while also clarifying the field more accurately as estimation as opposed to concrete prediction. The goal is not to predict the future; it is to realize the importance of an event before it occurs.[1]

Nothing will prove to be flawless when it comes to forecasting using various methods. However, there are certain methods that are more reliable than others, with many of the reliable ones important to a variety of sectors. Governments, private companies, militaries, and even individuals seek this ability to be successful in whatever they desire—be it the defense of a nation, economic growth, success for a company or idea, disaster prevention, or some other aim. Defined as the study of the future for developing strategy, strategic foresight is how individuals attempt to make the future less ambiguous. In other words, the focus is on the process used for forecasting. Looking into strategic foresight further, the public sector and private sectors have distinct similarities and differences, derived in part from their differing goals. Summed up in a general sense, the private sector has the goal of maintaining relevance to its consumers and against competing companies—it is unlikely that any company would volunteer to become the next Blackberry or Blockbuster.[2] In comparison, the public sector has the overarching goal of exerting influence in one way or another over other nations—the US arguably does this more successfully than most, if not all, other nations.[3]

Before analyzing how the public and private sectors conduct strategic foresight, we set the stage with an overview of a cross-section of methods commonly used. As a concept, strategic foresight has been around for hundreds of years. Recognized as one of the first military strategists, Carl von Clausewitz is famous for defining the character and nature of war.[4] While there is research on both linear and nonlinear strategic development, little is offered in the realm of strategic analysis or development for the future. Unlike trend analysis, strategic foresight reaches beyond forecasting the

future of a given entity; it focuses on illuminating actions recommended today to achieve the desired end state of tomorrow. Common methods for doing so include the pursuit of disruptive and sustaining innovations, Blue Ocean Strategy, use of offset strategies for asymmetric advantages, scenario planning, war gaming, futurecasting, and threatcasting.

An overview of different methods begins with disruptive innovations, sustaining innovations, and Blue Ocean Strategy—all intending to identify ways of gaining or maintaining the advantage. Disruptive innovation, one strategy based on technology for the future, is a development that interrupts market processes in unexpected ways. Contrastingly, sustaining innovations are those that persist for an extended period. First coined by Clayton M. Christensen in 1995, *disruptive and sustaining innovations* identified abstract thoughts in business, developing them into a formal strategy (now called disruption theory). Christensen furthered his claims in his book *The Innovator's Dilemma* and its sequel *The Innovator's Solution*.[5] The norm has been to pursue sustaining innovations—those technologies that are improvements on an already-existing platform (that is, high-definition TV rather than standard television, faster computer processors, energy-efficient cars, and so forth).[6] Technologies widely accepted as disruptive are personal computers, smartphones, automobiles, and digital photography. In summation, a disruptive technology is a "game-changing opportunity" that will alter the market, the world, and individual lifestyles in a revolutionary way.[7] Disruptive technologies may or may not render others obsolete (that is, the automobile did not bring about the abolishment of trains, but online streaming platforms such as Netflix have rendered traditional movie rental companies noncompetitive).[8] Businesses that continuously develop and implement solutions to solve their customers' next-generation problems or satisfy emerging unfilled needs separate from mainstream commercialization—think Skunk Works, Phantom Works, or other small elite teams focused on advanced projects—will "catch the wave" of disruptive innovation.[9]

Similar to Christensen's disruptive and sustaining innovations business models, W. Chan Kim and Renee Mauborgne's *Blue Ocean Strategy* illuminates other methods for corporations to use. They argue that a business can be successful by entering or creating an uncontested market or "blue ocean" in which to operate; this is more desirable than a "red ocean," in which companies focus on their successes relating to competition.[10] Blue oceans are analogous to horizontal and vertical integration—a blue ocean would consist of a single company commanding a particular market and its subsequent products within that given market. Published in 2005, the use of Blue Ocean Strategy is still a new model for categorizing a company's success in strategic forecasting. Ford Motor Company and Apple Inc., are cited as successful blue-ocean companies for their "high product differentiation at a low cost."[11] However, it is too early to state conclusively whether this model is a successful one for strategic development or not.

Whereas disruptive innovation, sustaining innovation, and the Blue Ocean Strategy are more common in the private sector, the use of offset strategies remains wholly in the public sector. In 1952, President Dwight D. Eisenhower implemented the New Look strategy. Built on the tenets of deterrence, massive retaliation, and the potential use of nuclear weapons, the New Look targeted the Soviet Union during

the early stages of the Cold War.[12] At the end of the Vietnam War more than 20 years later, the US military saw significant manning losses and growing budget constraints. Secretary of Defense Harold Brown, at the time, sought to use technology as a means to counteract these limiting factors—stealth capabilities, precision-guided munitions, intelligence, surveillance, and reconnaissance platforms, and space capabilities formed the core tenets of Secretary Brown's initiative.[13] In 2014, Secretary of Defense Chuck Hagel tasked Deputy Secretary Bob Work with the development of a third offset strategy—one that "will require innovative thinking, the development of new operational concepts, new ways of organizing, and long-term strategies."[14] Termed the *Defense Innovation Initiative* (DII), or more commonly the third offset strategy, the US looks to use technology once again for expanding its military might.[15]

The New Look, the Offset Strategy, and the Defense Innovation Initiative (DII) all have the goal of achieving an asymmetric advantage over an adversary through the use or development of new technologies. The New Look used nuclear weapons and deterrence capabilities, the Offset Strategy sought for stealth, space, and other revolutionary technologies, and the DII looks toward artificial intelligence, human-machine teaming, and deep learning capabilities. All of these military strategies rely on technology for an advantage over any adversary the US will face. Arguably, the first two offset strategies were successful in gaining technology or capabilities that other nations would not have until years later.

Moving forward into other methods championed by the military includes scenario planning and war gaming. *Scenario planning* is "a disciplined method for imaging possible futures in which organizational decisions may be played out."[16] First termed in the modern sense by Herman Kahn at the RAND Corporation, *scenario planning* is the intentional development of simulations or scenarios for strategic development.[17] Likened to a glorified version of storytelling, it is inherently a method used to plan for the future. Both the military and private sectors use scenario planning more often than any other method for strategic development. However, *scenario planning*, as it is currently termed, was not popularized until the 1980s, when it became an independent field of study.[18] While there is no general consensus as to the exact methods by which to execute scenario planning, there are certain accepted techniques.

Used by both the military and private companies, scenario planning forms an integral part of many organizational models for strategic development. The military often acts out developed scenarios in war-gaming exercises. Accomplished through a variety of ways, war gaming can be done in a seminar with state actors, via a board game, conference, or through massive exercises with live troops and equipment. Perhaps the largest scale war games occurred during the Cold War in the 1970s and 1980s. Known as Operation Able Archer, the US conducted an annual troop movement with the North Atlantic Treaty Organization as a simulation of war preparations against the USSR.[19] The US is also known for creating mock up urban environments for military training exercises, as well as hosting conferences for strategic development during both wartime and peacetime. At its core, war gaming is the physical implementation of scenario planning for military use.

Similar to many other methods of future analysis or forecast analysis, scenario planning is often wrong. The value of scenario planning does not lie in creating or

acting out the scenario itself and being right about the outcome. The value lies in the identification of the necessary actions to be taken to achieve a desired objective through an iterative process.

Next are the lesser-known methods of futurecasting and threatcasting. A combination of scenario planning and science fiction, futurecasting is a unique methodology with the purpose of forecasting the future usually five to ten years in advance. Taking scenarios developed in a planning or modeling process, futurecasting selects a desired scenario and then plans actions in the present to reach the desired future, known as backcasting. Still a relatively new field of study, it is not used in any meaningful capacity by the military and has been successful only in rare instances within the private sector.[20]

The first mention of futurecasting, a methodology driven toward engineering a possible future, was likely in 1970 with Alvin Toffler's *Future Shock*. Describing a state of mind relatable to culture shock, future shock occurs when novelty, transience, choice, and diversity overwhelm an individual to the point of paralysis. In addition to this main point, he argued that the human race is living in an increasingly transient lifestyle and is "living faster." He also argued that humans have physical limits of adaptability; exceeding these limits leads to the state of future shock.[21] Paralysis may not be a legitimate worry in an ever-adapting society, but the concepts Toffler identified formed the foundation for futurecasting. He posited the processes futurecasting would come to follow—a human-centric approach to forecasting the future.

Futurecasting found some limelight with Joel Kurtzman's *Futurecasting: Charting a Way to Your Future*. Providing a synopsis of the techniques and various processes used for futurecasting, Kurtzman developed futurecasting into a concrete methodology rather than the abstract concepts developed by Toffler. Kurtzman focused on the development of three topics: the complexity of the world and its connectivity, observations from critics, and trend analysis.[22] These three tenets added pillars to the human-centric foundation that Toffler developed. Later, these pillars would be refined more closely as expert interviews, trend analysis, and forecasting, and breaking down a complex problem into categories of information.

Another notable use of futurecasting, and the first major use by a corporation, came with Peter Schwartz's *The Art of the Long View: Planning for the Future in an Uncertain World* in 1991. Arising from the success of Royal Dutch/Shell Group's futurecasting in the 1970s, this book stresses the importance of using scenarios to drive action for a desirable future.[23] This brought futurecasting into the eyes of the private sector.[24] Intel Corporation now employs a "resident futurecaster," and other companies have futurecasters or futurists for strategic development and planning.

The last major addition to the futurecasting realm is Dan Gardner's *Future Babble*. Dividing the world into foxes and hedgehogs—foxes are those who draw information from a variety of sources and make cautious predictions, whereas hedgehogs pledge themselves to a single framework that fails more often than not—Gardner used an analogy to form his claims toward predicting the future. Arguing that the future is too complex to hope to predict, he asserted that it is not about getting a right answer, it is about getting an answer to begin with.[25] Predictions, he states, are about psychology, people would rather have a wrong answer instead of the lack of one.

Predictions or forecasts in futurecasting are not meant to be correct; their primary goal is to provide a possible way forward, similar to scenario modeling.

Another method like futurecasting, threatcasting is a new subset method with a focus on preventing, mitigating, and combatting future threats. Using a similar method as futurecasting, threatcasting branched out within the past 10 years. Brian David Johnson developed the threatcasting method around 2010, working with both the USAFA and Intel Corporation to develop it.[26] Whereas futurecasting focuses on actions toward a specific future in mind, threatcasting focuses on actions taken to counter a future threat.[27] The Department of Defense has used threatcasting in extremely limited environments and only for research application, such as in the Department of Homeland Security's Center of Innovation, and now more recently at the Army Cyber Institute. While both threatcasting and futurecasting are similar processes, it is important to differentiate the two, as their purposes are inherently different. Whereas futurecasting seeks to take action toward a desirable end goal, threatcasting focuses on taking action to prevent, mitigate, or combat a future threat.

The public and private sectors have a number of tools at their disposal for strategic development, many of which are annotated above. While each sector has a different goal than the other, it is clear to see why both pursue better methods for forecasting the future. Creating independent branches with this goal in mind, such as the Office of Net Assessment, the Federal Foresight Council, Defense Advanced Research Projects Agency, Phantom Works, or Skunk Works, is one way companies and organizations seek to maintain the competitive advantage in an evolving market. However, although research points to different methods for success, there is currently no comparison of these different methods for strategic foresight analysis or its effectiveness. While the private and public sectors seem relatively successful in their own right, much can be learned from analyzing strategic development methods within each sector and how each compares to the other sector. This would be an important milestone in strategic foresight studies.

Resulting from this study were a number of insights with regard to the method of strategic foresight and its effectiveness for both the private and public sectors. As a general overview, the public sector began the push for long-term strategic development with intentional steps toward achievable goals. As a result, it is more successful with developing and executing strategy roughly 20 or more years in advance, although it still has not tapped its full potential.[28] In comparison, the private sector underutilizes strategic foresight methods used for development of long-term strategy. As a result, many successful companies seek out sustaining or disruptive technologies to maintain upward growth.[29] Unlike the public sector, the private sector thrives on rapid adaptation, exemplified by the adoption of new technology in major companies. While the public sector "follows the threats" for strategic development, the private sector "follows the money."

Some may argue that perhaps now more than ever it is imperative that the US armed forces anticipate adversarial actions. In a world of increasing rapidity and transiency, the military finds itself at the forefront of what some may call a new era of warfare.[30] Whether it was because of emergent threats, a directive provided from a higher authority, or a new way of preparing for warfare, the military now utilizes a number of strategic development methodologies to prepare for current and potential

future conflicts. From a superficial point of view, one can state that the US military has been successful in their foresight endeavors with lower casualty levels than ever and remaining a dominant conventional force in the world.[31] For the last 70 years, the US has operated without near-parity in all conflicts.[32] However, none of these successes are the clear result of proper foresight or strategy implemented by the military.

Since the Cold War, the military has expanded its strategic foresight largely through scenario planning and war-gaming exercises—many of which are in conjunction with allied nations or coalitions.[33] In this way, US forces have been able to maintain parts of long-term strategies, carrying across multiple administrations. One of the prime examples of this continuity was with Andrew Marshall, the so-called "Yoda" who recently retired as head of the Office of Net Assessment (ONA). In addition to these long-term strategies are an increasing number of new foresight committees, including the Public Sector Foresight Network and the Pentagon's long-standing Checkmate. These organizations work to plan for and counter long-term threats the US may face. Meanwhile, military leaders effectively seek to develop asymmetric advantages over adversaries (commonly through Offset Strategies).[34]

Although the military has found success through these scenario-based methods, they are limiting in nature. Unlike other methods of strategic foresight that involve the development of probable, plausible, and unlikely futures, scenario modeling and war gaming are largely constrained to the specific scenario at hand.[35] Possible futures not explored in these scenarios could pose a threat to an unprepared military. Rather than relying solely on contingency planning resulting from scenario modeling, the military could use these scenarios and war games in conjunction with other methods that require alternative solutions to unconventional problems.

Aside from these common methods, the US military also utilizes the geopolitical forecasting and net assessment methodologies in a limited capacity. Geopolitical forecasting, a lesser-known method of foresight based on the effects of geography in the future, is rarely used by the military.[36] Many experts might argue that the application of this method could have led to the preparation for World War II, the Russian invasion of Ukraine, and other conflicts.[37] Similar to geopolitical forecasting, net assessment is also a little-understood method of foresight. Used most often in the ONA, the military uses this form of strategic foresight to make long-term decisions. A method that is gradually becoming more common, net assessment was popularized by Andrew Marshall, the first director who served for more than 30 years.[38] Little is known about the ONA; however, its importance in military planning is not questioned. Although it plays a major role in long-term planning, the use of net assessment is extremely limited, similar to geopolitical forecasting.

The military as a whole entrenches itself in a standard way of solving problems—for a military that has the advantage in budget, technology, and quality of forces, this is not an issue. However, should an unconventional problem arise, this type of force—the US military—will find itself with no way to create and implement a feasible solution.[39] This is exemplified with the current struggles with Russia's hybrid warfare and China's Anti-Access/Area Denial (A2/AD) strategies. Therefore, while the US military has a number of entities that focus on strategic foresight, the public sector, overall, is mediocre for using accepted methodologies to develop strategies.

Whereas the US military keeps its focus on external threats, the private sector primarily looks to competition as the main threat. Analogous to an existential threat for a nation is the fear of business failure for a major corporation. For this reason, the private sector also has begun to undertake strategic foresight methods to ensure private companies' own survival and success. However, there is little to no information on how companies employ strategic foresight into their planning processes, with the exception of a few case studies.

The first major success story of strategic foresight within a large corporation was Shell's use of exploring alternative futures. Beginning in 1987 with the establishment of the Global Business Network, Shell focused on analyzing and anticipating future trends to form the basis of organizational level decisions.[40] This method is extremely similar to the threatcasting and futurecasting methodologies, and its proper employment rose Shell to the top of prosperous oil companies.[41] The Shell case study is a classic example used to emphasize the important role strategic foresight can play.

Another common case study for utilizing strategic foresight is Skunk Works, a proprietary lab within Lockheed Martin. Created for the sole purpose of innovation, Skunk Works is an elite team of expert engineers focused on designing the next generation of aircraft.[42] Results from this team arose in the form of the U-2, F-117, F-22, and F-35.[43] All aircraft won major contract deals from the US military, possibly proving that a small team with minimal oversight can create unconventional solutions.

While there are success stories for using strategic foresight, there are also companies that failed. Blockbuster and Blackberry, once two giants in the technology field, now find themselves in shambles. Both are still around today, but they are not nearly as successful as they were previously—Blockbuster having been acquired by Dish.[44] Both companies failed largely for the same reason. In short, they failed to adapt to a changing environment, one in which consumers flocked to competing companies.[45] Both believed that the strategies they implemented in the past, leading to their success, would continue to work in the future.[46] This assumption was incorrect and ultimately led to their downfall.

Currently, there are no specific case studies for uses of time series analysis and Blue Ocean Strategy. Time-series analysis, most commonly used to make stock market trades, is likened to pattern analysis.[47] Rather than a foresight method, it takes on the subset role within a larger method. Blue Ocean Strategy, published in a book in 2005, similarly offers little for continuous strategic development in the long-term.[48] More of a way of thinking about competition in the private sector than a method of strategic foresight, Blue Ocean Strategy argues that businesses must develop an independent operating sphere, one that shuts out competition and allows for free market space operation.

While there is little information on the private sector and its implementation of strategic foresight, the few case studies available show its value. Typically, businesses will pursue a sustaining or disruptive innovation on which to form their base—tech companies thrive on these developments.[49] Overall, similar to the public sector, the private sector also fails to accommodate strategic foresight methods into business strategy. Similar to the public sector that reacts to potential and present threats, the private sector reacts to growth, expansion, and competition.

Table 1. Summary of results

Public sector	*Similarities*	*Private sector*
Excels in developing and executing strategy 20-plus years in the future	Failure to employ strategic foresight methods can prove disastrous	Relies on disrupting/sustaining innovations for growth
Strategy based on historical analysis and scenario planning	Underutilizes strategic foresight methods	Thrives on rapid adaptation
Slow to adopt new technologies and strategies	Overall growth in the use of strategic foresight methods	Follows the money
Follows the threats	Case studies demonstrate the success of foresight analysis	
Reliance on war gaming for planning conflicts and contingencies	Utilizes small elite teams or agencies for advanced, long-term planning	
	Use of subset foresight analysis within larger and multiple methods of foresight analysis	

Although strategic foresight is still a developing subject, the public and private sectors must realize each method's limitations. The military largely utilizes scenario planning and war gaming as methods of strategic foresight—results of these methods lead to huge decisions on asset allocation, force structure, and even how the US may interact with other nations. However, both of these methods have certain inherent limitations. In other words, as stand-alone approaches, neither scenario planning or war gaming allow for the development of alternative futures—possible occurrences, anomalies, or other unforeseen circumstances that could drastically alter the scenario. Similar to the public sector, the private sector also limits its strategic foresight capabilities. Relying primarily on disruptive and sustaining innovations to maintain legitimacy during an extended period, companies largely do not employ other methods of strategic foresight. However, in the instances when companies utilized strategic foresight as a part of their decision-making process, they were extremely successful.

If both the private and public sectors intend to make well-informed decisions toward their respective goals, strategic foresight must be a part of this process. The results of this study show the benefits of any method of strategic foresight. No military desires an existential threat, and no corporation seeks to become overshadowed by competition. Strategic foresight methods ultimately help avoid undesirable end states by planning for future possibilities. Throughout this research process, some methods have shown their worth.

However, each method also has its shortcomings. This can be summed up by a method's level of *fitness*. Defined as a method's effectiveness and suitability to fulfill a particular role or task given the objectives of a specific organization, a less effective method only has suitability and utility in a very limited number of situations.[50] In addition to fitness is the level of flexibility afforded by a certain method. *Flexibility* is the assessment of a method's level of modification or adaptability.[51] From

these two definitions, strategic foresight methodologies can be plotted on a chart with flexibility on the x-axis and fitness on the y-axis (see the figure below). The strategic foresight model illustrates the level of desirability for each method, plotting its respective level of fitness and flexibility.

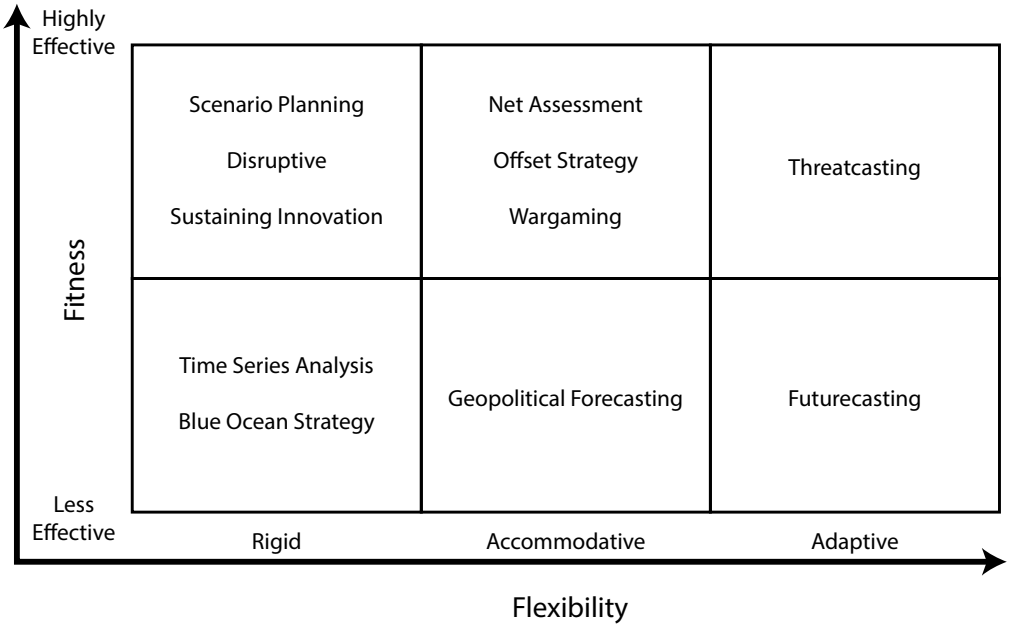

Figure. Strategic foresight model

To qualify which method belongs in what portion of the model, it is important to identify certain criteria that must be met for each section. For fitness, methods will be plotted either in the top or bottom half. The top half contains methods proven to be predictably successful, or fit—either in specific case studies or for larger scale uses. These are all methods with clearly defined stages of development, execution, and analysis. Unlike the top half, the bottom half contains more ambiguous methods of study—most do not have clearly defined steps that allow anyone to execute a strategic forecast. Additionally, they have not proven to be as successful as their counterparts in the top half. Next is the qualification of flexibility. Divided into three sections, each method was categorized based on how each could be modified or altered by the user. Methods in the far left section can only be modified in a restricted manner, if at all. Methods in the middle are adaptable in some respects—throughout the process they can be altered to fit objectives or by the users themselves in limited capacities. Lastly, the far-right section contains methods with highly adaptable frameworks, major opportunities for user change, and overall fluidity to their development and execution within an overarching framework. For the sake of simplicity, each type is named for ease of description. To summarize the model, see table 2 for a list of characteristics for a method in its respective classification. In

addition to the characteristics each method has, a description of sample methods plotted on the model will be discussed in further detail.

Table 2. Strategic foresight model descriptions

	Rigid	*Accomodative*	*Adaptive*
Highly effective	• Unable to change or adapt • Predictably successful • Clear development, path to execution, and analysis	• Change and alterations within the method are allowed in a limited capacity • Are predictably successful • Clear development, path to execution, and analysis	• Allows for user flexibility, input, and creativity • Are predictably successful • Clear development, path to execution, and analysis
Less effective	• Unable to change or adapt • Limited application to public and private sectors • Difficult to implement	• Change and alterations within the method are allowed in a limited capacity • Limited application to public and private sectors • Difficult to implement	• Allows for user flexibility, input, and creativity • Limited application to public and private sectors • Difficult to implement

Beginning with highly effective-rigid methods of the model are scenario planning, sustaining innovation, and disruptive innovation. Regarding scenario planning, the US military utilizes this method in many respects—from large force exercises to conferences that use scenarios to develop contingencies. However, all of these methods offer little flexibility. Scenario planning is limited only to the specific scenario design; it cannot be fundamentally altered in any way. Additionally, sustaining and disruptive innovation rely on the development of technology for success—no amount of planning or design can overcome this.

Highly effective—accommodative methods contain the offset strategy, net assessment, and war-gaming methodologies. Net assessment, similar to geopolitical forecasting in its ambiguity, is a method becoming more and more common within the public sector. Similar to scenario planning, the US military also heavily relies on war gaming to develop contingencies, develop strategy, and analyze potential adversarial actions. Lastly, offset strategies are created with the purpose of gaining an asymmetric advantage over adversaries. All these methods bring about highly desirable outcomes, but what they do not allow for is flexibility. While not as limiting as scenario planning and sustaining or disruptive innovations, these methods still fundamentally bound themselves. War gaming allows for independent actions, but only within the rules of the game. Similarly, net assessment and offset strategies only function within official directives as well as a specified data set.

Located in the less effective-rigid box are the time-series analysis and Blue Ocean Strategy methods. Time-series analysis historically has been used in very limited capacities—its most common use is for stock-market trading. It does not lend the user any insight as to what action must be taken, this method only allows for pattern identification. The Blue Ocean Strategy, another form of strategic foresight most commonly applied to the private sector, is a still undefined method that does

not identify how an organization should act. Instead, it argues that an organization's goal should be to establish its area of operation.

The lone less effective-accommodative item is geopolitical forecasting. A largely ambiguous method of strategic forecasting, it is not desirable within the public or private sector for this reason. While the public sector occasionally uses geopolitical forecasting to forecast long-term developments, it is rarely, if ever, used within the private sector. However, geopolitical forecasting does allow for slightly more flexibility, more so than time-series analysis and Blue Ocean Strategy.

The only method that classifies as less effective-adaptive is the lesser-known method of futurecasting. A method that combines science fiction and scenario planning, futurecasting champions flexibility as one of its prime strengths. This method requires creativity and alternative futures to find success and develops some future scenarios from which strategic planning can arise. However, while futurecasting has high levels of flexibility, this method does not account for potential threats, competitors, or other obstacles. Therefore, it is less desirable. Any organization wishes to plan for potential threats that may lie in wait.

Where futurecasting falls short is what the threatcasting methodology rectifies. A highly effective-adaptive method, threatcasting allows for the highest levels of desirability and flexibility out of all other methods analyzed. Similar to futurecasting, threatcasting differentiates itself by solely focusing on developing future states based on a specific threat, then plans for how to prevent, mitigate, or counteract the threat in question. For the military, this method is extremely useful for long-term planning, strategic development, or countering adversarial strategies. Additionally, the private sector can find value by beating out competitors with the threatcasting method, aiming for a strategy of sustainment and growth.

How can the future best be forecasted? This question was the primary motive for the study. As can be expected, no single method appeared to be an all-encompassing answer—it depended on the context in which a forecasting method was used that determined its success. However, the Strategic Forecasting Model provides new insight as to how each forecasting method can be defined. *Flexibility* and *fitness* accurately describe the level of effectiveness a single method can have in a given situation. In a rapidly increasing pace of operation the world finds itself in, strategic foresight methods can change how the public and private sectors prepare for the future. Whether an organization "follows the money" or "follows the threats," strategic development and foresight will play an important role. ✪

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Cyber War and Deterrence

Applying a General Theoretical Framework

Capt Isaac Nacita, USAF
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Introduction

> *Military history, when superficially studied, will furnish arguments in support of any theory or opinion.*
>
> —Paul Bronsart von Schellendorf

In September 1870, after just six weeks of what many thought would be a prolonged war, Prussian bystanders jeered Louis-Napoléon Bonaparte as he was carried to captivity in what is now Kassel, Germany. It was a fitting portrait of French national disgrace.[1] Their military structures before the war and lack of strategic planning were partly to blame. National archivist Dallas D. Irvine points out, "it (the French system) was almost completely effective in excluding the army's brain power from the staff and high command. To the resulting lack of intelligence at the top can be ascribed all the inexcusable defects of French military policy."[2] Nevertheless, influenced by the idea that France had lost due to its lack of morale that an offensive approach would have provided, the military regrouped and refocused itself, this time adopting "attaque á outrance." This doctrine was French military strategy entering World War I, and it was almost immediately proved spectacularly wrong. The French lost 300,000 soldiers in the first month of war. Yet "the legacy of the adoption of the offensive was even more terrible in another sense. The wanton slaughter it spawned produced a similar reaction in all those who lived through it—a grim determination never to allow such slaughter again."[3] Once again, they turned to the defensive, and in the years leading up to World War II constructed the Maginot line. The Germans simply bypassed its strong points and broke through a weaker French line in unexpected terrain. The Maginot line is now a metaphor for something that creates a false sense of security.

There is a saying that politicians and generals are always fighting the last war, which is emphasized when the weapons and characteristics of warfare are changing rapidly. However, if this is true, it is often not due to an inability to learn lessons from previous conflicts, but to "overlearn" or overcompensate for the failures and experiences of the past. In reality, this is not a learning problem but one of forming poor implications from historical events, which leads to poor applications of doctrine the next time around.

The DOD now acknowledges that warfare has extended into cyberspace, and it is my central thesis that the military often suffers from a lack of meaningful conversation concerning the problems it faces in that domain. The lack of discourse is due partly to poorly adopted metaphors and analogies pulled from other domains of warfare and historical examples, and in general to a lack of rigorous strategic framing of the problem and its potential solutions.

The Problem

What problem doesn't the United States face in cyberspace? The online world reflects the totality of human societal issues. Is there a cyberwar occurring? Cyberspace is a "contested environment," but so is the global business market. Karl Von Clausewitz called war a clash of wills, a political act carried out by other means, yet also characterizes it with physical force that seems to require a physical domain.[4] Some, therefore, argue that acts of sabotage, espionage, and subversion occur, conducted through a different medium, but not warfare.[5] Martin C. Libicki suggests the possibility of "sub-rosa" warfare, implying the general population may be totally unaware of what is occuring.[6] Others downplay the terminology because what we have faced so far is overhyped and does not merit the title. In many cases the actual effects due to malicious cyberspace attacks are less than those that occur due to natural or accidental events. There is a somewhat humorous incident in which, a year after alleged Russian cyber attacks in Georgia, a 75-year-old woman accidentally cut a cable with a shovel and knocked out internet access in all of Armenia, outdoing Russia in terms of total effect.[7] All of this is also compounded by the tendency to treat all of America's social problems using warfare terminology. We are fighting a "war against poverty" and a "war on drugs." There is winning, and there is losing but rarely a clear winner or loser.

These things notwithstanding, the DOD has already recognized cyberspace as a war-fighting domain. But the nature of the problem is central to the question of deterring or prevailing in cyberspace. One source says, "stop debating on what to call the problem and get us some help!"[8] The point is understood, but if the problem is not, we should not expect to receive any meaningful help.

The Defense Science Board (DSB) presents some examples of cyber attack that may be used to frame the problem. It points to Iran's denial of service (DoS) attacks on Wall Street in 2012–13, North Korea's hack of Sony Pictures, Chinese intellectual property (IP) theft, and Russia's alleged involvement in the 2016 presidential elections. The document also refers to attacks by nonstate actors like Anonymous or New World Hackers, acknowledging that all of these represent only a small sampling. Fears

include the ability of these nations to hold US critical infrastructure at risk, to thwart American military response via the cyber domain, and to use a wide range of lower-intensity attacks that collectively take a toll on the foundations of national power.[9]

The DSB's recommendations for cyber deterrence read like a Cold War deterrence playbook and not without acknowledgement. Its first initiative, planning tailored deterrence campaigns to cope with a range of attacks, unmistakably resembles flexible response, the concept that moved US nuclear policy away from massive retaliation toward something more proportional. Its second initiative, creating a cyber-resilient "thin line" to key US strike systems, even uses the term "second strike" in a clear acknowledgement of its nuclear deterrence forbearers. Even "countervailing" appears in the document, a term used during the Carter administration years to convey a particular nuclear deterrence strategy.[10] The analogy is not limited to the DSB, presumably because the cold war itself is often invoked in discussions of the relationship between countries over their interactions in cyberspace.[11] A recently cited case described the suggestion to leak our cyber offensive capabilities, which takes the idea from nuclear deterrence, that is, a secret weapon cannot be a deterrence.[12] Even the question posed for this article seems to echo President Reagan's speeches on "prevailing" over the forces of communism and the Soviet Union.

In 2012, Defense Secretary Leon Panetta used the term "cyber Pearl Harbor" to convey the danger the US faced in the cyber domain;[13] others have similarly used "Cyber 9/11." In contrast, John Arquilla and David Rondfeldt suggested (more than a decade earlier) a "manifest destiny for the information age."[14] Others call cyberspace the new "wild, wild west" or harken the era of pirates and privateers, weak governments, and inexplicit or unenforced international norms.[15] All of these have something in common: the desire to explain something new in understandable terms by reminding us of the past. Cyberwar is complicated because it covers a range of attacks; DoS attacks and leaking of Democratic National Party documents represent two very different types of attacks and two very different strategies. The only thing they really have in common is that both were conducted using cyber domain tools and directed at the US.

Scholars have noted that metaphor is an essential part of how humans rationalize and understand the world, not just in language, but also thought processes.[16] Christopher R. Paparone argues that "management of meaning" is a primary task for leaders.[17] They are often the best way to frame the narrative, but with the obvious problem of oversimplification. A naïve translation of nuclear deterrence principles into cyberspace, therefore, obscures the real problems we face.[18] Metaphors "carry with them, often covertly and insidiously, natural 'solutions.' "[19] Computer viruses resemble biological viruses, so some have suggested a cyber version of the Center for Disease Control.[20] Online piracy, like real piracy, is a problem of establishing international norms and compelling nations to enforce them.[21] These are perhaps two of the better ideas, but they also show that the method of framing the problem affects the way the solution is formulated. Winston Churchill's iron curtain description painted a visceral image in Western minds that helped to shape the policy of containment under the Eisenhower administration. References to an "information curtain" or "tearing down this firewall" lack the same vitality.[22]

Paparone discusses categories of metaphor used by leaders: Newtonian, post-Newtonian, and Humanities and Arts.[23] Newtonian metaphors are based in the hard sciences, and tend to be deterministic in character. Military doctrine derives many of its concepts from Newtonian terminology, such as mass, friction, center of gravity, and power, which carry a quantitative quality. In contrast, post-Newtonian metaphors allude to the complexity and mutual interaction of a system, based in fields like biology, medicine, and quantum mechanics, in which probabilistic effects characterize outcomes rather than linear, deterministic ones. The terms are used extensively in the cyber domain; network, virus, infection, and worm all draw parallels to the "post-Newtonian" world. They are also used to explain things like terrorism and insurgency. Finally, the humanities and arts provide metaphors and analogies from historical, literary, and cultural references. In one of the better war metaphors, Clausewitz likened it to two wrestlers striving for dominance over one other.[24]

In summary, the cyberwar discussion is taking place within a language context that is as congested as the internet itself. This problem has some precedent. Lt Col Peter Faber, USAF, retired, argued that airpower theory and doctrine suffered inside a similar "prison house of language" during its development that mixed rationalist ideals, antirationalist thought, and army terminology.[25] In response, Lieutenant Colonel Faber suggested a framework originally conceived by Dr. Robert Pape and expanded by several works at the Air University.[26] This framework was intended to generalize the ideas of airpower, but without locking it into a particular linguistic context. Particularly, the goal of any strategy is to link ends with means. It is this framework that I propose can be utilized to help understand how to address the cyber-specific threats to national security that the US faces.

A Strategic Framework

The framework takes the form of six key questions in anticipation of any strategy utilizing military forces:[27]

1. What outcome am I seeking?
2. What are my specific politico-military capabilities and those of the adversary?
3. What type of strategy should I pursue?
4. What targets or objectives are most important?
5. What mechanisms do I expect my operation to trigger?
6. How should I time my actions?

Beginning with the first question, the outcome sought is primarily political in nature. However, it does not have to be destruction-oriented. In this case, the aim is to stop aggressive actions in cyberspace. Yet this requires further clarification. The outcome should be considered with respect to some receiver.[28] Who should stop conducting aggressive actions in cyberspace, and which actions should stop? Is the political outcome that China reduce IP theft from American corporations? Or is it to reduce the vulnerability of US critical infrastructure? Changing the formulation of

this outcome may change the direction of the strategy. For instance, the outcome may be stated in terms of stopping a particular nation-state from taking hostile cyber-actions against our power grid. Alternatively, it may be stated in terms of minimizing the *effects* of a power system cyber attack on the functioning of society. In the latter case, perhaps the receiver is not the adversary but the private owners or managers of US critical infrastructure. We should avoid the temptation of grand, unified strategic deterrence aims to cover all possible cyber actors and activities; such a thing is akin to a "land" or a "sea" deterrence.[29]

Next, the comparison of politico-military capabilities. Policy, readiness, training, domestic culture, equipment, tactics, and attribution are all applicable in the cyber domain as in every domain. Perhaps the US holds a conventional warfighting advantage, but how ready are forces to defend networks or conduct offensive actions in cyberspace? What about cultural strength, the responsiveness of the general populace to an information campaign pressing a particular narrative, as in alleged election meddling? Sun-Tzu may have summarized the importance of this question simply: know yourself, and know your enemy.[30]

The third key question asks that a particular strategy be considered. Lieutenant Colonel Faber suggests several:

- punishment—pushing a society past its economic or psychological breaking point
- risk—same as punishment but with gradual escalation
- denial—neutralizing ability to wage war
- decapitation—destroying or isolating leadership, national communications, or other centers of power
- disabling—disrupting offensive abilities
- delaying—using threats or deterrence method to preserve status quo
- enabling—creating stability where it is weak

It now becomes clearer why language problems have often been crippling to cyber discussions. Nuclear deterrence analogies, which have been used but found wanting in most cases, do not usually fit because they were formulated for specific political outcomes and specific assessments of capability. It is of course true that cyber weapons aren't nuclear bombs, but bombs were not the goal of deterrence, they were the means that fit the assessment. A more important lesson is how, not what, strategy was applied given the options. The delaying or punishment strategies may have worked then; maybe a denial or an enabling strategy is more appropriate now. A possible example of a "cyber" decapitation strategy was the release of the Mandiant report, which simply used well-documented exposure of the PLA to isolate it in the international community.[31] This led to international agreements, with observed decreases in the number of cyber intrusions since.[32]

The fourth key question regards critical targets and their importance. Lieutenant Colonel Faber points out issues to consider:

1. Which aspects of the receiver's power should be targeted?[33]

- Sources – military, industrial, cultural
- Manifestations – government, ideological
- Linkages – human and material networks

2. What is the generic strategy?
   - Direct – "head on" assault, confrontation, or support
   - Indirect – reduce will to fight or alter decision making
3. What level of destruction do I want?

Clearly, the previously mentioned adversaries make the same considerations. The indirect strategy is often assumed in cyberspace, which sometimes is translated denial, degradation, disruption, destruction, or manipulation of information.[34] In a general sense, however, a target may be chosen for either strengthening or weakening, depending on the previous formulations.[35] Targeting theory forms a large part of airpower theory and is a key aspect of nuclear strategy. The US also often uses economic leverage to target sources of power. Cyber-targeting is a less developed concept but was recently considered in a thesis at Air University.[36] As with airpower, the targets are endless. However, the linkage between this step and the next is what Lieutenant Colonel Faber refers to as the "holy grail" of airpower, something that has yet to be completely achieved.

The fifth key question is to ask which mechanisms are expected to be activated by the previous targeting choice. What changes or outcome should be expected? Political division? Mass confusion, revolt, or surrender? Increased will to fight? A key reminder from early airpower advocates is that they were often wrong; bombing cities sometimes resulted in chaos or surrender and sometimes strengthened the people's will to resist. Cyber power effects are similarly difficult to predict. The 2007 DoS attacks in Estonia do not appear to have achieved any lasting effect. Stuxnet delayed but did not seem to ultimately alter the direction of Iranian nuclear programs. On the other hand, understanding the real effect of the information campaigns during the 2016 election remains elusive. First-order effects in cyberspace are easier to calculate, as they were in strategic bombing, or they may not be the primary purpose at all. It is the second, third, and fourth-order effects that have always been difficult, and these depend greatly on whether proper attention has been paid to question two.

Ultimately, deterrence is not a matter of thwarting technology, but of influencing decisions. These decisions are usually specific and limited. US nuclear policy perhaps influenced Soviet decisions to not launch nuclear weapons but did not prevent every undesirable Soviet military action, because there is no way to guarantee human behavior in every situation. However, one can use critical thinking and good judgment to seek solutions if the problem is framed well, the desired outcome is clearly defined, and the work to know ourselves and our adversaries well enough to make reasonable estimates of their responses has been done.

Finally, Lieutenant Colonel Faber considers timing. Should actions be single or multiple? Incremental, sequential, cumulative, or simultaneous? Once again, this is

tied to the desired mechanism. Will a single response be enough to deter a particular actor from a particular behavior? Or actions taken on a regular basis? Declaratory policy may work in some cases and may not in others.

It is my assertion that this framework provides a helpful, yet nonprescriptive manner in which to gauge the question of strategy for war and deterrence in cyberspace. It is not prescriptive because war is ultimately not a deterministic mathematical equation, and linking means and ends has always proved difficult. Nevertheless, it reminds us of a few important lessons, and helps free us from the traps of communicating under a constrained set of references.

Some Final Recommendations

What then, should the US do to better prepare for deterrence and, if that fails, to prevail in cyberspace? There are at least three ideas that we should grasp from this exercise.

1. Critical thinking and judgment must replace lessons learned.

> *They said, that to go to the gate for entrance was, by all their countrymen, counted too far about; and that, therefore, their usual way was to make a short cut of it, and to climb over the wall, as they had done.*
>
> —John Bunyan, *Pilgrim's Progress*

The central idea of this article has been that a poor usage of language and a lack of framing the problem has complicated and crippled the discussion of cyberwar and deterrence strategy. Senior leaders will not and should not throw out all metaphorical language and historical references. Our language and our history are part of our country's strength. Therefore, communication of the right pictures and the right historical lessons for the purpose of formulating today's strategy remains the goal. This will happen to a greater degree when we commit ourselves to the hard task of critical thinking rather than taking the shortcut of a simplified lessons-learned approach. We must learn from those who considered nuclear warfare in the 1960s, or asymmetric warfare in the Middle East, but we should not try to take shortcuts in our solutions. We must consider problems on their own merit, while acknowledging the work of those before us, and reaping the benefit of strategic thinkers who helped provide a framework for thinking well today.

2. Courageous leadership will be required.

> *Never neglect the psychological, cultural, political, and human dimensions of warfare, which is inevitably tragic, inefficient, and uncertain. Be skeptical of systems analysis, computer models, game theories, or doctrines that suggest otherwise.*
>
> —Secretary of Defense Robert Gates, 2008

Decisions in war and peace are often based on insufficient intelligence, probabilities, and general principles. We can reduce the likelihood that we make fundamentally unsound links between our ends and our means by thinking clearly and critically and taking into account a broad set of perspectives. However, at the end of the

day, our leaders will have to be courageous enough to listen and courageous enough to act or not to act. We should expect nothing less. War is fundamentally uncertain, and courage to decide will always be required.

3. Humility is key.

> *A generally useful way of concluding a grim argument of this kind would be to affirm that we have the resources, intelligence, and courage to make the correct decisions. That is, of course, the case. And there is a good chance that we will do so. But perhaps, as a small aid toward making such decisions more likely, we should contemplate the possibility that they may not be made. They are hard, involve sacrifice, are affected by great uncertainties, concern matters in which much is altogether unknown and much else must be hedged by secrecy; and, above all, they entail a new image of ourselves in a world of persistent danger. It is by no means certain that we shall meet the test.*
>
> —Albert Wohlstetter, The Delicate Balance of Terror, 1958

Humility allows us to do several things. It allows us to consider the past and recognize that we are not unique in facing problems and challenges of humanity. It insists that we recognize and accept strategic miscalculations and change our course of action. It gives us the ability to work with others from different fields and different backgrounds to solve a common problem. It dictates that we defer to others who are more able, more knowledgeable, and more informed about particular areas that we will have to consider. It causes us to realize that complete answers and complete solutions are not part of the realm of warfare and deterrence. Finally, humility reminds us that it is not certain we will be successful and so shows us that we too must do the hard work that every past generation has faced in its own way. ✪

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28. A note is important here: these strategies were formulated in the context of airpower. Nevertheless, the ends of airpower have always been considered strategic. Deterrence is an inherently strategic concept, and the general considerations should apply, not only with an offensive focus, but a defensive one as well.

29. The object of deterrence or offensive action is a person, not a technology or a domain, as described further in this article. Faber lists several: an international organization, a nation-state, a nongovernmental organization, a terrorist network, and so forth. However, our receiver does not have to be the adversary; it may well be an ally. An example of this is the Berlin Airlift, which sought to ensure West Berlin did not fall to Soviet economic pressures. In this case, the adversary was the Soviet Union, but the receiver was the people of Berlin. Presumably, there is some adversary, but our outcome need not be formulated in their terms alone.

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Persistent Space Situation Awareness for the Guardians of the High Frontier

Roberta Ewart

> *Every moment of every day, year in and year out a watch is being kept. Because of the satellites, the world is a safer place. Through their constant watch, both sides know the number, location, and status of the other's weapons. And both sides know both sides know. New threats can be identified and countered. A nation can act from knowledge rather than from fear and ignorance. Surprise and bluff are no longer useful tactics. In this way, military satellites represent a stabilizing influence—acting as guardians of whatever peace exists in the world.*
>
> —Curtis Peebles
> Guardians: Strategic Reconnaissance Satellites

As a nation, the US will have been discussing space power, space warfare, space war fighting, or some combination of those concepts for almost 60 years, since approximately 1958. None of the recent material (2015 to the present) regarding the Space Enterprise Vision (SEV) promulgated by Air Force Space Command (AFSPC) or the at-large space control community is new. In 1994, a report was delivered to the Office of the Secretary of the Air Force Directorate for Space Programs, entitled "The Emerging Threat and the Future Necessity for Space Control," which reads eerily similar to the documents being delivered and discussed today.[1] So, to take a slightly different path for discourse, it is interesting to ask this question from a technologist's perspective: What should the nation do to better prepare, technologically, to deter aggressive action in space/cyber space—and if necessary—prevail, should deterrence fail?

To date, key pervasive technology investment approaches have been underutilized that could focus the discussion and execution of efforts to remediate perceived military space shortfalls and provide for a longer-term efficient and effective solution. This approach should be openly discussed as a foundation for stability, based on the theory of behavioral deterrence. It is not just for the benefit of the public that this

more open approach should be considered. It is because within the government it will not be possible to devise a security overlay capable of bringing about the breadth of integrated change. More of the SEV effort needs to be devised in a more open way so more of the existing acquisition and operational personnel can contribute to the total solution.

To create this open-discussion approach, the following ideas, derived from existing policy and guidance, are proposed as an initial foundation for common values. These ideas are not mutually exclusive and likely not completely comprehensive:

1. Seek technologies to maintain and enhance the national security advantages afforded to the US by military space.
2. Enable military space systems to deter adversaries—and if deterrence fails—to prevail.
3. Support a more reliable, available, maintainable, and survivable military space enterprise.
4. Energize the space industrial base supporting US national security.
5. Focus space and technology innovation and facilitate its transition to military space programs of record.

From a historical perspective, but not going too far back into history, in 1995, the USAF Science Advisory Board (SAB), completed a study, "New World Vistas: Air and Space Power for the 21st Century,"[2] which laid out similar conditions, future vision, conclusions, and recommendations the military space community has been revisiting today. The technologists—in this case, the SAB—provided the framework to modify the policy, doctrine, and guidance to enable organize, train, and equip functions for the future military space environment. While the SAB technologists formulated this framework, they were adhering to the idea, "Stand on the Shoulders of Giants." This motto is for those, who have gone before and devised some of the answer, to use what they have attained, and apply it to the current situation. The entire military space community needs to do the same thing 23 years later, that is, to stand on the shoulders of its giants, and not continually reinvent what has already been devised. In doing this, all can move more quickly forward, with an emphasis on seeking the technology components for the SEV. The key foundational ideas are summarized as follows with linkages to the present-day situation.

> Space based sources and transmissions are crucial for the "information" in information-based warfare, so that US forces can respond to changing operating environments and evolving threats. A huge mass of data is available from sensor systems, and many different sources, and this data needs to be processed into information useful to the warfighter.
>
> —New World Vistas: Air and Space Power for the 21st Century
> Department of the Air Force Science Advisory Board

Currently, a space system's military value is derived from its contribution to the information dominance in the terrestrial fight. There is nothing of inherent military value to "hold" in space. There is no "ground." There is currently no resource (people, raw material, or treasure) to be taken in conflict with other nations. The value is in the spatial position the space-based system provides in relation to the information dominance for exercising terrestrial dominance.

An overwhelmingly correct prediction, applicable to this discussion, in the 1995 *New World Vistas* study, was that technology would be dispersed more widely and equally, and that vast amounts of information available commercially would change the dynamics of the information dominance equation. Dispersion of technology and access to space, which has been occurring worldwide, unsettles the previous position of supremacy the US has experienced. It was sufficiently upsetting that a third offset was called for to regain and "maintain overmatch against any potential adversary."[3] Unfortunately, the third offset has not fully manifested so it is not possible to directly link that concept to the military space doctrine/policy/guidance evolution. Yet, the third offset clearly points to the desire to find a technological underpinning sufficient to bear the weight of the enterprise vision.

So, even without a fully formed policy at the level of a third offset, military space planners can proceed as follows and begin to devise a deterrence position. From a technologist's perspective, there are sufficient technologies currently available to convert the existing space enterprise to a space war-fighting enterprise as long as the goal is information dominance. If the community can momentarily leave aside kinetic and directed energy dominance in military space, the US can proceed on a path of deterrence strategies with an underpinning of more open systems development with a larger pool of information technologists. This will bring a greater diversity of ideas and allow the cost of the effort to drop dramatically. It is well-known that developing and procuring classified systems is very expensive and lowers the number of personnel from which to draw the technology solutions. Usually, the solutions devised in a highly classified realm are not those at the cutting edge, as those reside in universities and small businesses whose personnel generally do not have US government clearances and would not want the restrictions placed on their work for that privilege. So, the core of the new idea is that by narrowing the initial scope of the SEV to its support of information dominance, and that piece of information dominance is used for a deterrence function, and that deterrence function is best devised in an open way, it is possible to create a very cost-effective partnership for many parties. What is finally needed is a requirements definition process linked to a "system of system" engineering process that allows that technology to be mated to appropriate war-fighting skills sets to take advantage of that technology.

The war-fighting skill sets are founded on principles of war. Applying the "Principles of War," the versions associated with *On War* by Clausewitz, and *The Art of War* by Sun Tzu, to information dominance, renders two approaches.[4] The first is to use the Sun Tzu approach to avoid war altogether by a superior use of information before the engagement. This is the case where persistent space situation awareness and sufficient characterization of action in space, to attribute the parties taking actions in space, is particularly valuable. Once an engagement or conflict has begun, the second approach of applying the principles described by Clausewitz, becomes

more appropriate.[5] A subset of these principles include surprise, maneuver, concentration of force, singular objective, and fog of war. While devising the space infrastructure, adhering to these principles, to support information dominance, is the key contribution to SEV. Taking each principle, it is possible to arrive at the start of a requirements generation process with the constraints from policy and guidance. For example, surprise is avoided if space-based systems can gather more and better information than the adversary's systems can. This sounds trivial, but the space situation awareness (SSA) information requirements must be broken down into the volumetric aspects of the various orbits and aspect angles under illumination, the timeliness of the reports, the precise position, and the precise time to correlate the various types of information for the SSA attribution process. This is not trivial in the analysis or design of a persistent SSA system.

Assuming the majority agree that information dominance is the appropriate initial goal for SEV, the next step is to devise the objectives for attaining the deterrence strategy. There are several forms of deterrence strategy, and one is to deter action by making the actor aware their actions and possibly intentions have been discovered. In other words, that there is no surprise to their actions and that "fog of war" is not applicable in the particular instance they seek. Those trained in Sun Tzu will agree that once the adversary is aware of the action being planned, it is unwise to continue the action and risk valuable resources. Seek better terms at a later time. So, the strategy is to cause the adversary to be deterred from acting, and instead offer another path to attain some of their goals in a continuous sequence of deferred gratification steps. This approach works well with deterrence by denial, which is when the deterrence is aimed at ensuring the adversary knows they will be denied the objective of their action.

One theory on deterrence is that by showing the capability of the systems gathering the information, such as SSA systems, it leaves no doubt in the adversary's mind that they are known and their actions are characterized. The other advantage of opening up the security classification overlays for SSA is that more of the SSA systems can be procured in the "official-use only" channels. This lowers the cost of security and increases industrial-base competition by increasing the number of vendors capable of delivering the system. Much of "synoptic" SSA needs to be an open and unclassified system, that is, the SPACE Fence, Ground-Based Electro-Optical Deep Space Surveillance System, and more recently the Geo SSA Program (GSSAP), are all examples of that type of approach. The GSSAP, once veiled, was revealed by the AFSPC commander publicly. This reveal helped both the US SSA teams and the allied, international, and commercial partners improve their collaboration efficiency. It is likely more cost-effective then, to maintain open knowledge of the synoptic systems which can in a timely fashion cue other, more capable, and more classified systems. Only a few high-fidelity, cued, and exquisite SSA characterization systems would ultimately be needed for highly-tailored responses that preserve space, not only for the US, but ultimately for the space commons. In the process, the cost efficiencies of synoptic SSA systems could buy down the cost and risk of the high-fidelity, exquisite, SSA systems. The key objective then is to obtain and maintain the highest levels of information dominance at an "affordable" price and to do that, it is crucial to

have SSA at an "affordable price." It is time to consider how to make this information dominance affordable.

No nation currently has 100 percent persistent observation of the space surrounding the Earth. The most foundational space military utility is to provide a capability to constantly track objects in orbit with an emphasis on larger, maneuvering and active spacecraft. This information is the critical first step in any strategic operational or tactical process. It is necessary to accomplish this observation task for several reasons. One is that by knowing the locations of objects in space, many other activities are made possible at an affordable cost. For the national security space community, this includes protecting space operations and assets (military, civil, and commercial), supporting the underlying ability to verify international treaties and agreements, and continuing the tradition of enhancing terrestrial global military operations and freedom of movement about the globe.

Today, satellites are tracked for intervals of time. This has led to a set of SSA systems which intermittently must reacquire and retrack objects. In the intervals between observations, objects could change their orbits, deploy other objects, break up, or new satellites could be put into orbit. However, there are benefits both from an efficiency and from a characterization perspective to seek to continuously track an object, versus tracking, loosening, and reacquiring the object. The efficiency comes in the act of not having to continuously recalculate, recheck, and reacquire the object when the custody chain is broken. Constantly holding the object under surveillance lowers the cost of the additional computation, comparison, and reverification of the objects identity from its tracked behavior and eliminates errors which can occur during this process. The second benefit is that, once tracked and continuously tracked, any behavior of the object begins to indicate "its pattern of life," and this leads to a better understanding of the intent of the motion or action of the object. So, it is both more efficient with resources and provides better characterization of the behavior of an object to keep it under continuous surveillance custody.

There are numerous ways to continuously track satellites with designs that use active or passive sensors and sensors that employ different pheonomenologies throughout the energy spectrum. The strategy pursued here is to put a passive sensor far enough from the Earth so the entire volume from the low-earth orbit (LEO) to slightly beyond geosynchronous (GEO) orbits are continuously viewable. This technique of "stand-off" had been used effectively in many designs and military applications, but in all cases, pushes the state of art and the state of practice of the engineer to obtain the necessary performance at greater distance.

The additional feature of placing the sensor far from the Earth is that it will require great amounts of energy expended over time, "action" to get into this faraway position.[6] Because of the great action required, it is more difficult for any adversary to reach the system, or reach the system in a reasonable period of time to be militarily relevant, and any movement to that effect directly signals the intent of the adversary, as there is no other known reason for any system to be in the location at this great distance. So, a sensor, with this capability, at a distance which is clearly a deterrent, is itself the foundation of all deterrence functions of any space policies. Several options to realize that vision are devised below.[7]

The method chosen to constantly see any satellite is to increase the range from the observer to the satellite so that any satellite's orbit is constantly in view. Option one needs two satellites in a polar highly-elliptical orbit (HEO). Option two places one satellite in orbit about the L1 Lagrange point. Several scientific missions were or are to be conducted from versions of this orbit. Option three places a satellite in a pole-sitter orbit. From an observer on the ground, a pole-sitter orbit makes a halo over either the north or south poles. To maintain this orbit, near continuous thrusting is required.[8]

The table below compares these three options with respect to the percentage of orbit types continuously in view and the adversary action necessary to rendezvous with the satellite. The pole-sitter option offers the best continuous custody of satellites in GEO, medium-earth orbit (MEO) and HEO orbits. None of the options can constantly observe all possible satellites in LEO due to planetary obscuration. The pole-sitter option has the best resilience, necessitating about 400 times more "action" to reach than action to arrive at GEO. With current means, it would take 81 days to rendezvous with the pole-sitter.

Table. Options compared to continuity of orbit coverage and action to attack

Option	*12-day HEO*	*L1 location*	*Pole-sitter*
Percent of orbit in continuous view:			
GEO	100%	90%	100%
MEO	88%	88%	100%
HEO	80%	85%	96%
LEO	Polar 29% Equatorial 100%	29%	Polar 29% Equatorial 100%
Action needed for satellite (joules-seconds/kg)	$2.6\ 10^6$	$2.1\ 10^8$	$4.4\ 10^8$
Multiples of action to reach GEO	~ 2 to 3	~200	~400
Additional energy to achieve orbit (megajoules/kg)	61.7	62.4	63.5
Minimum energy time (days) to reach orbit	0.5	38	81

Note: The pole-sitter option provides the best continuous coverage of orbit types and the most resilience to adversary actions.

It is because of these advantages that the pole-sitter has been chosen as the system to further the objective of 100-percent persistent SSA that underpins deterrence, and if deterrence fails, this system will give the strategic, operational, and tactical advan-

tage to prevail in and through space. The other two options could be used as risk-reduction prototype efforts as a means to approach the capability of the polesitter.

The families of technologies comprising the pole-sitter are well-known and are already developed or in development.[9] This includes large cooled, low-noise telescopes and optics (National Aeronautics and Space Administration (NASA) James Webb Space Telescope), advanced large format infrared (IR) starring focal plane array technologies, (Space Based Infrared Systems), and solar electric propulsion systems such as NASA's Evolutionary Xenon Thruster (NEXT), which in 2010 reported the completion of a 48,000-hour (5.5 years) continuous test. Recent solar array demonstrations on the International Space Station have gathered data on large solar arrays to power the thrusters, called the Roll Out Solar Array.

The current focal plane assembly (FPA) technology readiness level (TRL) is estimated to be about 4, so it's necessary to advance this first in a laboratory setting. Solar electric propulsion (SEP), with the necessary specific impulse, are close to being demonstrated, but not with the necessary thrust. NASA reports demonstrated NEXT had achieved TRL 6.[10] Large telescopes have been placed into space, but for other wavelengths than those needed for this mission, so ground demonstration of the telescope seems prudent. Two small satellite demonstrations are suggested—one to fly a representative FPA with a representative SEP. This could be in LEO to reduce costs. Such a mission would help resolve any lingering risks associated with operation in the space environment, including jitter suppression and detectability through the SEP plume. The second space demonstration places a small satellite into the pole-sitter orbit to both characterize that environment and achieve maintaining the orbit with the necessary positional knowledge. Meanwhile the production of the full-scale telescope suitable for a space mission is accomplished and tested. While efforts are proving adequate FPA manufacture yield, a full-scale, reduced operational life system can be tested in the pole-sitter orbit using real satellite targets whose orbits are known by traditional means. This integrated technology effort was then shared with industry and industry provided improvements to the conceptual development.

Industry has deemed the technologies feasible, within the state of the art and within the planning horizon.[11] Industry advised that additional pointing and object location technologies need to be added to the list of critical technologies, due to the great distances the sensor would have to precisely identify the objects.

A scale engineering design unit (EDU) for the telescope should be constructed. This includes the mirrors or mirror panels, actuators, and control algorithms, and associated telescope structure. This EDU should undergo full environmental testing to prove that the vibration from the constant thrust component can be damped at the panel level, as well as for the entire mirror assembly. The mirrors can be cryogenically chilled and their surfaces mapped to enable the mirrors to be further polished at room temperature to achieve the appropriate shape at the designated operating temperature. Upon successful completion of scale EDU environmental testing, the telescope can be considered TRL 6. Given the complexity and effort already demonstrated on the James Webb space telescope, a great deal of the nonrecurring engineering knowledge has been gained.

To mature the solar propulsion system, put NEXT, or its equivalent, on a small satellite in LEO initially, with support from an additional payload (that is, the IR tracker) for a demonstration flight. An orbit of almost equatorial inclination is recommended, which might require additional chemical thrusters for positioning. From this orbit, the platform could start spiraling out to GEO, very slowly. Note: this will take months, if not years. Along the way, supplementary payload instruments could image satellites to calibrate optical payload capabilities and other elements of the pole-sitter SSA mission. If a hybrid solar-sail approach is pursued, a sun-synchronous orbit is preferred. This allows the spacecraft to ride the terminator and avoid eclipses so the solar arrays stay illuminated.

In summary, this article has provided a chain of thought and underlying data to illustrate that there is a key effort—persistent SSA— the nation can use to deter, and if deterrence fails, to prevail. Industry indicates they can produce a pole-sitter system at an affordable price and within the current planning horizon. This task is far less daunting than was the task facing Lt Gen Bernard A. Schriever 60 years ago. Today's Guardians of the High Frontier should consider 100-percent persistent SSA, for information dominance, as a worthy goal and consider the pole-sitter as a worthy contender to establish a pedigree of war fighting in and through space. ✪

Notes

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Airpower Applied: U.S., NATO, and Israeli Combat Experience edited by John Andreas Olsen. Naval Institute Press, (http://www.usni.org/store/books/us-naval-institute-chronicles/us-naval-institute-marine-corps-aviation), 291 Wood Road, Annapolis, Maryland 21402, 2017, 432 pages, $49.95 (hardcover), ISBN 978-1-68247-075-6.

Airpower Applied: U.S., NATO, and Israeli Combat Experience presents a critical assessment of the role and influence of airpower in modern warfare, focusing on the operational and strategic levels of war. The editor, Royal Norwegian Air Force Col John Andreas Olsen, and his team of distinguished authors review the evolution of airpower and its profound impact on the history of warfare. By comparing and contrasting US, North Atlantic Treaty Organization, and Israeli combat experience in the past 75 years, they offer unique insight into the use of airpower and demonstrate how airpower, as employed by its leading practitioners, has fundamentally changed the character of war. Exploring the underlying nature of airpower in action supplements these examinations.

Airpower Applied demonstrates to the fullest that the evolution of airpower depends on the evolution of technology and, more importantly, on the imagination and knowledge that enable the invention, development, and application of airpower instruments. As the 29 case studies in this book reveal, airmen from the US, Britain, France, Israel, and elsewhere in the world worked tirelessly during the twentieth century to embrace innovation, creativity, and change. *Airpower Applied* records the results of their efforts, demonstrated in conflicts ranging from the Allied strategic bomber offensive in World War II to today's campaigns against insurgents.

Airmen who fly and fight today have capabilities at their disposal their predecessors could not have imagined. With its survivability greatly enhanced by platform speed and low observability, modern airpower can strike anywhere around the globe—rapidly, in all weather, day or night—and with extreme precision. Equipped with weapons capable of exquisitely accurate targeting, a single aircraft today can achieve the same effects that took thousands of bombs on hundreds of aircraft during World War II.

However, while airpower has matured to the point where it is acknowledged as an indispensable element of modern warfare, current practitioners may have become too complacent regarding its potential to determine the outcomes of any given conflict. Since the fateful events of 11 September 2001, nations have applied airpower primarily in the context of counterinsurgency operations. This means that the vast majority of today's active duty airmen have only experienced operations at the low-intensity end of the conflict spectrum. Without having encountered the challenges posed by more demanding conflict environments, national leaders—both military and political—may become increasingly inclined to accept this most recent combat experience as normal. *Airpower Applied* provides a more comprehensive perspective by highlighting the application of airpower in a range of settings radically different from those familiar to today's active duty airmen. The case studies in this book illuminate both the intentions of airmen as they applied airpower in a range of conflict environments and the often unanticipated outcomes. This spectrum of historical operations will become more important to future generations of decision makers in all countries and all services who, themselves, have only experienced early twenty-first century counterinsurgency operations.

Perhaps the greatest strength of this book lies in its linkage of specific operational details to the wider political context in which nations and coalitions have employed airpower. The case studies not only identify how airpower achieved effects in various military campaigns but also explore the theoretical and doctrinal underpinnings of those operations. They demonstrate convincingly that leaders must understand the strengths and limitations of airpower relative to their goals in any given conflict. As the editor states in his introduction, "even the most robust and capable air weapon can never be more effective than the strategy and policy it is intended to support." Combining an understanding of these multiple contexts with their own experience and expertise will enable the airmen of the future to design and deliver airpower options that optimize evolving aerospace capabilities and best exploit the virtues and value of operating in the third dimension.

This comprehensive and thoughtful account of recent campaigns can help military professionals and interested general readers to understand how airpower has become an increasingly more important and at times decisive political tool for conflict resolution—but only when appropriately exercised as part of a carefully crafted policy. I highly recommend *Airpower Applied* to officers of all services and civilians interested in defense and security, international relations, and military history.

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Chinese Nuclear Proliferation: How Global Politics is Transforming China's Weapons Buildup and Modernization by Susan Turner Haynes. Potomac Books (http://www.nebraskapress.unl.edu/pages/PotomacBooks.aspx), 1111 Lincoln Mall, Lincoln, Nebraska 68588-0630, 2016, 198 pages, $29.50 (hardcover), ISBN 978-1-61234-821-6.

In *Chinese Nuclear Proliferation*, Susan Haynes provides a thoughtful, in-depth look at China's nuclear force, deftly merging both theory and practice. The author makes academic international relations theory accessible and useful to practitioners while her discursive framework places policy in a lens that will be of interest to academics. Key topics include Chinese nuclear policy and strategy viewed comparatively through the strategies and policies of other nuclear weapon states and states with "latent" nuclear capability (that is, Japan). Haynes impressively weaves primary sources together with secondary literature, producing credible, authoritative findings.

Her main argument is that the People's Republic of China is the only signatory to the Nonproliferation Treaty that is presently expanding, diversifying, and modernizing its nuclear arsenal. China does so, by its own account, because of a perceived threat from the US and for reasons of nuclear prestige. Using a longitudinal analysis of documents produced by the three main groups of nuclear-policy influencers in the People's Republic of China—Chinese academia, the military, and the state—Haynes shows that the country's nuclear strategy is in a stage of transformation from minimum deterrence to the more assertive limited deterrence.

This finding rests upon sophisticated theoretical foundations. The author begins by reconceptualizing nuclear proliferation into "horizontal" and "vertical" types (p. 5). Horizontal proliferation is the oft-used idea of the distribution of weapons, technology, and knowledge to new states. Vertical proliferation, Haynes's primary reconceptualization, is defined as the "buildup and modernization of nuclear weapons within established nuclear weapon states" (p. 5). She then develops an updated and expanded typology of nuclear deterrence strategies that includes existential, minimum, limited, extensive, and maximum deterrence (pp. 14–15). This attention to conceptual and theoretical details extends to the author's ability to

provide an analysis and explanation of China's position accurately and fairly. One key example is her explanation of the different meanings of deterrence in the Chinese language (assumedly Mandarin). Her discussion demonstrates how the different meanings conflict with, at least, the West's denotation and how these differences affect Chinese policy influencers' thinking, policies, and strategies (p. 58).

Granted, *Chinese Nuclear Proliferation* leaves things to be desired (perhaps in a second edition?). For instance, although the typology of nuclear strategies is an advancement in the literature, it could be better explained. Each category appears to be separate from the others. However, it is implied that as one moves up the chain of strategies, each progressive strategy includes everything that came before. This point is neither explored in detail or made explicit (nor refuted if this interpretation of the typology is incorrect).

The reader is also left wishing that the contradictions between and within Chinese nuclear-policy-influencing groups had been explored more thoroughly. The military is shown to contradict itself and the state in several key documents, meetings, and interviews. People's Liberation Army major general Dong Qingfu allows for the "possibility of *limited* nuclear war," which is not in line with the state's no-first-use policy (emphasis in original, p. 70). These contradictions even take place within the same documents. The *Science of Second Artillery Campaigns* (*SSAC*) permits the use of nuclear weapons "to restrict the size and scope of war [and to demonstrate] that nuclear war can, in fact, be limited" (p. 69). The *SSAC* also states that the use of deterrence, especially nuclear, will be constrained by the opinion of international society (pp. 137–38). This second statement is a no-first-use strategy while the first is a no-first-use-of-force strategy.

There is also the issue of Haynes appearing to relax her perceptive analysis somewhat when it comes to the United States. She does not accurately portray it as either a nuclear state that adheres to maximum deterrence (pp. 15, 39–43) or some hybrid of extensive (pp. 15, 36–39) and maximum deterrence. In her analysis, the US strategy clearly has aspects of both types. This idea is conveyed by Haynes's discussion of nuclear strategy and forces throughout the book as well as her later statement that the United States has a "policy of first-strike ambiguity" (p. 145)—a key criterion of maximum deterrence (p. 15). It is also, as the author deftly points out, one of the main issues regarding the Sino-US security dilemma (p. 145). This situation complicates matters. Misclassification of the US nuclear strategy within Haynes's brilliantly updated typology demands that the reader go through the book again with a more critical eye toward the US strategy. Even so, she perceptively points out that there is a Sino–US security dilemma that cuts both ways—one that is often left out of discussions of the situation (pp. 5, 143).

With all of the above in mind, it is clear that this book should be read and reread by both practitioners and academics. Anyone who wants to understand current events, especially those surrounding the world's nuclear powers, as well as have a better grasp of such topics as the East Asian regional security order, will benefit greatly from Haynes's impressive work. She has provided the world with both an excellent primer for the freshest greenhorn and a rigorous analysis for the most grizzled veteran. The author's first book is a tour de force and a clear signal that a promising mind has been brought to bear on one of the most pressing issues of our time. One would be wise to heed her policy recommendations and to incorporate her work into future analyses.

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Potomac Books for making a copy of the book available for review and the *ASPJ* editorial team for their time and effort. All mistakes are the reviewer's alone.

The U.S. Naval Institute on Marine Corps Aviation edited by Thomas J. Cutler. Naval Institute Press, (http://www.usni.org/store/books/us-naval-institute-chronicles/us-naval-institute-marine-corps-aviation), 291 Wood Road, Annapolis, Maryland 21402, 2016, 176 pages, $19.95 (softcover), ISBN 978-1-68247-040-4.

Long before today's US Air Force (USAF) ever came to be, the other services had airpower components that contributed to their victories in multiple campaigns. Today's military members, of course, know that each service has its elements of airpower. But what some of today's members may forget is how military weapons developed and the subsequent challenges that arose once air capabilities were introduced into the armed services. *The U.S. Naval Institute on Marine Corps Aviation* is one of a two-book series about the US Marine Corps (USMC) with nine chapters, written and published at various times throughout the twentieth century that expose different aspects of the development of USMC airpower. From explaining the people and units who paved the way in the early years of Marine air support to exploring the future of air expeditionary units, this succinct anthology delivers a brief introduction to the history of Marine Corps aviation.

This collection of essays presents a variety of authors' writing styles, and subjects—not a dry, technical history as one may expect with such a title. The authors are primarily military officers, and one wrote about himself in the third person as he gave a very detailed account of Marine Corps aviation in the Vietnam War. Lt Gen Keith B. McCutcheon, USMC, assumed command of the First Marine Aircraft Wing (1st MAW) in Vietnam in 1965. His chapter, "Marine Aviation in Vietnam," constitutes more than half of the book, making this a worthwhile read for anyone interested in learning about the specific details of the USMC air capabilities in the Vietnam War. Although it may interest those craving a thorough history of the 1st MAW, it is a lengthy, acronym-laden section that may deter more casual readers.

Other authors contribute significantly shorter and more easily accessible pieces, some with incredible stories of inventing new ways to employ aircraft just a few years after the Wright Brothers' invention. The first chapter focuses on the earliest utilization of aircraft by the Marine Corps in China in 1926, which was the first time the USMC had a combined "air-ground force" (p. 19). This 17-page exposé, which is an excellent start to the book, abounds in colorful stories about how having aviation units gave newfound advantages to ground troops. One of these new advantages was a radio station traveling with the ground troops that could use Morse code to communicate with friendly airplanes up to 15 miles away, allowing for intelligence transmissions and the option of aerial support if needed (p. 15).

Several of the articles reveal the authors' stances on the utility and significance of Marine airpower. Most notably, in the chapter "An Infantryman's Opinion," the author, Maj J. N. Rentz, USMC Reserve, boldly states, "The Marines on the ground . . . will insist on close-in air support by Marines for Marines . . . [the Marine commander] cannot afford misunderstandings which may arise as a result of inter-Service differences (p. 51)." This piece, written just two years after the birth of the USAF, advocates USMC control over the airpower for what was then known as "close-in air support" (CAS). He asserts that Marines understood Marine tactics and jargon better than a member of a different service and could, therefore, provide faster, more accurate support.

Although Major Rentz has an understandable concern in 1949, the modern American military has come to see that CAS can be reliably provided by Air Force pilots; these air warriors have worked hand-in-hand with Marine ground force commanders to aid them countless

times in the decades since. Major Rentz's arguments that USMC commanders would desire only Marine-operated CAS are antiquated in a world where the Air Force's contributions have been immeasurable and indispensable; today, the USAF has at least 10 air platforms with CAS-providing capabilities, ranging from the A-10 to the MQ-9. However, the reminder of the significance of interservice collaboration and how far the military has come in this partnership would serve well any enthusiasts craving more exposure to the Marine Corps side of military aviation history.

This book, detailed and specific, engages those curious about the backstory of USMC aviation. While it is certainly not all-encompassing, it provides a wide range of perspectives that, although slightly dated, vivify the growth of aviation as a Marine Corps asset. From the use of biplanes in China to supporting the Second Nicaraguan Campaign in 1927 to F/A-18s dropping ordinance in the Persian Gulf War, the Marine Corps' airpower has come a long way, and the compendious collection of these stories and analyses in 176 pages rewards the time investment.

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Sam Houston: A Study in Leadership by Bill O'Neal. Eakin Press, An Imprint of Wild Horse Media Group, (http://www.eakinpress.com), P. O. Box 331779, Fort Worth, Texas 76163, 2016, 270 pages, $19.95 (softcover), ISBN-13: 978-1-68179-037-4.

"Remember the Alamo" was a phrase I heard when studying and taking field trips to the Alamo. A few decades later, a sense of pride overwhelms me when pondering how in "October 1835 . . . Gen Santa Anna and an invading army were bombarding the Alamo" (p. 99). During the same month 181 years later, I humbly led my 700th US national anthem in front of this historic mission for the Team Red, White, and Blue "Old Glory Relay."

The description of the gallant defense, defeat, and rallying cry of Gen Sam Houston resulted in Texans declaring independence on 2 March 1836, and the defeat of Santa Anna less than two months later. Today's global conflicts may overshadow these and other events in our nation's history; however, the leadership lessons and behaviors mentioned in the biography *Sam Houston: A Study in Leadership* remain relevant for today's and future leaders.

Mr. O'Neal, the state historian of Texas, is a prolific and eloquent storyteller. Dedicated to his art, he documented General Houston's journey in a literary and pictorial format that included inserting his photographs in the book. An in-depth scholar, Mr. O'Neal provides a robust bibliography and leadership influence overview to help readers explore the general's continuous personal and professional growth.

Much of the book predates the United States of America, the War Department, (that is, the present-day Department of Defense [DOD]), and airpower. However, the rich leadership lessons, resilience, and characteristics of General Houston make this book a must-read for anyone who has doubted themselves, desires to enhance their leadership skills, has made a leadership mistake or two, or endeavors to strengthen their resilience.

General Houston embodied "integrity," "service before self," and "excellence in all we do." These were characteristics ingrained in him by his parents and Sam wished to emulate his military hero father. Because of his curious, live outside-the-box nature, Sam lived with a Cherokee tribe as a Cherokee. His charisma and ability to make friends resulted in him being called "the Raven, a Cherokee symbol of good fortune" (p. 7).

This name was prophetic because more than once General Houston was severely wounded on the battlefield but continued to lead from the front. He made what some in his

command deemed bad leadership decisions, and they sought to undermine him. Understanding the depth of leadership, the general adapted his leadership style to complete the mission and developed options to include even those with dissenting opinions.

General Houston made a transactional decision to not consult with his leaders and take the burden on himself when he directed a strategic retreat from Santa Anna's Mexican Army. Understanding and accepting the burden of command, he focused on ensuring his troops had time to physically and mentally heal. The general also required inspections and drills to build a cohesive unit to hone skills and work as a team in battle. He employed transformational leadership to discuss options for engaging the Mexican Army. His leadership decisions and battlefield strategy resulted in the defeat of Santa Anna and his troops in 20 minutes.

Military success was a significant stepping-stone in Sam Houston's mentors and leadership network that included several key leaders and 14 consecutive US presidents. The foundation for this evolved from voracious reading and the belief he could accomplish anything. Like Abraham Lincoln, he dropped out of school but because of his desire to self-educate, he opened a school. He also learned, studied, and practiced as an attorney.

Perhaps unbeknownst to some, General Houston was a heavy drinker until later in life. He also had two failed marriages before his third marriage to Margaret Lea that lasted 23 years. During one of the darkest times in his early professional life, The Raven returned and found solace with his Cherokee support system. This form of resilience by returning to a place of comfort and healing oneself is noteworthy. General Houston realized that by reaching out for help, he could serve others with a renewed sense of purpose. In today's hectic environment this is an invaluable lesson for all leaders to employ.

The general's impressive inclusive perspective and seeking greater positions of authority to influence change resulted in an impressive career path that could inspire generations such as the youngest members of the USAF—the millennials. Specifically, at 21 he was a combat hero, a major general of [the] Tennessee militia, governor of Tennessee ". . . general of the Texan army, the first [and only twice] elected president of the Republic of Texas" (p. 171), US congressman (Texas senator), and later governor of Texas. The embodiment of today's USAF core values, General Houston made several mistakes, learned from them, sought help, and created success for himself and others.

The themes in Mr. O'Neal's book provide insight into Houston's character, personal and professional influences, and his determination to create positive change. "Eight years before [President] Abraham Lincoln's 'House Divided' speech" (p. 186), Texas senator Houston proclaimed those words in Congress when he differed from many Southerners who emphatically sought secession. Reading about his perspectives, leadership behaviors, failures, and successes could facilitate inclusion within the USAF, the DOD, and those unfamiliar with our rich heritage stemming from leaders like General Houston.

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Eyeing the Red Storm: Eisenhower and the First Attempt to Build a Spy Satellite by Robert M. Dienesch. University of Nebraska Press (http://www.nebraskapress.unl.edu), 1111 Lincoln Mall, Ste. 400, Lincoln, Nebraska 68588–0630, 2016, 296 pages, $34.95 (hardcover), ISBN 978-0-8032-5572-2.

The Eisenhower administration (1953–61) marked a watershed moment in strategic reconnaissance, including such projects as the U-2 and SR-71, the Project Genetrix reconnaissance balloons, and the Advanced Reconnaissance System or Weapon System 117L (WS-117L). The WS-117L transformed into Project Corona (codenamed Discoverer), the Satellite and Missile Observation System (SAMOS), and the Missile Defense Alarm System (MIDAS). This reconnaissance revolution was designed to provide critically needed intelligence on denied areas of the Soviet Union but also in Asia.

Robert Dienesch wrote an engaging military history of part of this story, focusing on the WS-117L program as the progenitor for subsequent space-based reconnaissance programs. He aims to shed light on the early US military space program in the context of President Dwight D. Eisenhower's goals of defending the nation and promoting the economy, while grappling with secrecy, bureaucracy, interservice rivalries, and the creation of new organizations within (that is, the Advanced Research Projects Agency) and outside (that is, the National Aeronautics and Space Administration) the military. Writing on a program that was previously classified and has garnered far less attention than some other early Cold War programs (that is, the U-2 and Corona) fills a gap in the study of the history of reconnaissance and early US space policy. The book, which is well organized and engagingly written, will be a good reference for readers interested in early Cold War reconnaissance.

Dienesch organizes the book into two parts. Part I (the first three chapters) lays out several framing concepts, including the nature of the Cold War and the need for intelligence to determine Soviet capabilities and intentions; President Eisenhower's goals of defending the nation and fostering economic security in part by corralling high defense spending; and advice from the scientific community and technical and policy solutions. The author covers a lot of ground quite competently, but topics such as the Soviet Union as an adversary, nuclear deterrence, intelligence collection, and some of the challenges facing the Eisenhower administration are well-known.

This reviewer was hoping for a bit less attention on the early Cold War and the Eisenhower administration and more on reconnaissance efforts before the WS-117L and why the Soviet target necessitated new thinking. Consider for example, the closed society and large landmass of the Soviet Union; the Soviet ability to track or shoot down—and the limitations of—existing aerial reconnaissance systems (e.g. Genetrix); the potential for political fallout (Soviet and others protesting overflights); and the great technological advances at this time in rocketry, communications, and so forth.

Part II describes the WS-117L program. Beginning in 1945, RAND Corporation published a series of important and encouraging reports on satellites and their uses and impact, which culminated in the two-volume report "Project Feedback" in 1954. The author competently summarizes these reports and then describes the first few years of the WS-117L program under the Air Force. In particular, the author notes how the lack of adequate funding slowed the program. This changed after Sputnik, when a more concerted effort was made to launch a satellite into space (Explorer I).

During 1957–58, WS-117L split into three programs. One program was Discoverer, the code name for the Corona satellites, which in place of film scanning would take pictures of the Soviet Union and then return the film to Earth for processing, a system that was thought more achievable in the short term. A second program was SAMOS (originally called Sentry) that followed the original goals of the WS-117L program. SAMOS attempted to use a film

readout system when the film was processed onboard the satellite, scanned and transmitted to the ground. A third program was MIDAS, which would employ an infrared sensor to detect Soviet missile launches and provide early warning to the United States.

A strength and weakness of Part II is that the author provides many informative details about the program, but then the author's research appears to have stopped more than 10 years ago. This is unfortunate because significant additional information has come out since then. Examples include: declassified National Reconnaissance Office (and a few Central Intelligence Agency) records on WS-117L, SAMOS, and Sentry; the papers of Richard M. Bissell, Jr.; and a number of new books that included a treatment of early Cold War reconnaissance efforts, such as Dino Brugioni's *Eyes in the Sky*. Brugioni focuses on aerial reconnaissance during the same period and covers some of the same ground. The inclusion of this newer material would have supplemented the author's earlier research and would have made the book more of a one-stop shop for information on the WS-117L.

Two less critical issues are notable. First, this reviewer wishes that the author and others would have provided a timeline dating all the studies, programs, policies, and agencies' involvement for readers' reference. Second, there are several small editing errors or questionable statements throughout the book that one wishes could have been caught before publication. Statements such as "In 1954 the idea of space-based reconnaissance was at best something from a science fiction novel (p. 58)," or "By 1945 aerial photography allowed for extremely high-resolution color photographs (p. 95)" shouldn't dissuade the reader, but they do form an unnecessary distraction.

Overall, this is a good addition to the bookshelf for *ASPJ* readers interested in Cold War reconnaissance and space programs. Reading the book is an education, but also stimulates an effort to look into earlier information, such as the RAND reports, concurrent programs such as Explorer and Vanguard, and subsequent programs like SAMOS and MIDAS.

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