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What Do People Want from Work?

The Simple Question that Can Transform Unit Engagement and Retention

Brig Gen George M. Reynolds, USAF

Creating an organization that can consistently attract, engage, and retain talented people is difficult. It is especially challenging in industries where competition for talent is intense. Likewise, the transitory nature of careers is forcing organizations to pay special attention to how they discretely manage employees. Individuals have redefined their expectations and relationships with employers. Today's employees view work differently and are progressively reevaluating and prioritizing work attributes such as flexibility, development, and enjoyment. These changes can be problematic for traditional human resource departments and organizational leaders. Developing effective cross-organizational programs, policies, processes, and culture that can satisfy employees while staying competitive is difficult for even the best teams. Organizations realize they must adapt and shift their focus toward employee-centric approaches. In short, they are asking and solving a simple question: What do people want from work?

On its surface, this seems like an easy question for any organization to answer and maybe even too simplistic to base a complex human resources strategy. However, organizations are repeatedly struggling to get this right. Many consistently miss recruiting,

productivity, or retention goals. Even those which are succeeding have difficulty anticipating external and internal changes that can quickly drain talent. These are not easy tasks, but organizations that can focus on this simple question have the best chance to successfully attract, engage, and retain talent.

This question is especially important for military organizations. Answering and focusing on what people want from work is not only necessary but also requires an organization-wide effort. Although most personnel solutions are conceived and executed at the higher-headquarter level, commanders and supervisors play an incredibly important role, especially with unit productivity and retention. Yet, they may not know where to focus their limited time and resources. This article's individual-centric framework (ICF) provides organizations, commanders, and supervisors that focus by considering the question: "What do people want from work?" The ICF uses five distinct categories to answer this question—compensation, enjoyment, interest (and balance), career opportunity, and recognition.

Why Should the Military Use an Individually-Focused Talent Management Framework?

During the past decades, numerous social and business changes reshaped the relationships, expectations, and social contracts between employees and companies including those within the military. These changes include improved productivity, declining union influence, the flattening of corporate structures, automation, a reliance on technology and information operations, lean operations, consolidations, and shifting from manufacturing to services and technology. Individual work experiences also changed and could involve telecommuting, flexible work schedules, extensive use of electronic communications and scheduling, and improved benefits transportability. Maybe more consequential, attitudes toward work and happiness have shifted. Research has shown "emotions matter a lot at work. Happiness is important. To be fully engaged, people need vision, meaning, purpose, and resonant relationships."[1] It turns out individuals are increasingly expecting more from work and are willing to explore other employment options when expectations are not met.

Today's dynamic, competitive labor markets are putting pressure on existing human resource programs and forcing them to be more flexible, transparent, creative, and responsive. These changes also apply to the military in unique ways as well. The all-volunteer force model requires a consistent flow of high-quality recruits and sufficient numbers deciding to make the military a career. The all-volunteer force is not only expensive but also sensitive to societal changes and perceptions about military service. Today, there are numerous factors that should cause the military to rethink how it recruits, engages, and retains personnel. These factors include:

- Recruiting and retaining talent is difficult when "the economy is robust, civilian unemployment is low, and young people find it easy to secure civilian employment."[2] In fact, there is a strong correlation between the unemployment rate and number of

high-quality recruits. As unemployment rates remain low or the military expands, recruiting (and retention) will become more difficult.[3]

- There are fewer Americans qualified and available to serve. According to an Office of the Under Secretary of Defense Accession Policy study, "only 17 percent of 17- to 24-year-olds are qualified and available (for example, not enrolled in college) to enlist without a waiver."[4] This number drops to 13 percent if those scoring in the bottom 30th percentile on the Armed Forces Qualification Test are excluded, which is a common practice of the military services.
- The number of recruits joining the military who have a close relative in the military is high. In fact, "between 77 and 86 percent of new military recruits have a family member who has served in the military, and approximately one-third have a parent who has served."[5] Although it is not surprising that children follow in the parents' professional footsteps, this trend highlights that the all-volunteer military force is less diverse and is appealing to a very small subset of the population.
- The number of entry-level positions across industries is shrinking. According to *Axios*, "Despite a growing worker shortage, American companies today are only rarely prepared to spend the money to train their own workers. Instead, they want fully formed workers to show up at the door."[6] If this trend continues, it could benefit military recruiting. However, the demand for highly-trained and highly-educated military members will remain high. Those joining the military as a path to future, nonmilitary careers may be less likely to pursue a military career.
- Technologies such as artificial intelligence, automation, quantum computing, big-data analytics, and smart manufacturing will change the nature of work including within the military services. Future Airmen will be aided by these technologies and will move up the "value chain" into analysis, diagnostics, information operations, and problem solving. Some existing jobs will be eliminated, but most that remain will require individuals who possess advanced skills, training, and experiences. These super-enabled technicians will be in high demand by the military and private sectors alike.
- It is increasingly expensive to train highly-skilled professionals. "The cost to train a fifth-generation fighter pilot to prepare him or her for their first operational squadron is approximately $11 million."[7] The cost to prepare a cyber-security professional could exceed $250,000.[8] Equally important, it takes years to fully train and certify these professionals. The investment of both time and money in these Airmen is enormous.
- The military services do not typically access personnel laterally from outside organizations. Although there are career fields that access highly specialized professions and fast-track new recruits to higher rank (doctors, lawyers, and dentists), this is a very small percentage of the total force.

- Although the Air Force is expanding, it has contracted in the past two decades, while the demand for USAF capabilities remains high. For example, since Operation Desert Storm, the number of Air Force personnel and aircraft have decreased by 30 percent and 37 percent, respectively.[9] This combination of high demand and low supply is overloading units and individuals.
- Specific career fields are either not meeting retention goals and/or are short-staffed.
- Benefits and retention incentives such as the 20-year retirement plan have changed. Although it is too early to conclude how these changes will impact recruiting or retention, existing retention models and goals may be affected.
- Retention models require accurate predictions; however, the science of prediction is still imperfect. This problem is further complicated when existing systems do not have sufficient excess capacity and/or fluidity to offset earlier inaccurate predictions. This is even more problematic for the military's up-or-out personnel model.
- The world is too dynamic and military weapon systems too complex to rely on a surge of new recruits or draftees. The Air Force's dependence on advance technology requires a sufficiently sized, highly skilled, and experienced force.

Singularly, each of these trends poses a challenge, but collectively, they require the military to reexamine how it approaches the recruitment, engagement, and retention for all Airmen—enlisted, officers, and civilians—individually. Focusing on "individualism" is a departure for military organizations that value self-sacrifice, teamwork, dedication, and selflessness. These attributes are absolutely necessary to accomplish the mission, and for unit cohesion and esprit de corps. However, when it comes to recruitment, engagement, and retention, individuals and families are making decisions based on their own needs, goals, and aspirations. The ICF acknowledges people are self-reflective, internally and externally motivated, and seek to optimize opportunities. This framework provides answers to address what individuals want from work as a mechanism to specifically improve recruitment, engagement, and retention.

What do People Want from Work?

Research and exit surveys regularly confirm individuals join organizations, stay productive, and ultimately decide to stay or leave for very similar reasons. According to the article, "Why People Really Quit Their Jobs," Facebook employees "left when their job wasn't enjoyable, their strengths weren't being used, and they weren't growing in their careers."[10] In their book *What Millennials Want from Work: How to Maximize Engagement in Today's Workforce*, Jennifer J. Deal and Alec Levenson offer a compelling model focused on people, work, and opportunities.[11] In Annie McKee's article, "Being Happy at Work Matters," she highlights, "To be fully engaged, people need vision, meaning, purpose, and resonant relationships."[12] In his article, "Keeping the Talent: Understanding the Needs of Engineers and Scientists in the Defense Acquisition Workforce," Alan K. Jenkins stresses

"pay and benefits, growth and development opportunities, relevance or meaning of job, supervision, feelings toward coworkers, job security, and workplace satisfaction" as essential to workplace satisfaction and organizational commitment.[13] Even Air Force surveys provide lists of similar reasons ranging from interesting, but balanced work, assignment flexibility, meaning and purpose, development opportunities, and enjoyment.

The ICF is a consolidation of the most common individual wants or attributes. They are organized into five categories—compensation, enjoyment, interesting (and balanced), career opportunity, and recognition. Individuals generally want each of these. The degree to which one prioritizes individual attributes varies, but ultimately, most employees want a mix of these attributes. The consideration of these attributes applies when individuals consider joining, staying engaged, or remaining with an organization. Although it could be argued engagement also affects retention and therefore they are not mutually exclusive. However, the use of the ICF provides organizations a mechanism to improve productivity and engagement independent of retention decisions.

Table. Individual-centric framework: what people want from work

Enjoyment Friends and Mentors Team Supervisor
Interesting (but balanced) Meaning and purpose Adventure and challenge Innovative and creative Goal-oriented Autonomy and empowerment Flexibility and predictability
Compensation Pay Benefits Retirement
Career Opportunity Feedback and communication Development Training and education "Experience" Promotion, upgrade and leadership
Recognition Want to be valued (formally and informally) Supervisor's appreciation Support network to value their work

Compensation

Although this framework in the table lists only three compensation categories—pay, benefits, and retirement—these categories can also include overtime, bonuses, commissions, allowances, insurance, and paid vacation. Regardless of what compensation includes, it remains important. According to *What People Want from Work: Motivation*,

"Money still provides the basic motivation for employees."[14] In fact, "compensation is important to 99 percent of millennials and very or extremely important to 81 percent of them."[15] This is not unique to younger employees. Compensation is still at the top of most employee priority lists regardless of age, but it may be prioritized differently.

It is important to point out that compensation is only one dimension of what people want from work. In fact, "almost two-thirds (64 percent) of millennials said they would rather make $40,000 a year at a job they love than $100,000 a year at a job they think is boring."[16] But, even in this example, they did not say $0 a year, but rather quantified their premium for interesting work. It is important to make this distinction because compensation represents more than paying bills, providing disposable income, or creating savings. Organizations use compensation to entice potential employees, measure performance, shape behavior, provide a comparable yardstick, and retain talent; and employees still value compensation and use it to make comparison judgements about other factors.

The military is no different. Service members value compensation, too. Since implementing the all-volunteer force in 1973, improving military pay and benefits was important to entice and retain high-quality recruits. The 1970 Gates Commission recognized "adequate pay alone will not attract, but inadequate pay can certainly deter."[17] Compensation is also one of the most utilized levers to influence recruiting and retention goals. The military offers new recruits college tuition, medical insurance, paid vacation, and housing to entice them to join the military. Bonuses and monthly incentive pay are utilized to retain members of critical career fields. Spouse tuition, expanded GI Bill, and commissary access are provided to support and retain families. Pay and benefit programs are implemented to shape decisions, behavior, and offset bills. Compensation may not be the most important or influential factor when individuals consider military service or remain in uniform, but it is still an important variable nonetheless, especially when comparing employment options.

Enjoyment

Individuals want to come to work and enjoy the experience with coworkers, mentors, teammates, or supervisors. These relationships are incredibly influential on enjoyment, productivity, and desire to stay with an organization. In fact, "we know that people join an organization and leave a boss. A dissonant relationship with one's boss is downright painful. So, too, are bad relationships with colleagues. Leaders, managers, and employees have all (said) that close, trusting and supportive relationships are hugely important to their state of mind—and their willingness to contribute to a team."[18] A bad work environment may be offset by other work attributes but certainly at a cost.

Interesting (and Balanced)

Generally, people want to belong to organizations that do meaningful and purposeful work. They want work that is challenging, innovative, goal oriented, and an adventure. "People want to feel as if their work matters, and that their contributions help achieve

something really important. They want to know that they—and their organization—are doing something big that matters to other people."[19] More and more organizations are turning to "purpose" to motivate and fulfill employee desires to belong to meaningful organizations. Some companies offer volunteer opportunities, direct profits toward charities, and even ensure employees understand the broader, positive impact their products and services provide to the world community.

Although the separation between work and life have blurred as technology connects people to work, people still want scheduling control and predictability. Having a constant connection to work is becoming a standard. Many people see a positive side of continuous connectivity, but they also want the flexibility that should come with this technology. In fact, "Millennials expect flexibility. It is critical to them because of the way they live their lives, because they are independent, and because it is logical."[20] However, like many attributes, this phenomenon is not unique to only one generation.

It is also important to note that balancing life and work requires sufficient resources, competent leadership, and accommodating policies. Organizations that lack these crucial ingredients often rely on individuals to make up the shortfalls. Work/life balance can be affected as employees put in longer hours, become overloaded, work during weekends, or delay vacations. Military personnel and their families also have additional unique challenges, including long deployments, a lack of predictability, stressful environments, and the possibility of physical injury. Most people will tolerate an imbalance—but only to a point.

Career Opportunity

Having career opportunities are important to individuals regardless of their experience and age. According to Deal and Levenson, Millennials "place a high priority on development. About three-quarters say they see their position as an opportunity to develop technical expertise, develop leadership potential, and demonstrate their abilities as a leader."[21] Baby Boomers are exploring different career opportunities. They value giving back. "Many (Baby Boomer's second) careers tend to be in education, nonprofits, healthcare and faith-based organizations as this generation seeks to 'self-actualize and make a meaningful contribution in their life.'"[22] Regardless of priorities and aspirations, belonging to organizations that provide career opportunities remains essential. Development is one of the most important reasons employees join specific companies, while the lack of development is a reason many leave a company.

Yet, career opportunities must also include training and education programs, feedback, and open communications. It is important to recognize that "people want to be able to see the future and know how they fit in. People learn and change when they have a personal vision that is linked to an organizational vision."[23] The best organizations link career opportunities to development programs, promotions, upgrades, and leadership positions—and are open and transparent about their processes. Career opportunities and development must also align with enjoyment, interests, compensation, and recognition programs. Get-

ting these attributes and processes aligned correctly is especially important in today's work environment.

Military members share similar expectations and goals. Promotions offer additional responsibility, pay increases, improved chances for future advancement, validation for hard work, and a measuring stick among peers. Assignment actions provide leadership opportunities, experience, adventure, but also unpredictability and stress. Professional development provides certifications, experience, and opens doors for greater opportunities.

Recognition

People want to be formally and informally recognized for their hard work. They want their supervisor to appreciate their efforts and give them time and attention. Individuals want responsibilities and autonomy, but they also need recognition and feedback. The author of *Business Innovation for Dummies*, Alexander Hiam, may say it best: "Responsibility is about giving them a chance to make a difference, but attention is the human dimension of managing."[24]

Recognition can also serve as a measuring stick and an informal feedback loop, but it needs to connect to broader company incentives. In their book *The Human Capital Edge,* Bruce N. Pfau and Ira T. Kay point out: "People want recognition for their individual performance with pay tied to their performance."[25] Although in general, the military cannot tie performance directly to pay, feedback should reflect in statements on performance reports and signal a supervisee's ability to handle greater levels of responsibilities.

If the Attributes are Simple and Obvious, Why is This So Hard to Implement?

It is not easy crafting the right policies, procedures, and programs that satisfy every employee's wants. Although there are many reasons why it is difficult, each organization has their own distinct challenges. Some of these challenges, relevant to both the private sector and the military, are summarized below.

Organizations have another purpose. Organizations exist for purposes beyond satisfying employee wants. They create shareholder wealth, provide needed services, educate students, or defend the country. Individuals are central to achieving these objectives, but many organizations have historically viewed employees as "inputs" and "requirements."

Organizations have competing priorities. Often organizations must place their priorities ahead of individual wants to accomplish their missions. Supervisors may ask an individual to work on weekends or put in longer hours to meet an impending deadline. Typically, organizational priorities outweigh individual wants, which employees understand. However, they may vote with their feet if the balance becomes lopsided for too long.

Organizational personnel requirements can change quickly. Most organizations compete in environments that are complex and change rapidly. This puts extra pressure on organizations to find experienced talent and keep their employees relevant. If they have the flexibility, organizations can hire individuals directly to fill voids or offer training

to redirect existing employees to an emerging career field. However, these changes may not align with existing employee expectations.

Numerous stakeholders with degrees of influence. All organizations have relationships with external and internal agents. Organizations with diffused relationships must work with these agents who have their own equities, interests, and priorities. Military organizations also have numerous relationships with groups with different levels of influence, authority, and priorities including Congress, contractors, combatant commands, interagency partners, foreign militaries, and sister services.

Lack of authority. Hierarchical institutions retain and delegate authority throughout their organizational structure differently. Although unit-level leaders have direct interaction with their personnel, they may lack specific authorities to address individual wants such as pay, benefits, and promotion selection.

Supervisors are overloaded. It takes time and energy to lead and support individuals. Supervisors can also experience too much work, which leads to little time for feedback, recognition, or time to focus on individuals. Following a framework that is focused on individual wants requires supervisors who have sufficient resources including time.

Individuals prioritize wants differently and change them over time. Individual demands, attitudes, and priorities toward specific attributes change from person to person, as well as throughout an individual's employment. For example, an employee with significant college debt may value compensation, loan forgiveness programs, and rapid career development until they repay their loans. It is not to say individuals with no student loans do not value similar benefits, but they may prioritize travel, adventure, and working with likeminded teammates more.

Difficult to anticipate change. Prediction is tough business, but it is even harder to implement precrisis steps when there is no crisis. This is especially true for government organizations that use a complex budgeting process. It is challenging to put retention strategies in place in advance of an anticipated exodus, while retention is good. This situation can place organizations in reaction mode. Fairness drives policy. Employees demand fair and transparent policies but also want unique consideration of their own individual circumstances. This paradox is especially challenging for large organizations where important processes are centralized. Fairness drives the creation of universal standards and policies.

Processes must work for thousands of people. Beyond fairness, large organizations' policies, programs, and processes must work on an industrial scale. To manage, organizations often use *requirements* or ridged standardized processes to ensure consequential personnel actions are manageable including promotions, assignments, and development. As a result, organizational requirements and processes can overshadow individual wants.

There is a supply and demand problem for important development positions. The quality of today's military personnel is remarkable. Often, there are too many qualified candidates to fill coveted positions such as squadron superintendent or commander. Those not selected still have meaningful opportunities available. However, they may re-

prioritize their willingness to accept other positions, especially if they believe future promotion opportunities are affected.

People are not open or honest with supervisors about their current and future aspirations. It is tough to share personal aspirations if an individual believes their organization or supervisor will react negatively. However, supervisors must have open and honest feedback with supervisees, because individuals will evaluate their non-Air Force options with or without their supervisors and may not have the benefit of understanding their Air Force opportunities.

Culture plays an important role. Culture includes the values, priorities, and behaviors emphasized by and within an organization. The ICF describes the basic cultural building blocks that are valued, prioritized and emphasized. No organization is the same because the mix of attributes is different. Some place a higher value on teamwork, while others might embrace individual empowerment. Regardless of the mix, it is possible to see an organization's culture using the ICF. Culture is often referenced as an organization's most important attribute, while changing an organization with a strong culture is difficult. This is especially true for the military. Although the military is certainly adaptive, it can take time to change culturally-influenced processes. For example, the military recruits, develops, and promotes leaders within the existing military force structure. Changing this paradigm goes against years of traditional norms. This is not to say change will not happen, but rather it takes time to change large institutions. The importance of culture cannot be overemphasized.

These are just a few reasons why it is difficult to use the ICF. Although each of these issues are complicated or labor intensive, this does not mean change will not occur. In fact, the Air Force is undertaking unprecedented steps to support Airmen and their families. However, to truly improve recruitment, engagement, and retention, the entire organization must take an active role, including at the unit level. Commanders and supervisors have tremendous influence to improve productivity, engagement, and retention. Yet, some may find it difficult to see how and where they can make a difference. The ICF provides commanders and supervisors with a useful guide to focus their limited time and energy to improve unit engagement and retention.

How Can This Framework Help Commanders and Supervisors Improve Engagement and Retention?

Today, senior Air Force leaders are tackling numerous individual concerns, most of which are found in the ICF (see the table). They are pushing for better work/life balance, eliminating barriers, and rethinking how to support individual goals. For example, a task force is seeking root causes for low pilot retention, which led to initiatives such as adding more "white space" to personal schedules, increasing time at home station, adjusting exercise schedules, reducing deployments to 179 days, limiting year-long fighter pilot deployments to those in command or Joint Staff assignment, increasing aviation bonuses and aviation incentive pay, and establishing a second assignment in-place program.[26] Senior

leaders are also exploring how to give "female pilots time off when they have children, give them access to the base, have them maintain proficiency through simulators, and roll back their year group so they remain competitive for assignments and promotions."[27] Each of these initiatives address specific ICF attributes such as development, flexibility, and recognition.

Senior leaders are also championing cross-enterprise initiatives such as revitalizing squadrons, changing course 14 and 15 requirements, cutting assignment cycles from three to two, opening remotely piloted aircraft training to enlisted members, reducing Air Force instructions, delegating waiver authorities, changing the officer in-residence professional military education (PME) declination process, increasing Stripes for Exceptional Performers promotion opportunities, eliminating additional duties, changing computer-based training requirements, modifying squadron commander training, assigning more support personnel to units, and considering direct accessions programs for cyber security experts. They are also supporting military spouses and their families by pushing local governments to accept reciprocity for out-of-state certifications, improving quality of schools near bases, and supporting spouse employment. Using the ICF as a guide, it is easier to explain why each of these initiatives are being implemented or discussed—they address individual and family wants and concerns. More succinctly, senior commanders are reducing barriers and improving support to unit leaders. But what can commanders and supervisors do if most of these efforts are above their unit level?

For hierarchical organizations like the Air Force, it is understandable that large-scale changes occur above the unit. However, commanders, supervisors, and peers still play a critical role in improving engagement and retention—especially within their unit. They have the most direct impact on Airmen, and they know them best. The following are some examples of how commanders and supervisors can improve unit engagement and retention by using the ICF.

Do Airmen enjoy work? Research shows that people want to enjoy their work, and those who loathe their boss, peers, or team will probably leave. The adage, "Supervisors need to know their Airmen," remains important. This includes the need to find out if their Airmen enjoy work. If they do not, why? Regardless of the reasons, supervisors must be cognizant of their Airmen's connection and interest with work. The ICF illustrates enjoyment is important to individuals. Hence, commanders and supervisors need to consider Airmen enjoyment during feedback sessions, while reviewing unit climate assessments, and when constructing unit policies, programs, and processes.

Empower Airmen to improve unit processes, policies, and programs. In his article, "*Top Ten Reasons Why Large Companies Fail to Keep Their Best Talent,*" Eric Jackson writes, "When top talent is complaining (about big company bureaucracy), it's usually a sign that they didn't feel as if they had a say in these rules."[28] Using the ICF, commanders and supervisors can take an active role to reverse these frustrations and empower unit personnel to change unit policies, programs, and processes, or better yet, make recommendations on how to change policies, programs, and processes outside the unit. Commanders can ask specific, meaningful questions such as, "If you could change two things that would make

work more balanced, what would they be?" The ICF provides a mechanism to frame and understand Airmen concerns so root causes can be uncovered and identified for change. Commanders and supervisors can then improve engagement by empowering their personnel to tackle these specific suggestions.

Set the example, and do not fake it. This is not a new insight, but it remains valuable. Commanders and supervisors are always being watched by those they lead. If commanders dislike their jobs, or they do not have good life/work balance, those considering a similar career track will notice. Commanders and supervisors can use the ICF to make a self-assessment of their own engagement and satisfaction with work. If their life is off-balanced, they should discuss this with their supervisors, peers, family, and friends. Commanders and supervisors are asked to do a lot, but forcing them to put in long hours and getting out of work/life balance will affect their performance and may dampen their replacement's excitement to replace them in the future as well.

Conduct meaningful unit self-assessments. The ICF offers a framework for unit self-assessments. For example, unit leadership can evaluate specific attributes such as how much unit Airmen are working, if they are working on the weekends, or lack predictability. It is essential to understand why individuals are putting in the long hours and have unpredictable schedules, especially if the root cause is within a commander's span of control. If the lack of resources is the root cause, supervisors and commanders can identify the shortfalls and seek relief. The ICF is useful to uncover blind spots, resource shortfalls, and process gaps that affect unit engagement and retention.

Fight for and give feedback. Constant, relentless feedback is important. To truly improve engagement and retention, commanders and supervisors need to know their personnel's goals and expectations. This engagement must happen on a consistent basis because people's priorities change over time. Those considering outside employment will make comparison judgments about their future employment, including their own prospects within the Air Force. Feedback sessions must be more than the Airman Comprehensive Assessment's minimums. Supervisors and leaders must consider "what people want from work" during their feedback sessions and map out a plan. They should also ensure their supervisees understand existing compensation and benefits, development expectations, and career options. Airmen want to develop and know they are on the right track. If they are off-track, then they need to know and have a path to improve. The ICF places an emphasis on a better understanding an individual's goals, expectations, and aspirations because today's employees expect it.

Establish recognition that matters. One important aspect to the ICF, is that each attribute interacts and supports other attributes. This aspect goes for the commander's and supervisor's priorities as well. If commanders value those who fly safely, use good crew resource management practices, and make appropriate judgments, they should reward and incentivize this behavior. If awards are not what interest certain Airmen, but rather, they would like to lead an innovation project or attend a unique training class, these might be better incentives and forms of recognition. Regardless of the forum or

format, everyone wants recognition for their work. The best informal and formal recognition programs reward the behavior and decisions valued by individuals and unit leadership.

Address individual wants during commander calls. Creating engaging commander's call presentations can be challenging, but the ICF provides a good starting point. Before addressing any audience, it is useful to review each ICF attribute to identify items of interest. Commanders can select topics that address new compensation programs, development opportunities, meaningful recognition, and impacts from the unit's work.

Lead innovation through experimentation and pilot projects. Individuals can become frustrated with organizations and supervisors who are risk adverse or unwilling to try something different. Innovation, creativity, empowerment, autonomy, and flexibility are important to Airmen. Experimentation and pilot projects are useful approaches to create an innovative environment while also providing unit leadership a measured, goal-oriented process. Some organizations are fortunate to have visionaries and critical thinkers who can identify problems. Others need commanders to play this role. Regardless of who initiates a project, commanders must empower and support Airmen, knock down barriers, and flight following progress.

Assessment for additional authority and command flexibility. Commanders who want to improve their unit's ability to retain personnel should consider the ICF attributes to determine how much authority, influence, and decision space they possess to support their Airmen. If they believe they lack any of these, they need to address their concerns with higher-level commanders and staffs. In some cases, they will not gain delegated authority (e.g., the ability to give pay increases); however, there are numerous other individual concerns upon which commanders could and probably should have input (e.g., assignments, attending PME, announcing promotions, and eliminating unnecessary additional duties).

These are just a few examples of how commanders and supervisors can use the ICF to address their Airmen's concerns and goals. Improving unit productivity and retaining talent requires feedback, an understanding of what individuals want, providing meaningful recognition, and connecting people to organizational success and purpose. Most importantly, unit-level engagement is essential and complimentary to servicewide engagement and retention initiatives. It requires a cultural shift—a mindset focused on individuals. Although these examples do not specifically address how they can improve recruitment, the elements within ICF are what potential employees are looking for from an organization. Organizations who address "what people want from work" and make this synonymous with their culture will successfully and consistently attract talent.

Conclusion

Out of necessity, organizations are rethinking how they can better recruit, engage, and retain their employees. By focusing on individuals, many are making themselves more competitive at attracting talent, making their workforce more productive, and retaining talent. The ICF simplifies complex human resource programs, processes, and policies by

answering the question, "What do people want from work?" Why? Because, this is exactly what potential and existing employees consider when they join or decide to remain with an organization. Individuals desire work that is enjoyable, interesting (but balanced), provides compensation, gives career opportunities, and recognizes their efforts.

Clearly, improving organizational recruitment, engagement, and retention is complicated. It is also very personal for individuals. Organizations must execute their mission, which will require individual sacrifice. Airmen understand this, and in fact, they are seeking meaningful, productive work and want to be part of a profession that is bigger than themselves. However, there must be a balance and a recognition that individuals have their own goals, priorities, and limited patience. Military commanders and supervisors may not think about adopting unit policies, processes, and programs with engagement and retention in mind, but they have consequential influence on Airmen within their unit. The practical problem is commanders and supervisors may not know where to focus their limited time and resources to improve productivity and retention. The ICF provides a simple guide to help commanders and supervisors address what Airmen want from work. This approach has to become a part of their unit's culture and more broadly, part of the service's culture. Having a culture that considers and addresses individual goals and desires is an advantage. Today's Airmen are highly educated, motivated, and in demand. Focusing on what they want from work is not only necessary but is essential to improve recruitment, engagement, and retention throughout the Air Force. ✪

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Small Unmanned Aerial Systems and Tactical Air Control

Maj Jules "Jay" Hurst, USAR

Dominion of the air domain during war has long belonged to the wealthiest militaries. The complications of placing combatants in the air domain and the lack of terrain to mitigate technological overmatch have made airpower a rich man's game. Increasingly capable small unmanned aerial systems (sUAS) threaten to change this dynamic by providing a pathway for impoverished militaries to contest the air domain at the tactical level, but they also offer advanced militaries opportunities to push the control of air platforms down to lower-ground echelons inexpensively. Nations like the US will need to increase investment in sUAS development and counters to prevent competitors from taking advantage of a capability gap created by the emergence of small systems performing a wider range of conventional airpower missions.

> ***Air Superiority***—That degree of control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats.
>
> ***Air Supremacy***—That degree of control of the air wherein the opposing force is incapable of effective interference within the operational area using air and missile threats.
>
> Joint Publication (JP) 3-01
> *Countering Air and Missile Threats*

Introduction

Advances in small UASs and supporting technologies will democratize access to the air domain and change the current dynamics of air control from a high-end contest to one that spans a larger spectrum of capabilities—from low to high. During the next two decades, these small UASs will increasingly supplement traditional aircraft in the performance of close-air support (CAS), reconnaissance, counterair, communications, and resupply missions. This miniaturization of air platforms will enable commanders to cost-effectively divide and apportion airpower, reducing its scarcity by pushing air assets down to the increasingly lower echelons of control and promoting the division of capabilities. The increased accessibility of airpower will make attaining air supremacy more difficult and air control even more temporal. Traditional contests for the domain between high-end systems or operational air control (OAC) will occur in simultaneity with tactical contests between sUAS platforms and short-range air defenses at lower altitudes for tactical air control (TAC). Increasingly autonomous small systems will make airpower more plentiful and the difficulty of sustaining control of the air domain greater than ever before.

Why Is Airpower Scarce?

No matter how dominant an invading force, few instances in history exist where an opposing army has become "incapable of interference" in a ground campaign. Defeated armies can reform, new bodies of troops can be raised, and partisans can continue effective resistance long after governments have conceded defeat. As Napoleon drove back Russian armies and burned Moscow in 1812, bands of partisans attacked his line of communications.[1] Later, during the Battle of Waterloo, Napoleon found himself flanked by two corps of Prussians who had reconstituted themselves in record time after a serious defeat at the Battle of Ligny two days earlier.[2] The control of the land rarely remains uncontested while adversaries retain the will to resist.

The sea, air, and space, however, can be controlled to the point of limiting effective resistance because of the environmental difficulties of operating forces in those domains.[3] Fortitude, alone, cannot sustain resistance. Unlike on land, sea, air, and space forces can only operate for a limited duration without returning to a logistics node. Sea, air, and space forces cannot scavenge food from adversarial lands as they maneuver, and they cannot refuel their weapon systems from the networks of petrol stations that populate developed countries. Ships require specific port calls for resupply and repair, fuel, and pilot fatigue that prevent aircraft from remaining in the air much beyond 24 hours at a time, and satellites, and spacecraft can only sustain themselves for set periods before falling to earth. The logistical complications of operating in unnatural environments help create scarcity: a situation where the demand for a service surpasses supply.

Despite the difficulties of operating in the air domain, its natural advantages ensure that the demand for airpower remains unsated within the joint force, causing an airpower shortfall. Every infantry company in Iraq or Afghanistan wants air cover midpatrol, and

every navy expeditionary strike group desires a P-8 Poseidon's protection against enemy submarines. The nature of the air medium grants aircraft observation over large areas, extends the range of weapon systems and sensors, and allows unrivaled battlespace alacrity.[4] These advantages cause ground and naval forces to request CAS, offensive counterair (OCA), mobility, and airborne reconnaissance in quantities that cannot always be satisfied by traditional aircraft. The expense of fielding aircraft, short endurance of air platforms, a limited number of airfields and runways, and large size of the air domain prevent militaries, particularly resource-constrained ones, from easily upping supply to overcome this airpower deficit.

Expense per combatant: Modern aircraft are expensive to build and maintain, and the pilots who operate them require long, expensive training to operate their platforms effectively. This limits the number of aircraft that armed forces can supply in a conflict and the speed with which they can be replaced. The procurement of a squadron of 12 F-35A Lightning II fighters will cost the US government more than $1.1 billion dollars at current prices.[5] The assembly of each jet requires 43,000 man-hours—the effort of more than 20 people working full-time for a year—to create a fighter jet out of almost 300,000 components sourced from 1,100 suppliers.[6] Considering that only about 15 countries in the world spend more than $20 billion on defense each year,[7] the acquisition and maintenance of a state-of-the-art air force is out of reach for almost all countries except the very wealthiest. The need for highly-trained crews greatly adds to these expenses. In 2011, USAF pilots required one-to-two years of training at a cost of between $600,000–$2.6 million dependent on the platform they flew.[8] More recently, Lt Gen Gina M. Grosso, the USAF deputy chief of staff for manpower and personnel services, told the House Armed Services Committee that training a fifth-generation fighter pilot could cost up to $11 million.[9]

Modern military aircraft also have tremendous maintenance and fuel costs. The cost per flying hour (CPFH), a summation of operation and support costs, range from approximately $5,000 a flight hour for the A-10C Warthog to almost $60,000 an hour for the B-2A Spirit. The F-35A has a CPFH of more than $17,000.[10] These high costs, long production, and longer training cycles compel joint force commanders (JFC) to ration airpower and ensure that it supports only their highest mission priorities, particularly during initial attempts to establish air supremacy/superiority.

Duration: After a nation successfully develops and builds aircraft and trains pilots to fly them proficiently, they receive a highly capable weapon system with short endurance. Without aerial refueling, most fourth- and fifth-generation fighter aircraft have a combat radius of less than 700 miles.[11] Even when aerial refueling permits longer flights, fighter and attack aircraft are limited by the relatively small amount of ordnance they can carry onboard, and unlike combatants in the land and sea domain, aircraft cannot rearm midmission. The complexity of piloting aircraft reduces the endurance of these platforms even further. The USAF mandates that pilots receive 12 hours of crew rest before a mission outside of exceptional circumstances.[12] Even superlative examples of air endurance come across as minute compared to combatants in other domains. The longest military

bombing run in history lasted 44 hours. Relative to ships at sea, which routinely conduct operations for months at a time, or grizzled infantrymen, this endurance level falls short of combatants in other domains. Modern aircraft constitute a highly effective but fleeting presence on the battlefield, and the small numbers of planes available to most air forces restrict a military's ability to take advantage of the air domain's benefits.

Limited runways and specialized support: Unlike land and sea forces, air combatants cannot be supplied while operating in their domain. They have to descend to earth and assume a vulnerable state on land. Aircraft return to airfields often for refueling, rearmament, recrewing, and maintenance. The limited number of airfields available to air operations and extensive operational support requirements constrict the supply of airpower. This constriction becomes more severe if airfields are located far from where aircraft conduct operations. Gravitational forces acting on aircraft and the severe consequences of a mechanical failure during flight require aircraft to receive maintenance more often than other vehicles, further limiting airpower availability. Furthermore, airfields constrain aircraft dispersion, making them vulnerable to attacks by precision-guided or cluster munitions by enemy forces attempting to seize air control during any stage of a conflict but primarily during its opening phase.

Size of domain: With the exception of space, air remains the largest physical domain in warfare. Water covers 71 percent of the earth's surface, but the air domain covers all of it.[13] The small number of combatants that operate in the air makes airpower a scarce resource for the JFC attempting to control the domain within the joint operational area. Because of this, the JFC controls air forces through centrally planned measures like air tasking orders that define altitudes, locations, and missions for aircraft within the operational area during a 24-hour cycle.

Effect of Airpower Scarcity

Collectively, these four dynamics constrain the supply of airpower capabilities in quantities that satisfy demand from joint forces. The resource costs and difficulties of designing, manufacturing, sustaining modern aircraft, and training individuals to fly them, ensures that the number of aircraft on the battlefield remain relatively small.

For the last 40 years, world-class militaries have trended toward consolidating combat roles and exquisite capabilities into multimission aircraft, further driving up costs. During the Vietnam War, the F-4 Phantom fighter-bomber cost roughly $20 million per aircraft (2018 dollars).[14] Today, an F-35A joint strike fighter costs almost five times that amount.[15] While the F-35's stealth attributes, advanced sensor package, and electronic warfare/communications suite provide necessary advantages in air-to-air combat or strike missions that involve penetrating sophisticated air defenses, they are less useful in low-threat environments. In these situations, the exquisiteness of the aircraft contributes to airpower scarcity. A single F-35A can carry roughly 18,000 pounds of air-to-ground ordnance and support a single CAS request at a time. For the same procurement cost, five F-4s could carry almost 75,000 pounds of ordnance and simultaneously support five en-

gagements in different areas of the battlefield.[16] This clustering of capabilities within expensive airframes reduces the ability of the commander to divide capabilities across the battlefield at need. Combat power offered by an infantry company can be subdivided into platoons and squads, but the intelligence, CAS, strike, or transportation abilities offered by modern aircraft are tied to indivisible, expensive platforms. This link creates strong opportunity costs for committing aircraft to a mission that are only partially overcome by their speed, an enabler that allows aircraft to travel between missions at faster rates than vehicles from other domains. The consolidation of capabilities in high-priced air-to-air combatants drives up the price of entry for weaker states. Developing nations are loathe to risk their air forces against first-world powers during conflict even when tactical opportunities present themselves because of the high cost of defeat in terms of monetary and pilot investment.[17] If airpower is scarce for the richest militaries in the world, it is much more so for the poorest.

Small Unmanned Aerial Systems Can Reduce Scarcity

While small UASs will never completely replace larger manned or unmanned or adequately meet all airpower mission requirements, they can and will help satiate the demand for high-end systems at the tactical level. Current small UASs have great difficulty operating in adverse weather and lack the capacity or celerity of their larger brethren. These small UASs will never drop enormous munitions like the 30,000 pound (lb.) GBU-57A/B Massive Ordnance Penetrator or transport tanks like the C-17 Globemaster III, but as their capability grows in concordance with leaps in computing power, sensor technology, artificial intelligence, and other autonomy-enabling technologies, they will gain the capacity to fill a majority of tactical airpower roles at a reduced cost. A smartphone gives us the capacity to perform 70–80 percent of our required computing tasks but rarely do we require access to more powerful devices. Future sUAS platforms, respectively, have the potential to satisfy a significant portion of small-unit airpower demands. Instead of relying on low numbers of exquisite assets to support ground operations, units at the battalion-level and below will have direct control over lower-cost sUAS platforms that supplement the capabilities of legacy aircraft.

During the next decade, improvements in computer perception and cognition will allow small unmanned aerial systems to perform more independent actions without human control and minimal guidance.[18] Nascent technologies like computer vision will increasingly allow autonomous vehicles to self-navigate across the battlefield, identify objects on their own, and interact with those objects according to rules set under human direction.[19] Cheap, commercially available drones can already use satellite navigation to transit between points without human control, and hobbyists have begun using freeware computer vision algorithms like YOLO (You Only Look Once) to provide object recognition capabilities with sub-$1000 investments.[20] As engineers refine algorithms designed for sUAS sensors, and training data becomes more available through drone proliferation, these open-source algorithms will grow in effectiveness. Nation-state investment

in sUAS computer vision will only mature it more quickly. In 2017, the DOD took the first step by greenlighting Project Maven, an Undersecretary of Defense for Intelligence effort to grant tactical- and medium-altitude intelligence, surveillance, and reconnaissance (ISR) platforms computer-vision capabilities.[21]

In parallel with private sector efforts to expand machine object recognition capabilities, government-funded, private sector, and university researchers are working to improve machine-to-machine communications in aerial platforms. In July 2015, Dr. Timothy Cheung of the Naval Postgraduate School led an effort to simultaneously launch 50 small unmanned aerial drones capable of acting cooperatively in a swarm through Wi-Fi communication, all controlled by one pilot.[22] And in 2018, Intel Corporation preprogrammed 300 small drones to fly cooperatively for the Super Bowl halftime show.[23] Once configured for military tasks, this level of automation could reduce the number of pilots and level of training required to control aircraft, particularly if drone flights are permitted to incur more risk without human passengers. If automation advances to a point where small unmanned aerial systems do not require piloting, ground forces could easily control their own organic air assets without intermediaries, increasing their ability to quickly leverage airpower capabilities during small-unit operations. As the mission profile of small UASs grow, the demand for this organic control will likely rise in parallel.

Defense contractors have already begun miniaturizing weapon, intelligence, and electronic warfare payloads for use on small unmanned aerial vehicles (UAV) in anticipation of their growing battlefield roles. Raytheon's Pyros, 6 kilogram glide bombs with GPS, inertial, and laser guidance options for deployment from small UAVs, even have a fuse programmable for airburst, delay, or point detonation.[24] Lockheed Martin's Shadow Hawk, a similar micro precision-guided munition (PGM), weighs just 11 lb. Both of these weapon systems could easily be carried by commercial drones like the DJI MG-1, a $15,000 sUAS with a payload capacity of 22–26 lb.[25] The Japanese company PRODRONE's PD6B-AW-ARM can carry almost twice as much as the MG-1 and obtain altitudes of 16,000 feet.[26] Commercially-available drones could easily be carried into battle by land forces with micro-PGMs and quickly deployed for dynamic air support.

Intelligence and electronic warfare payloads continue to shrink as well. Small UAVs, like the 40 lb. Insitu Scan Eagle, carry electro-optical or infrared sensors to support intelligence collection.[27] Drones can also carry additional intelligence payloads beyond imagery sensors.[28] The US company V-Star Systems created a signals intelligence package that weighs just 2 lb. and consumes only 25 watts of power. Like the micro-PGMs above, many commercially-available small UASs can lift these payloads, providing an avenue to field inexpensive aerial intelligence platforms.[29]

Progressive miniaturization of PGMs, intelligence sensors, and perception-enabled autonomy will allow small UASs to fill tactical CAS, ISR, tactical resupply, electronic attack, and communications missions currently reserved for large UAVs (groups 4 and 5) or manned assets.[30] The simultaneous increase in capability and greater commercial availability offers an avenue for militaries to reduce the scarcity of airpower. The sUAS platforms can be acquired and sustained for a fraction of the price of modern manned aircraft.[31] And increasingly, commercial and military semiautonomous sUAS platforms reduce the need for highly trained pilots.[32] The compactness of small UASs makes launch and recovery possible from almost any location, and their reduced weight and lack of embedded pilot could allow them to stay in the air longer without rest. This combination of traits could substantially reduce airpower shortages that small units routinely face at the tactical level by providing a cost-effective means of filling in air coverage gaps.

Expense per combatant. UAVs and small UASs can be procured and sustained for much lower amounts than modern manned aircraft through public or private channels.[33] Extremely capable UAVs, like the MQ-9 Reaper (group 5) have similar procurement costs to manned vehicles—roughly $16 million per aircraft, but cost less to operate, just $486 PFH in FY 2018.[34] Group 3 small UASs, like the RQ-7 Shadow ($750,000 per unit) or Scan Eagle ($100,000 per aircraft), cost significantly less to procure than larger UAVs and have even lower operational costs. Multiple, and in some cases dozens or hundreds, of group 1 and group 2 unmanned systems, can be procured for the cost of a single F-35A flight hour.[35]

Table 1. Current DOD UASs and group definitions

DOD unmanned aerial systems by group

Category	*Group*	*Weight*	*Max altitude*	*Speed*
sUAS	1	0–20 lb.	1,200 ft AGL*	<100 kn
sUAS	2	21–50 lb.	3,500 ft AGL	<250 kn
sUAS	3	<1,320 lb.	18,000 ft AGL	<250 kn
UAS	4	>1,320 lb.	18,000 ft	undefined
UAS	5	>1,320 lb.	18,000 ft	undefined

* Above ground-level

(Source: Derived from DOD, Unmanned Systems Integrated Roadmap FY2011–2036)

The cost of training pilots for a sUAS is also drastically lower than manned aircraft. All US military services except the USA use commissioned officers to fly manned aircraft because of aircraft expense and the high potential for aerial accidents. These systems are less difficult to fly and less expensive to lose, opening the possibility that all US services could use enlisted personnel to control small UASs or automate flight for tremendous cost savings.[36] The USAF spends $135,000 to train each UAS pilot, far less than other fixed-wing platforms.[37] Opening up more UAS pilot positions to enlisted personnel could drive these costs down even further and broaden the pool of potential pilots. As

machine perception grows, and semiautonomous vehicles gain the ability to perform simple wartime tasks while they self-navigate, the piloting requirements for aerial vehicles will decline drastically. If the amount of direction required continues to decrease, militaries will find additional utility from employing large numbers of small, self-guiding aircraft capable of performing missions independently or with limited guidance.

Duration: Despite their size, a sUAS can rival the endurance of larger UAVs or manned systems—albeit carrying much smaller payloads. In 1998, a 28 lb. Aerosonde drone crossed the Atlantic Ocean after being launched off the roof of a car. It consumed a mere 1.8 gallons of fuel during its 26-hour flight.[38] Another group 2 UAS, the Scan Eagle, can stay airborne for more than 20 hours, far longer than most manned aircraft without refueling.[39] Additionally, the low cost of small UASs permits them to be fielded in numbers that allow them to be rotated on and off mission in a manner that precludes mission interruption. Swarms or flocks of small systems may fulfill the same mission of MQ-9s with better geographic and temporal coverage at a fraction of the cost.

Limited runways and operational support: The size of small unmanned aerial systems permits them to be launched from innumerable locations from air, land, or sea. This mobility allows them to avoid being targeted at fixed airfields or prevented from launch by the enemy's preemptive bombing of runways. The sUAS can take off vertically, be released from larger aircraft, use pneumatic and slingshot launchers, or make use of small stretches of flat terrain to get airborne. This flexibility allows their launch and recovery element (LRE) to travel around the battlespace to avoid threats and reduce flight time to their mission locations. The scale of the sUAS also minimizes the infrastructure required to support flight operations. Even support systems for group 3 UAVs can be carried around on small trailers with less difficulty than a towed 105 mm howitzer. Iterative engineering work on launch and recovery systems will likely make them even more mobile and compact. Future sUAS operators may have specially tailored vehicles to support their aircraft, aiding them in the speedy deployment of their vehicles for operational effect. The USN has already created pneumatic launchers capable of deploying large swarms of small unmanned aerial systems in seconds.[40] Variants of this technology could be used to quickly push out airpower on demand, hiding the sUAS capability until its moment of need to protect it from counterunmanned aerial system (C-UAS) efforts or OCA.

Size of domain: Small UASs will struggle with the size of the aerial domain but may be less impacted than larger, more expensive aircraft because they likely can cover more air space due to the low cost of fielding systems. The control of small UASs will also likely occur at lower echelons allowing supported forces to have better control over their ISR, CAS, and resupply aircraft. The size of the air domain will still be an impediment to increasing the supply of airpower, but supported forces should be able to employ air assets in their support more quickly due to their potential organic control and collocation. Soldiers, Sailors, Airmen, and Marines may even have the capacity to locally print small UASs in near- real-time through deployed three-dimensional printers to meet demand.[41]

Implications of sUAS Democratization in the US Air Domain

If sUAS development continues on the trajectory outlined in the USAF's *Small Unmanned Aircraft Systems* (*sUAS) Flight Plan: 2016–2036: Bridging the Gap between Tactical and Strategic*, small UAVs will lower the price of access to the aerial domain and broaden the range of actors able to take advantage of the domain's unique attributes. Enemy forces previously unable to contest the air domain or utilize aerial strike, reconnaissance, electronic attack against US forces will have an affordable means of doing so. The widespread enemy employment of small UASs will continue to stimulate US investment in C-UAS and short-range air defense (SHORAD) that have been absent from US arsenals for decades. Additionally, if small UASs continue to expand their capabilities to conduct a variety of traditional airpower missions effectively, the US military will need to invest in airborne platforms and air-to-air munitions specifically designed to conduct counterair missions against small UAVs. Enemy development of capable small systems would exploit a current gap in American capabilities geared toward high-end air combat and endanger US ability to achieve air control.[42]

Contesting Enemy sUAS Capabilities and Tactical Air Control

In 2000, fewer than 17 countries employed aerial drones for military purposes. By 2015, 75 countries had drones in their arsenals.[43] As the accessibility of drones grows through commercial innovation, and platforms become cheaper and more capable, almost all militaries will employ small UASs in expanding roles. Nonstate actors like the Islamic State have already showcased the ability to weaponize DJI Phantom drones with 40 mm grenades.[44] Actors with more substantial research and development budgets will quickly exceed this mark.[45]

As nations improve the intelligence sensors and micro-PGMs on sUAS platforms, the US military will need to mature its SHORAD and C-UAS capabilities to protect ground troops from enemy sUAS CAS and surveillance. The US may even need to invest in sUAS-based OCAs to protect ground forces vulnerable during maneuver and to overcome innate range advantages that air platforms have over ground assets. Typically, air-to-ground munitions can outrange ground-to-air munitions acquired at similar cost because they are released at higher elevations, permitting them additional flight time before gravity pulls them to earth. Additionally, as intelligence sensor payloads improve, tactical UAVs will have collection capabilities beyond the range of ground-based counterunmanned aerial system defenses, necessitating the deployment of UAVs designed and equipped for counterair missions.

At present, the US military is inadequately prepared to contest control of the airspace with a foe who emphasizes the development of a sUAS force capable of mobile launch. C-UAS systems provide strong protection for fixed sites, but maneuvering ground forces could prove more vulnerable to drone attack. High-end systems like the F-22 Raptor, F-35, F-15 Eagle, F-16 Falcon, and F/A-18 Hornet have been specifically designed to wage war against other manned aircraft and have a limited ability to adapt to the prolif-

eration of smaller drone assets. Air-to-air missiles like the AIM-7 Sparrow, AIM 9X Sidewinder, and AIM-120 advanced medium-range air-to-air missile have limited utility against groups 1-to-3 UAS, and the opportunity cost of using a $125,000 AIM-7 to engage a $15,000 drone would be immense, particularly if an opposing force deployed drones in quantities that dwarfed the number of munitions fixed-wing aircraft can carry.[46] Even the flight time of fourth- and fifth-generation aircraft is too valuable to expend on engaging small unmanned aerial systems. Current US air defense systems like the MM-104 Patriot missile system have similar cost asymmetries with commercial small UASs. The $3 million air-to-surface missiles make financially inefficient drone interceptors.[47]

Modern fighters could target sUAS launch vehicles on the ground, but launchers may be as concealable as a small field artillery piece or potentially, a man-portable surface-to-air missile launcher. This concealability and mobility would allow sUAS threats to persist on the battlefield long after US airpower neutralized enemy aircraft that relied on standard-length runways. Locating and targeting mobile small UAS launchers could prove even more challenging than SCUD hunting during the first Gulf War.[48]

In effect, this capability gap between small UASs and fourth- and fifth-generation aircraft could result in two distinct contests for air control, a traditional one between air superiority fighters and air defense systems (OAC) and another at lower altitudes between multitudes of less expensive drones and shorter-range air defenses (TAC) (see fig 1).

In a contest between an actor that emphasized the deployment of small UASs and another that fielded more traditional aircraft, both parties could experience superiority at different levels of air control. While operational air superiority will arguably always have more battlefield impact than tactical air superiority, sUAS-derived TAC could shape the outcomes of small-scale land and sea engagements. An infantry platoon entering an engagement with a situational awareness advantage from superior sUAS coverage has a better chance of winning a gunfight.[49] Ground units with organic sUAS CAS or electronic warfare abilities would have an even greater advantage.

Although an sUAS-driven contest for TAC would have many of the characteristics of contests between high-end platforms, the faster rate at which small UASs can be deployed to the battlefield, the potential for the use of mobile launch systems, and likelihood of control at lower echelons may make the competition for TAC more dynamic and air superiority more temporary than historical contests. Unlike large fixed-wing manned or unmanned aircraft, dozens of smaller drones can be airdropped, pneumatically launched, or slung into the sky in a matter of minutes by current support apparatus.

Squad or platoon-sized units can even hand-carry small UASs into combat. Future battlefields could see squadrons of dozens, hundreds, or thousands of drones launched into the air by mobile LREs to aid ground units requiring air support or to pursue airpower missions of their own. This ability to rapidly surge air assets to specific areas of the battlefield will degrade the potential for militaries to preserve air dominance with certainty over large areas, even if opponents possess superior aircraft technology. A mobile sUAS LRE could remain hidden by operating under emissions control conditions and

suddenly release individual UAVs or a swarm of drones to impact operations at a critical moment or as enemy air defense gaps are identified.

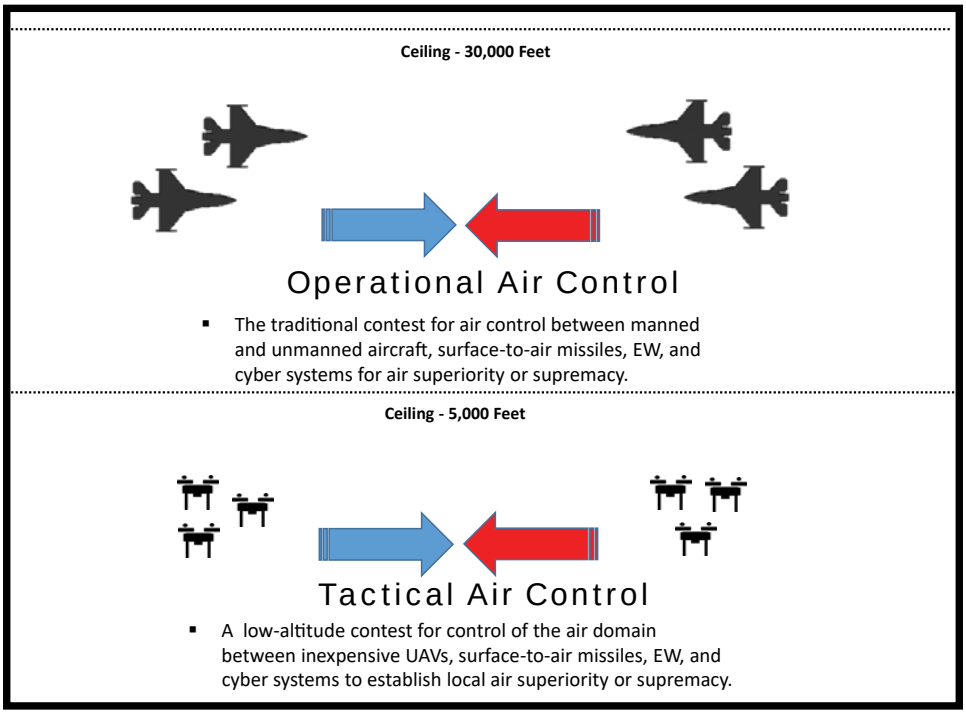

Figure 1. Two levels of competition for air control
(Source: Derived from Raytheon, "Arming the F-35," modified from a graphic by Christopher Desrocher, "Aircraft of Atlantic Trident 2017")

Also, sUAS swarms could be configured to conduct emergency CAS for troops in contact, resupply a unit isolated by enemy forces through a decentralized supply drop, conduct reconnaissance in force before a major land or naval attack, form a redundant aerial communications network, or participate in a mass electronic warfare or cyber attack. At a more tactical level, small groups of small UASs could be quickly deployed to facilitate a local breakthrough or gain a temporary advantage in firepower or an awareness to support decisive maneuvers. Again, small UASs cannot replace larger airframes, but could be used to complement them by supporting tactical airpower missions that fall outside commander priorities or provide small maneuver units a semblance of persistent air cover.

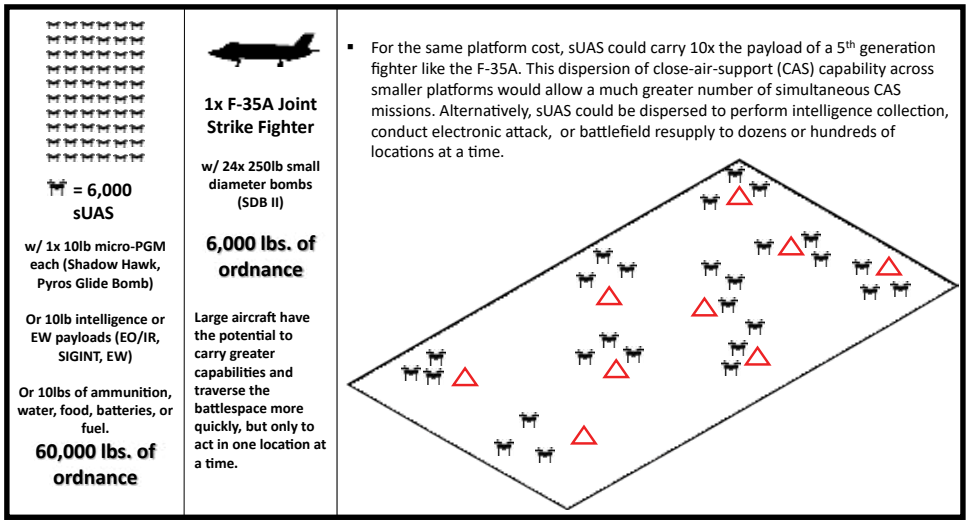

Figure 2. Diffusion of capabilities through sUAS deployment
(Source: Dave Gandy, "Fighter Jet Silhouette")

Inexpensive small UASs could be used disposably en masse by brigades, battalions, or companies and still cost less than the manufacture of a single fifth-generation fighter. The USN's Low-Cost Unmanned Aerial Vehicle Swarming Technology (LOCUST) costs roughly $15,000 per vehicle. Almost 6,000 LOCUST small UASs could be purchased for the price of a single F-35A.[50] Instead of concentrating airpower capabilities in a single expensive platform, the JFC could divide these 6,000 small UASs to fulfill strike, intelligence collection or electronic attack missions across hundreds of areas on the battlefield at once, directly affecting tactical outcomes for supported forces (see fig 2). Alternatively, commanders could vertically stack hundreds or thousands of small UASs in a small area, enabling a concentration of combat power inconceivable with manned vehicles for reasons of pilot safety and aircraft size. This division of airpower capabilities into smaller platforms may allow controllers to achieve efficiency in the allocation of aircraft made impossible today by supply constraints and investment in exquisite platforms over larger numbers of utility aircraft.

Conclusion

The development and proliferation of small UAVs capable of playing traditional airpower roles at the tactical level will complicate contests for air control by decreasing costs of fielding aerial combatants. Foreign powers incapable of procuring fifth-generation fighter aircraft may increasingly turn toward smaller unmanned platforms to prevent opponents from holding complete dominion of the air domain. These small UASs will not match the capabilities of modern manned aircraft, but their portability and low cost

may allow them to sustain a greater presence in the battlespace and create an environment where US forces face enemies with persistent air cover provided by small UAVs.

As sUAS technologies develop, the US military must not only adapt short-range air defenses to deal with them as emerging threats but also pioneer the expansion of sUAS roles in CAS, reconnaissance, tactical resupply, electronic warfare, counterair, and communications. The US cannot simply counter enemy drones; it needs to cleverly apply sUAS technology in ways that provide supported ground and sea forces decisive tactical advantages and prevent enemies from gaining tactical air control, no matter its duration. The US has led the world in sUAS development; now it must broaden the practical application of small UASs to ensure we preserve our capability to control the air domain at the tactical level. ✪

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Maj Jules "Jay" Hurst, USAR

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Twenty-First Century Deterrence in the Space War-Fighting Domain

Not Your Father's Century, Deterrence, or Domain

Maj Bryan Boyce, USA, Retired

At present, our potential adversaries understand the competitive advantage we derive from space and view our reliance on space as a critical vulnerability they can exploit. As I have testified before, in the not too distant future, near-peer competitors will have the ability to hold every U.S. space asset in every orbital regime at risk. To meet this challenge, we need to embrace the fact that space is a warfighting domain just like the Air, Land, Cyberspace and Maritime domains, which requires that we address our vulnerabilities and maintain our resolve to ensure the peace.

—Gen John W. Raymond
Commander, Air Force Space Command

Deterrence for the twenty-first century will not be the nuclear deterrence that keeps superpowers from engaging each other, nor the ad-hoc conventional deterrence that fails to keep perhaps thousands of smaller conflicts from erupting across the globe. Effective twenty-first century deterrence needs to be national and multinational, multidiscipline, and multidomain, combining diplomatic, informational, military, and economic (DIME) means to prevent terrestrial conflicts from extending to space. For the new space war-fighting domain, defining and understanding what *space deterrence* is and what it is not will be critical to developing space war-fighting capabilities that enable the "M" aspect of DIME. Space deterrence used in this article is not meant to claim that deterrence in space is separate and distinct from the over-arching deterrence of combined factors of DIME, including the "M" for Military, but rather to highlight the factors and considerations that will enable or disable space contributions to deterrence.

Introduction

The century isn't new, but it is very young. The euphoria of the triumph of deterrence, demonstrated by the fall of the Berlin Wall on 9 November 1989 and signaling the end of the Cold War, had lasted just nine months when Saddam Hussein thumbed his nose at conventional wisdom and invaded Kuwait. Eighteen months later, after a combination of many diplomatic, informational, and economic responses failed to oust Iraq, the US-led coalition freed Kuwait in 12 days of military response, adding the missing "M."

Post-Cold War deterrence isn't new, but it, too, is very young. Our fathers' deterrence was often seen far too narrowly as described in meaning (b) below—*"discouraging attack*

(e.g., nuclear deterrence):" *De·ter·rence (də ˈtərəns)* "the act or process of deterring, such as (a): the inhibition of criminal behavior by fear, especially of punishment; (b): the maintenance of military power for the purpose of discouraging attack" (e.g., nuclear deterrence).[1]

Nuclear deterrence was then and remains very binary; it either works 100 percent of the time, or it fails. The lack of *any* nuclear weapon attacks or exchanges (since the first two bombs) seems to support a 100-percent success rate of *"the maintenance of military power"* in nuclear deterrence, regardless of the myriad factors contributing to the lack of nuclear incidents. Unfortunately, the result is a very narrowly focused strategic deterrence—routinely associated only with nuclear weapons—including the misconception that successful deterrence is measured by a 100-percent lack of incidents.

Space certainly isn't new either, but as a war-fighting domain, it is very new. Just a few years ago the words *space* and *war fighting* weren't used in the same sentence. The character of outer space has changed since our fathers' time as well. If space were ever a peaceful sanctuary (interrupted only in science fiction movies' imaginary scenarios), that is certainly no longer the case. In April 2011, Ambassador Gregory L. Schulte, the DOD deputy assistant secretary of defense for space policy, spoke about the "three Cs" of space—congested, contested, and competitive—when he addressed the 27th National Space Symposium. It's not beyond imagining that a fourth "C"—combative—would be added if major space-faring nations found themselves in a terrestrial conflict.

This article is presented in three parts:

Part 1: New Century—Deterrence for the Twenty-First Century—extends Clausewitz's statement that "war is politics by other means" to "deterrence is politics by all means"—DIME.

Part 2: New Deterrence—(with Space) Multidomain Flexible Deterrence—focuses on the "M" part of DIME, positioning for military flexible deterrent options (FDO), the development of flexible response options (FRO), and the process for planning and executing FDO → FRO transitions.

Part 3: New War-Fighting Domain—Deterrence in Space War-Fighting Domain—connects war gaming of space deterrence using the FDO → FRO process to discussions of potential operational deterrence futures.

Part 1: New Century—Deterrence in the Twenty-First Century

Deterrence for the twenty-first century and beyond is based on two fundamental concepts. First is the set of three "Cs" for deterrence: capability, communication, and credibility. Capability refers to the power, capacity, or ability to accomplish something. Communication is the imparting of the capability information to others. Credibility is the believability. Any deterrence objective must meet all three criteria to succeed, to which one might once again add a fourth "C" for conditioning—based on the experience that senior leaders gain through war games. That enables them to have confidence in the deterrent response system.[2]

The second concept involves DIME, the acronym that stands for the diplomatic, informational, military, and economic instruments of national power, each considered across a spectrum of "carrot-and-stick" actions (or responses) shown (as triangles) in figure 1. Although figure 1 shows multiple notional movements from carrots to sticks, it is also possible that there are movements in the opposite direction because international actors may be induced instead of compelled to change undesirable behaviors. The responses executed across a spectrum of DIME categories combine to underpin all deterrence.

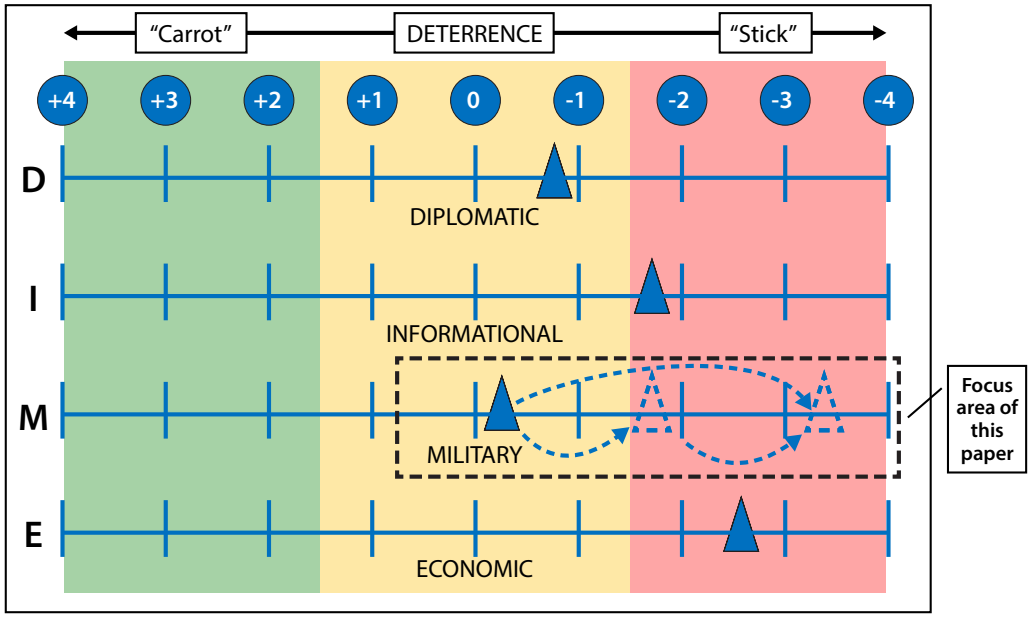

Figure 1. "Deterrence is politics by all means" visualized across diplomatic, informational, military, and economic means.

Each DIME category has its own row with nine columns of possible responses ranging from the most positive on the left to the most negative on the right. Figure 1 is an example of ongoing peacetime deterrence where the status triangles on each DIME category are on the positive side of 0. This article touches on deterrence across DIME but highlights the choice to develop and war-game the military options for space deterrence that move from 0 toward the stick side of the model to fulfill the four "Cs" of deterrence, accepting that a choice to move military options toward the carrot side may prove just as effective. Carrots and sticks enable four basic options when multiplied by two execution verbs: withhold and give. Give carrots or give sticks. Withhold carrots or withhold sticks. These options cover what some refer to as *deterrence by denial* and *deterrence by punishment*. Across DIME, bad actors can receive sticks or carrots, and have carrots or sticks withheld, and any desired combination.

Based on the global record since the end of the Cold War and the twentieth century, deterrence in the twenty-first century will not look like nuclear deterrence with no attacks or incidents. Rather, it must be a multidomain strategic deterrence against behavior at the international level, with examples ranging from Russian military intervention in Ukraine and annexation of Crimea (2014–present) to China (spring 2018) forcing Vietnam to suspend yet another oil drilling project occurring too close to the U-shaped "nine–dash line" that marks the vast area that China claims in the South China Sea.[3] Transformational deterrence thinking is captured in the new *Joint Concept on Integrated Campaigning* (*JCIC*) from March 2018 that acknowledges a very complex twenty-first century world and the challenges of "integrating military activities within the DOD and aligning those activities with interorganizational partners."[4] The *JCIC* goes on to define *integrated campaigning* as "Joint Force and interorganizational partner efforts to enable the achievement and maintenance of policy aims by integrating military activities and aligning non-military activities of sufficient scope, scale, simultaneity, and duration across multiple domains."[5] Future international deterrence in an integrated, interorganizational, multidomain (including space deterrence) world will have to include some of the first definition (a) of deterrence above: *"the inhibition of [state/non-state] behavior by fear, especially of punishment."*

Part 2: New Deterrence—Multidomain (with Space) Flexible Deterrence

> ***Deterrence*** *consists of essentially two basic components: first, the expressed intention to defend a certain interest; secondly, the demonstrated capability to actually achieve the defense of the interest in question, or to inflict such a cost on the attacker that, even if he should be able to gain his end, it would not seem worth the effort to him.*
>
> —William Kaufmann, "The Evolution of Deterrence 1945–1958" in Martin C. Libicki, *Cyberdeterrence and Cyberwar*

Background

Deterrence and flexible response have been a part of US national security thinking and policy at least since the end of World War II, and more specifically since President John F. Kennedy and Secretary of Defense Robert S. McNamara sought strategic alternatives to nuclear weapons, "massive retaliation," and mutual assured destruction. According to Joint Publication (JP) 5-0, *Joint Planning*, FDOs are "preplanned, *deterrence-oriented actions* carefully tailored to send the right signal and influence an adversary's actions. . . established to dissuade actions before a crisis arises or to *deter further aggression* during a crisis. . . developed for each instrument of national power—diplomatic, informational, military, and economic [DIME]. . . most effective when used to combine the influence across instruments of national power."[6] *FROs* are defined as "the capability of military

forces for an effective reaction to any enemy threat or attack with actions appropriate and adaptable to the circumstances existing."[7] FROs are "operational to strategic-level *concepts of operation* that are easily scalable, provides military options, and facilitates rapid decision making by national leaders. . ."[8]

Domains first came into the DOD lexicon in *Joint Vision 2020* (June 2000). *Full-spectrum dominance* required that "US forces are able to conduct prompt, sustained, and synchronized operations with combinations of forces tailored to specific situations and with access to and freedom to operate in all domains; space, sea, land, air, and information."[9] In his article, "Multi-Domain Confusion: All Domains Are Not Created Equal" for *The Security Bridge* on 26 May 2017, Erik Heftye referenced JP 3-0 *Joint Operations* (17 January 2017) that describes the operational environment as "encompassing the physical areas of the air, land, maritime, and space domains; the information environment (including cyberspace); the electromagnetic spectrum; and other factors."[10] This is perhaps the latest (and best) capture of multidomain terminology.

Included but not discussed at length in this article are other critical "multi-s" that flesh out the rest of the picture, including critical multinational and multisource (civil, commercial, etc.) capabilities. Allied and commercial augmentation to deterrence, particularly in mission assurance is addressed below.

Developing Space Deterrence Strategy

"Deterrence has failed!" Nearly ubiquitous across war games is the failure of deterrence leading to war—it is a war game after all. Dozens of ongoing wars across the globe in 2018 demonstrate that only nuclear deterrence can be counted on to work. Other forms of strategic and conventional deterrence offer mixed results as state and nonstate actors pursue their objectives. As mentioned earlier, space deterrence presents a new challenge—that of defining what deterrence in the space domain looks like and how it might prevent conventional conflicts from starting in, or extending to, space. Future war games offer partial answers as moves are planned, and space war fighters develop their portion of the plan to respond to conflict in space based on their capabilities in the notional space order of battle (SOB). War-game space war fighters may not know at the time how or why space capabilities failed to deter the conflict in space, but it deserves a discussion here.

War games can only offer partial answers to deterrence in the space domain because war games often result in more questions than answers, including questions about the notional SOB, the rules of engagement, responding to a conflict extending to space, the risks of escalation, and national policy and strategy. Furthermore, anticipating DOD acquisition challenges, future notional SOB capabilities must be a primary investment area today if they are to be available in the decades to come.

War-game space deterrence and war fighting face four key challenges presented in chronological order (despite war games generally assuming challenges 1-3 and starting with 4):

1. Develop and publish space deterrence and war-fighting policy and strategy

2. Define and codify space deterrence and war-fighting requirements
3. Develop, acquire and deliver space deterrence and war-fighting systems
4. Execute space deterrence to deter and dissuade conflict in space with known (communicated) credible space war-fighting capabilities (three "Cs" of deterrence).

Foundational to any military capability is the policy and strategy that requires it. Figure 2 depicts an activity flow for developing a deterrence policy, strategy, alternatives, and so forth. The key boxes are numbered and in bold borders.

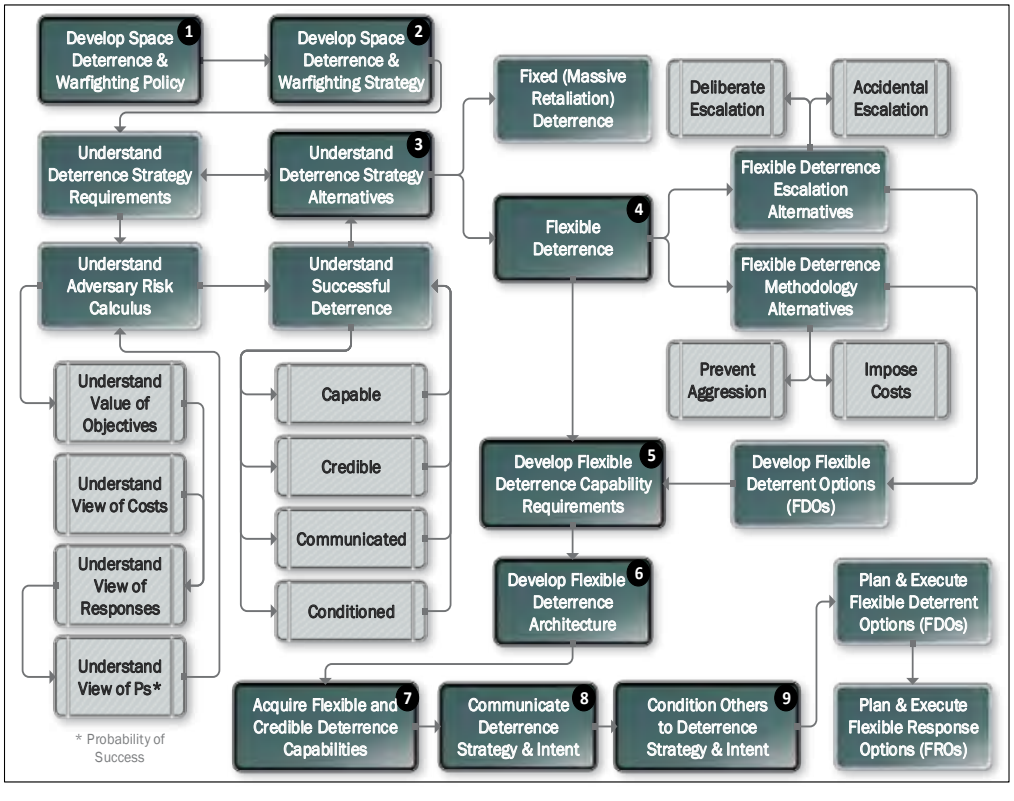

Figure 2. Activity diagram for developing and executing space deterrence and war-fighting strategy

Deterrence Doctrine

Deterrence policy and strategy are codified for the DOD in doctrine. Space deterrence and space war-fighting doctrine are implied but need further definition and codification. In a general sense, the *Deterrence Operations Joint Operating Concept* 2.0, December 2006, lays out an ends-ways-means strategy for achieving deterrence.[11]

Ends

The deterrence of aggression and coercion against US vital interests

Ways

Credibly threaten to impose costs and deny benefits

Encourage adversary restraint

Means

Global situational awareness

Command and control (C2)

Forward presence

Security cooperation and military integration and interoperability

Force projection

Active and passive defenses

Global strike

Strategic communication

Deterrence assessment, metrics, and experimentation[12]

JP 5-0 *Joint Planning* states that "contingency plans should provide a range of military options, to include flexible deterrent options (FDOs) and/or flexible response options (FROs) and should be coordinated with the total US government response."[13] JP 5-0 also suggests combining the instruments of national power (DIME) as the most effective deterrent. Specific military deterrence options include:

- Increase the readiness posture of in-place forces
- Upgrade alert status
- Increase intelligence, surveillance, and reconnaissance (ISR)
- Initiate or increase show-of-force actions
- Increase training and exercise activities
- Increase defense support to public diplomacy
- Increase information operations
- Deploy forces into or near the potential operational area
- Increase active and passive protection measures[14]

Flexible Deterrent Options

The Air War College (AWC) uses DIME to categorize FDOs in the "Tailored Responses" section of "Contingency Planning (Figure 3 is a tailored figure for space deterrence FDOs.)."[15] For deterrence to be successful, the DIME instruments of national power combine to ensure an adversary's perception and decision making is understood and influenced, based upon their perception of the costs-benefits (or consequences) of a course of action (COA) and the consequences of restraint or inaction (or the costs-benefits of not taking the COA in question).[16]

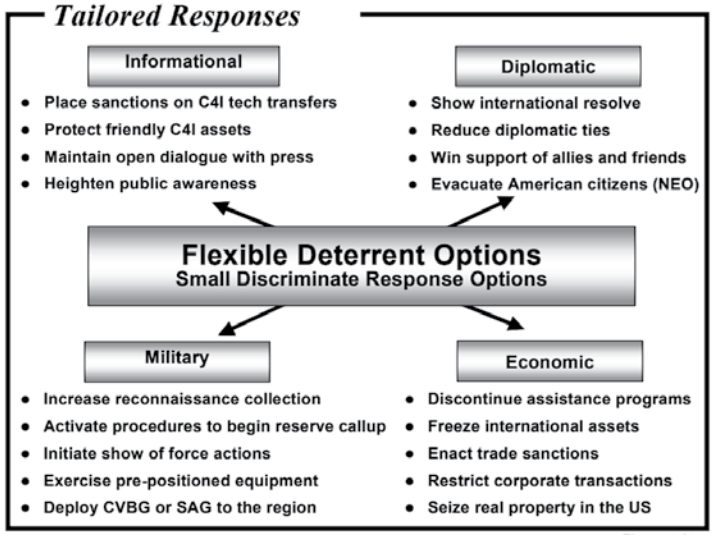

Figure 3. Space deterrence-tailored AWC model FDOs → FROs in DIME categories

Critical to national and allied security objectives and supporting space deterrence is maintaining space superiority. Adapting to and overcoming the challenges to maintaining space superiority requires mission assurance (MA) across all space mission areas including:

- Satellite communications—redundancy, resiliency, back-up, surge, and so forth.
- Launch—Launch-on-demand, replenishment, surge, constellation growth, and so forth.
- Space situational awareness (SSA)—persistent/real-time tracking and reporting, fingerprinting, status change, indications and warning (I&W), action/behavior attribution, space traffic management, and so forth.
- ISR—I&W, status change, tip and cue, action attribution, and so forth.
- Radio frequency interference—Identification, mitigation, geolocation, and so forth.

- Position, navigation, and timing—redundancy, resiliency, back-up, surge, and so forth.
- On-orbit servicing—future capability supporting resiliency, resupply, repair, and so forth.

There are multiple measures in three categories of MA measures across DIME from national and allies, including commercial:[17]

- Defense
- Reconstitution
- Resilience
  - Disaggregation
  - Distribution
  - Diversification
  - Protection
  - Proliferation
  - Deception

Combining the above in MA enables deterrence in two major ways: (1) It makes adversary counterspace capabilities infeasible due to the ubiquitous nature of space capabilities across missions, and (2) it makes actions in space visible and known and known to be visible.

In war games, FROs from commerce and allies show international resolve to reveal information in public and social media that exposes formerly ambiguous actions in space and enables strategic messaging about undesirable behaviors and requests to cease. These actions combine to support space deterrence.

FDOs and FROs have proven a successful planning construct for other war-fighting domains and are now doing so for the space war-fighting domain, as demonstrated in war games and exercises. Planning for space deterrence and war fighting based on identified trigger events, which enables the transition from FDOs → FROs, has proven groundbreaking in war games and likely holds as much potential for real-world operational planning going forward. The FDOs → FROs construct in war-game space war fighting is well-served by the find, fix, track, target, engage, and assess (F2T2EA) paradigm. F2T2EA came into common usage in Air Force terminology when Gen John P. Jumper was commander of Air Combat Command for 18 months early in 2000–01, and then chief of staff of the Air Force from 2001–05. Although there have been several efforts to update it, including the "U.S. Special Operations' Find, Fix, Finish, Exploit, Analyze, and Disseminate and Find, Fix, Fire, Finish, and Feedback,"[18] finding, fixing, and tracking is particularly well-suited for the space domain, and target, engage, and assess enable war-game war fighting.

Meeting the challenges of war-game war fighting in the new space domain often requires making dubious assumptions, as the solutions have yet to be developed and tested. Space war games need equal effort by war-game "white-cell" planners (for foundational and starting status), and "blue-cell" players (for operational planning and execution) to develop the intelligence assessments and event triggers, preplanned monitoring and reporting, assured timely detection, unambiguous assessment, positive identification, precise orbit determination, and so forth, whether the event is supported by "white-card" injects or modeling and simulation. Whether the event is a new space launch, the unexpected maneuver of a resident space object, or numerous other anomalous events, war-game scenarios and events enable an assessment of how and why space deterrence fails (if the conflict extends to space).

Flexible Response Options

As stated above, the FRO is an operational-to-strategic-level concept of operation that is easily scalable, provides military options, and facilitates rapid decision making by national leaders. The implementation of FROs is based on the contingency planning process to prevent or respond to threats. Prevention relies heavily on warning intelligence and threat warning, formerly known as I&W, and response on attribution. Timely orders and execution of FROs require a commander's thorough situational awareness. The SSA within the space domain combines ISR to characterize "space objects and the operational environment upon which space operations depends."[19] Using the inset from figure 1 above, figure 4 shows two options of either moving gradually into FRO responses in the "M" of DIME or jumping directly to a punishing military response.

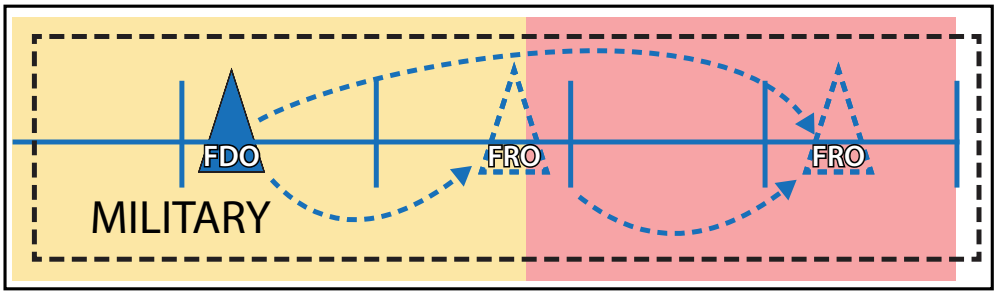

Figure 4. Detail from figure 1 showing "M" deterrence options into response options

Redlines and Triggers

Redlines and triggers or triggering events are defined as "the final straw that sets things in motion."[20] Formerly associated with I&W, redlines and trigger events are now captured in JP 2-01, *Joint and National Intelligence Support to Military Operations*, 5 July 2017: "*Threat warning* is closely associated with, but functionally distinct from, *warning*

intelligence. Threat warning is the urgent communication and acknowledgment of time-critical information essential to the preservation of life and/or resources. The nature of threat warning is urgency."[21]

Warning intelligence is primarily an intelligence function while *threat warning* can come from any informed source. Both can provide the tip-off of imminent or hostile activity, in best practice combining to form the triggering event that kicks off the FRO. Redlines and triggers were in the news recently associated with the Iran nuclear accord. In his article, "Triggers, Redlines, and the Fate of the Nuclear Accord," in a usage very similar to what is implied in the FDO → FRO construct introduced herein, Richard Nephew explains that "first and foremost, if drawn tightly, . . . redlines and triggers could create unwarranted and unnecessary crises with Iran, . . . Triggers and redlines are intended to serve as a forcing function in which A automatically results in B."[22] The ambiguities of detecting and assessing events in space deterrence and war fighting produce latencies that require some responses to be preapproved for execution upon detection of redlines and triggers to have any chance of being effective. This does not suggest automated (no-human-in-the-loop) responses, but rather thorough planning, seamless monitoring, and prebriefed and approved COAs.

FDOs → Redlines and Triggers → FROs

Developing and planning FDOs, identifying redlines and triggering events, conducting the contingency planning for the FROs, and requesting preapproval for FROs orders upon detection of the triggers, has been transformational in war games and exercises. As illustrated in figure 5, transitioning from FDOs to FROs (FDO → FRO) is basically developing "if-then" contingencies for the commander. The FDO is "commander, recommend approve this now," while the FRO is "commander, recommend if trigger is detected, then approve this response." The key boxes are numbered and bold borders.

Planning for FROs is similar in steps to crisis planning. For space operations planners, developing redlines and triggers is the least familiar of the steps shown above. Redlines and triggers are based on knowing what to monitor, tasking for the collections, and detecting and comparing newly collected data and assessing it against known starting conditions.

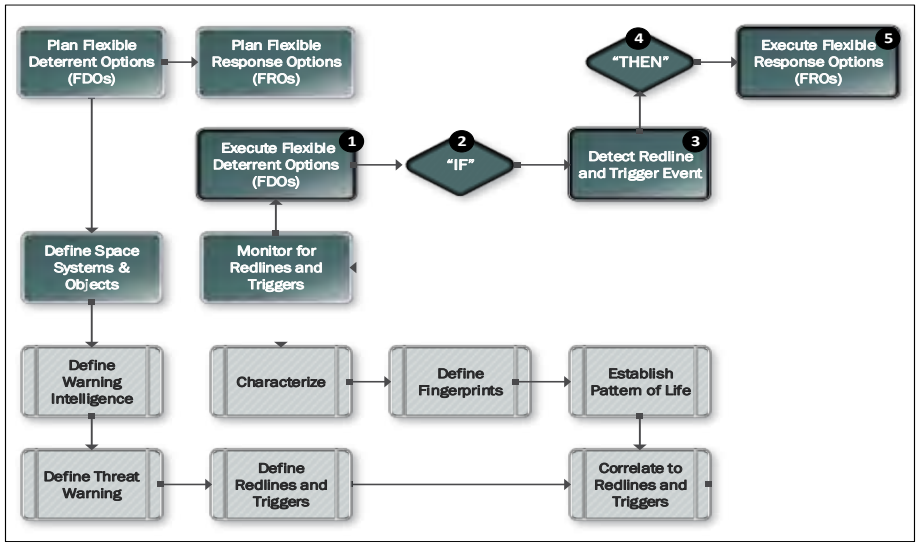

Figure 5. Moving from FDO → FRO in the space domain supported by redline and trigger detection

Part 3: New Domain: Deterrence in the Space War-Fighting Domain

Space deterrence will never be similar to the binary nature of nuclear deterrence discussed above, nor can the space domain be expected to be free from incidents. Space deterrence will be flexible deterrence, as it is in all other war-fighting domains, which by definition allows for varied situationally-dependent responses to the inevitable incidents in the space domain. China proved this on 11 January 2007, when in its fourth antisatellite (ASAT) test, it destroyed one of its own aging weather satellites and caused a 10-percent increase in debris (thousands of pieces) at an altitude of about 530 miles.[23] It was in the early 2000s before the last of hundreds of pieces of debris from the last ASAT test by the US at a lower altitude in 1985 burned in.[24] Another public-space event occurred on 10 February 2009, when Iridium 33 and Cosmos 2251 collided at a speed of 42,120 km/h (26,170 mph) at an altitude of 789 km (490 mi.) above the Taymyr Peninsula in Siberia. Although accidental, it was easy to imagine similar effects if an intentional collision were to occur. Whether the space domain sees a terrestrial conflict "extend to space," or space incidents precede and foreshadow terrestrial conflict, deterrence in space should consider and utilize flexible deterrence paradigms.

As a new war-fighting domain, space is catching up to methodologies and processes that are routine practices in other domains. War games and exercises require breaking old paradigms and mind-sets as space planners and operators look at "4-C" space environments with space forces and missions at risk from peer or near-peer space adversaries. Among the

many observations and lessons learned from war-gaming notional space operations in the coming decades, coming to grips with space deterrence in policy and strategy and applying it to planning flexible deterrent options is among the most important. In terrestrial domains, strategic deterrence is very clear. When the US sent B-1 Lancer bombers and F-15 Eagle jets off the coast of Korea in the fall of 2017, it left little doubt in anyone's mind what the real objective was, which according to the Pentagon was a "demonstration of U.S. resolve and a clear message that the President has many military options to defeat any threat."[25] But what does space deterrence look like? Only in war games can players work through various combinations of "sticks and carrots" to discover what does and doesn't work in the space domain. The FDO → FRO process provides a critical piece to successful space operations—issuing orders while the probability of mission success is as high as possible. Issuing timely orders requires an FDO → FRO model with preapproved orders upon detection of the triggering event (when possible).

Figure 6 shows the space C2 performance model with the adversary kill-chain in the dark arrow across the top and protection countermeasures beneath with representative effectiveness bars decreasing over time from 100–10 percent. SSA quality/quantity is down the left side and C2 (commander) confidence on the right. Space C2 performance is notionally expressed improving from the bottom large dotted line (no FDOs, monitoring, or orders), smaller dotted line in the middle (no FROs and late orders at the white star), and solid line on the top (FROs, detection triggers, and timely orders at the black star). In wargames, a fully-developed space war-fighting FDO → FRO process with preapproved FROs has been shown to help move from no orders or late orders, to timely orders.

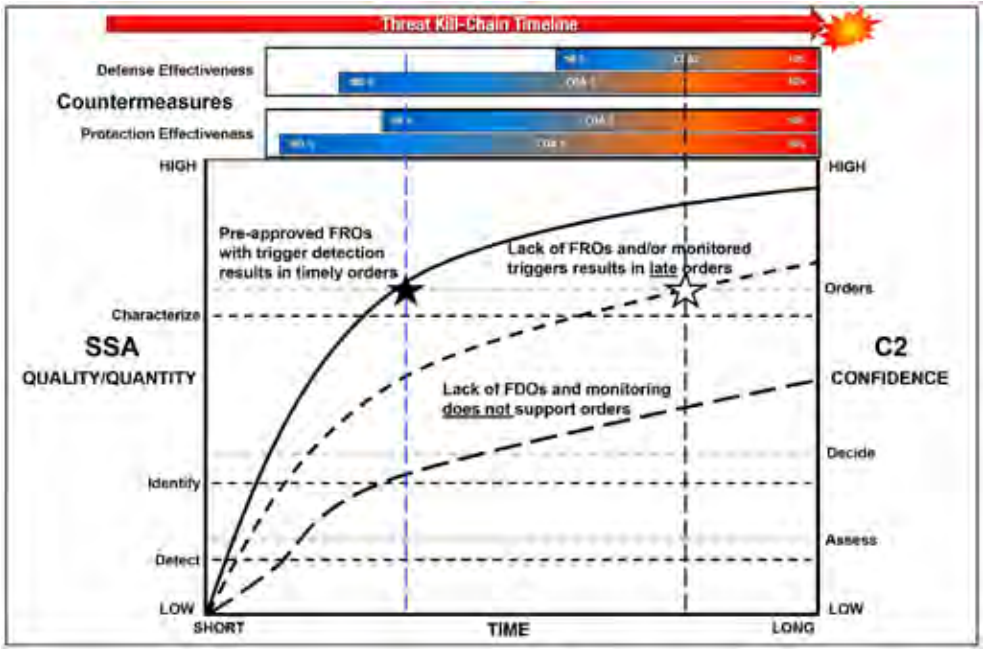

Figure 6. Space command and control operations model for FDOs and FROs

Learning from War-Gaming Flexible Space Deterrence

What does flexible space deterrence look like in a war-game scenario? It usually starts with an international actor doing something that upsets the status quo in the region, regardless of DIME deterrence activity by the US or other international actors. As in the real world, that first act is an initial failure of deterrence as defined above: *"the inhibition of behavior by fear, especially of punishment."* But flexible space deterrence is not done yet, the conflict has not extended into space, and FROs are planned and ready. The only question that remains is how dramatic the FRO—measured or massive? Carrot or stick? Further carrots may be forthcoming. On the stick side, the punishment for undesired international behavior cannot be considered escalatory or warmongering. Nations that upset the status quo have done so with a calculated risk about the response of the international community and the US and have accepted that risk. Perhaps ambiguous or nonpunitive responses in the past have lulled potential adversaries into miscalculating risks. Calculations in the space domain are even more complex. China accepted that risk with the January 2007 ASAT test but seemingly learned a lesson from the international reaction, as there have been no further debris-causing tests.

War games and exercises are the perfect means to condition and acclimatize leaders (at least senior military leaders) that some FROs may need to be swift, harsh, and violent to return a region to the status quo without a major conflagration.[26] Fears of escalation—tripping misunderstood or invisible redlines, or the possibility of issuing an order that contributes to wars instead of preventing them—cannot be allowed to hobble decision makers and senior leaders. The cliché of responding to international crises with a "tersely worded State Department demarche" cannot rule the day in war games and exercises. If space is a war-fighting domain, then actually fighting a war that extends into space may be required to maintain space superiority, should space deterrence fail.

FDO → FRO Success for Operational Space Deterrence

In war games and exercises, success for deterrence and the FDO → FRO process in planning and execution can be measured during adjudication or assessment. Questions are asked and answered such as:

1. Was there appropriate multidomain FDO planning?
2. Were redline and trigger conditions identified and monitored?
3. Were multidomain FROs planned with possible branches and sequels in mind?
4. Was the threat warning adequate and timely, and did it enable FROs?
5. Did the commander have the authorities to order the FROs?
6. How did the FRO impact the conflict?

All well and good for future war games adjudicated in distinct moves, but what is the impact of deterrence and the FDO → FRO process on real-world operations in 2018

and beyond? The impact could be negligible unless the following challenges are addressed. Starting with deterrence strategy and policy:

Challenge 1: Develop and publish appropriate space deterrence and war-fighting policy and strategy.

Challenge 2: Define and codify space deterrence and war-fighting requirements.

Challenge 3: Develop, acquire and deliver space deterrence and war-fighting systems.

Challenge 4: Execute space deterrence to deter and dissuade conflict in space with known (communicated to adversaries) credible space war-fighting capabilities (three "Cs" of deterrence). Recall the classic quote from Dr. Strangelove, "The whole point of a Doomsday Machine is lost, if you keep it a secret!"

Summary

Space is a war-fighting domain. Air, land, and maritime domains understand flexible deterrence. Examples are routinely in the news as mentioned above. Space and cyberspace operations deterrence activities may not be in the headlines—yet. But merging FDO planning with FRO preplanning for space war-fighting operations in war games and exercises, based on identified trigger events, represents a paradigm shift in thinking for flexible deterrence in the newest war-fighting domain.

What does the road ahead look like for deterrence in the twenty-first century space war-fighting domain? Some of the steps going forward include:

1. Developing a comprehensive national and multinational, multidiscipline, and multidomain DIME deterrence policy and strategy
2. Applying and tailoring DIME deterrence strategy for key defense planning scenarios
3. Exercising and war-gaming deterrence defense planning scenarios across all levels of DIME participants to identify deterrence capability, communication, and credibility gaps
4. Proposing and developing near-, mid-, and long-term solutions for deterrence gaps across national agencies, organizations, and armed services
5. Repeating and improving steps 3–4, integrating and synchronizing vertically and horizontally. ✪

Notes

1. *Merriam-Webster Dictionary*, s. v. "deterrence," accessed 16 June 2018, https://www.merriam-webster.com/dictionary/deterrence.

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12. The suggested addition was made by the author.

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14. Ibid.

15. Air War College, "Flexible Deterrent Options in the Tailored Response Section of Contingency Planning," fig. 4–18, accessed 16 June 2018, http://www.au.af.mil/au/awc/awcgate/pub1/fdo.pdf.

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20. Answers, "What is a Triggering Event?" accessed 16 June 2018, http://www.answers.com/Q/What_is_a_triggering_event?#slide=1.

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24. Ibid.

25. Doug Stanglin, "U.S. Bombers, Fighter Jets Counter 'Reckless Behavior' in Show of Force off North Korea Coast," *USA Today*, 23 September 2017, https://www.usatoday.com/story/news/2017/09/23/u-s-b-1-bombers-f-15-jets-carry-out-rare-show-force-off-north-korean-coast/696480001/.

26. Hopefully, similar "war games" occur at the highest levels of civilian leadership, as well, conditioning the ultimate decision makers to make the hard decisions.

Maj Bryan Boyce, USA, Retired

Major Boyce retired after 22 years in the USA (MI35 military intelligence and FA40 space operations), where he specialized in space control operations, systems engineering, and integration, capability and sufficiency analysis, system architecture, and force structure analysis.

Joint Mission Control

From Component to Joint Leadership of All-Domain Missions

Capt Matthew B. Chapman, USAF
Lt Col Gerrit H. Dalman, USAF

The joint force can no longer rely on superior technology to maintain a competitive advantage against its adversaries. Rather, the American military's asymmetric strength must rely on its ability to command and control (C2) a plethora of multidomain capabilities faster and more effectively than the enemy. Robert Work, the deputy secretary of defense, who shaped the DOD's third offset strategy, called for innovative, human-centered solutions to re-establish an advantage.[1] A faster, more agile C2 battle management enterprise can create the advantage that achieves the third offset vision. The answer must be a joint solution, built to integrate and battle-manage multidomain effects at the tactical level. The Air Force is uniquely positioned to lead the multidomain battle management effort by developing joint mission controllers (JMC). Just as the Joint Terminal Attack Controller (JTAC) revolutionized joint fire support, the JMC could revolutionize multi-domain integration.

The JMC is a necessary position to integrate and leverage multidomain effects faster than an increasingly advanced adversary. In short, the JMC is an individual or team with the flexibility to operate from anyplace in the battlespace with proximity to and direct access to tactical edge networks. From a forward position, the JMC's role is to simultaneously and dynamically battle-manage the air, land, surface, subsurface, cyber, space, and electronic spectrum domains at the tactical level in support of the joint force commander (JFC).

Joint Integration—A Growing Need

> *From now on the enemy is stronger than you. From now on you are always about to lose… but you will win.*
>
> —Mazer Rackham in Orson Scott Card, *Ender's Game*

An illustration of joint mission control can be found in Card's 1985 science fiction novel *Ender's Game*. Card's antagonists, the alien "Formics," possessed tremendous decision speed with instantaneous telepathic communication capabilities, which they used to disseminate commander's intent and coordinate action. Like Ender Wiggin's challenge against the fictitious Buggers, the joint force faces enemies who can adapt and communicate

faster than it can. Today's adversaries leverage rapidly proliferating technologies to—almost instantaneously—access information and coordinate effects. The joint force can't afford to match every adversary's technological advancement at the scale of the full military, but by using JMCs to integrate joint capabilities faster and more effectively, the joint force can outperform adversary decision cycles to gain an advantage.

To realize this competitive advantage, the JMC must achieve three outcomes: increase the speed of quality decision making, integrate a broader range of capabilities at the tactical level, and achieve unity of command. Ender and his team were trained and equipped to use situational awareness through a combined operating picture and broad responsibilities and necessary authorities over all available effects. The joint force must develop its Ender Wiggins.

Future success will depend on the joint force's ability to select, train, and employ multidomain battle managers. These leaders must integrate joint kinetic and nonkinetic effects faster than the adversary. Ender wasn't a practitioner of any particular weapon system. He was not a pilot or a cyberspace operator. Ender was a battle manager, and his weapons system was the C2 network.

A Struggle between Domains

In the late 1970s, the US developed a strategy to better integrate airpower into dynamic land maneuver. This was the precursor to the joint warfare emphasis in the 1980s, clearly instantiated in the Goldwater-Nichols Act. Air integration into dynamic land maneuver later became known as AirLand Battle.[2] Once the Cold War ended, the focus shifted to state actors with capable navies, such as China and Iran, and joint doctrine expanded to include Air-Sea Battle.

The current generation of department and service strategy documents envision integrated, transregional, and cross-domain operations. An increasing number of programs, demonstrations, and concepts exist to pursue such visions, but they exist, overwhelmingly, to address the operational level of war. In addition, most Air Force multidomain C2 efforts are constrained by defining *multidomain* as: air, space, and cyber.[3] In the joint community, the preferred term *all-domain* demands a necessarily broader perspective. To operate "across regions, domains, and functions"[4] will require coordination beyond just campaign planning to where individual effects are combined at the tactical edge.

This degree of integration and interdependence will require leaders with joint competencies who focus on the exercise of mission command over multicomponent forces at echelons below the JFC and component commands. In 2003, Lt Gen David A. Deptula, USAF, retired, similarly recognized a joint C2 gap, specifically for synchronizing air-domain kinetic effects when in close proximity to friendly forces on the ground. His answer was to create a joint position called the JTAC. The general's joint solution effectively filled a desperate need, so that the JTAC is now one of the most recognizable positions in the DOD.

The DOD is poised to make the next shift in integrating joint effects. This next era will build on and expand past the traditional two physical domain construct the JTAC so effectively integrated and will heavily rely on the cyber and space domains.

Just as JTACs continue to be vital to integrating air fires into land maneuver, the JMC will fuse diverse capabilities into necessary effects for a variety of missions. The JTAC was designed to integrate fires in close proximity to friendly forces. (see fig. 1) The JMC is intended to integrate effects beyond the close fight. (see fig. 2)

Figure 1. The JTAC was developed to synchronize air-domain kinetic effects when in close proximity to friendly forces on the ground.

Figure 2. The JMC is intended to integrate joint effects beyond the close fight. The USAF Control and Reporting Center, with access to multiple communication networks and radar feeds, is a potential operating location for a JMC.

Solving for Joint Mission Control

The JMC will be an all-domain combat mission qualification performing battle management functions of orient, pair, solve, decide, order, and assess to more effectively enable the joint team to achieve the effects of information dominance, decision superiority, and synergy among operations. The JMC will be a member of a team that is delegated joint authorities; better able to anticipate, adapt, and solve problems; manage information; and coordinate multidomain effects to achieve joint mission objectives throughout assigned missions, operations, or campaigns.

The JMC will provide operational commanders with improved tactical decision making through three mutually reinforcing advantages. First, they will increase the speed and quality of tactical decision making by overcoming barriers to trust and collaboration such that higher-level commanders can confidently delegate risk and decision authorities to the tactical edge. Second, JMCs will leverage superior access to joint resources through deliberate awareness, trained cognizance, and the ability to synchronize and sequence joint resources and capabilities. Third, they will increase unity of effort by averting service-biased perspectives in favor of a JFC objective-oriented perspective. Full-time JMCs will make and implement decisions faster, incorporate more collaboration between joint capabilities, and better align their effects to support campaign objectives.

Rapid Decision Making

Today, many modern technical and doctrinal trends have had the collective effect of slowing decision-making cycles. An example is the increasingly centralized C2 system. Technology has driven an increased demand by decision makers for more information from more sources. Simultaneously, that information is being leveraged increasingly by distributed, parallel, and collaborative teams that include more participants from more locations. Those flat organizational relationships have advantages, however, assimilating more information, and conducting more coordination inevitably takes more time without increased resources. Those two factors—more information and more participants—often compound each other and lead to even greater delays. As a result, decisions are often based on more information but are less timely. In addition, when engagement authority is retained above the tactical level and, further, when such higher authority is compartmentalized in separate domain commands, multiple approval processes must be completed, delaying the desired effects. This trend must be countered to be successful against future adversaries.

By implementing a JMC position, the joint force can increase the speed of decision making by delegating more decision authorities to the tactical edge. As a rule of thumb, the closer that decision authority can be delegated to the point of action, the better. General Deptula recently advised leaders to "delegate execution authority to the echelon with the greatest relevant situational knowledge and control."[5] Senior leaders are likely to retain authorities at higher levels when risk outweighs trust. Trust in tactical-level control, and thus the delegation of decision authority, can be developed by building the JMC to be the JFC's trusted agent in the forward battlespace. In other words, delegating more authorities over all-domain effects to JMCs requires improved joint force competence.

Cross-Domain Effects

The modern battlefield has grown so complex that battle management from a single-domain perspective has become a significant limiting factor. This is due to the rampant expansion of both the variety of capabilities and the complexity of each. In addition, future wars will be highly contested and highly complex because the adversary will also attack from positions in multiple domains. This means the joint force must be able to defend and attack in multiple domains.

JMCs will be trained to break these complex battlespace problems down into complicated but solvable ones. Unlike career component leaders, JMCs will receive training on a wider range of joint capabilities, control networks, and the associated authorities required to wield them. A deliberate effort to divorce JMCs from individual service bias will also free them to assess available capabilities to generate desired effects more objectively. What is complex to a leader from a single-service background may be processed as merely complicated after the methodical development of competence and perspective.

Unity of Effort

JMCs must provide the ability to attack and defend from multiple domains simultaneously. Unity of command remains an enduring tenet of US military doctrine.[6] Clear responsibility and accountability is necessary to ensure progress toward strategic objectives and is demanded by democratic governments. Some doctrinal trends and advancements in technology complicate the exercise of mission command. Organizations increasingly value lateral flow that can cause friction with structurally hierarchical military units. Technology enables higher-echelon staffs to micromanage tactical operations from rear headquarters, which can cause confusion at the tactical level when general situational awareness of the battlefield situation is lacking.

Since Goldwater-Nichols, the DOD has gradually become more comfortable with joint mission planning, but execution still takes place predominantly within service silos. The International Security Assistance Force and joint task forces around the world routinely plan jointly but still assign a lead component to carry out those plans.

Supporting and supported relationships are an outdated convention that limits the joint force's maximum potential. Supporting units make their own risk and resource decisions, often competing organic concerns against mission concerns. Supported units often have strong domain or service doctrine bias and either under- or over-utilize information and resources accordingly. Collectively, decisions are often degraded, delayed, avoided, or missed, to the detriment of the mission. Gen Joseph Dunford, chairman of the Joint Chiefs of Staff, has publicly advocated for integrated responsibilities over supporting and supported roles.[7] To accomplish such integration, control at lower levels should always reflect a direct alignment with the overall campaign and strategy objectives. There is much to be gained by transitioning to a model of more dynamic relationships that promote interdependence and real-time sharing of responsibilities, authorities, and resources.

Truly all-domain battle management requires the seamless synchronization of information, maneuvers, and effects across space, air, land, sea, cyber, and spectrum. JMCs can integrate the domains by harmonizing component priorities. Because the JMC will have a clear understanding of JFC objectives and intent unclouded by competing component priorities and will not be distracted by force support responsibilities, they will be free to focus singularly on mission accomplishment in the battle. By moving the authority to reallocate, reroll, retarget, or retask all the way to the tactical level, missions can truly make the best use of available resources and emerging opportunities in line with the commander's intent.

Implementing Joint Mission Control

The increasing pace and complexity of battle demand the joint force make decisions faster and better integrate effects across all domains at the tactical level while maintaining unity of effort in alignment with operational objectives. Although the pursuit of these improvements can and will take many forms, career JMCs would provide a conduit for extending joint integration and interdependence all the way to the tactical level. The

DOD can select promising individuals early in their careers, provide them with specific training, manage career experiences, and develop flexible concepts of employment to integrate them when and where needed to helm its battle networks.

The DOD should shift the creation of joint-minded leaders below the operational level from a largely chance occurrence into a deliberate process. Currently, joint mission command at lower levels is invested in the only leaders available, service officers with limited training and experience integrating cross-component capabilities. There is a need for tactical level officers capable to receive all-domain authorities, perspective, and competencies from joint and component commanders. The challenge will be to select, build, and employ such capable company and field-grade officers.

Selection

Just as in any other key leadership position, selecting and caring for the right individuals will be essential to building a JMC capability. Candidates will be selected from the services based on demonstrated capacity to orchestrate tactical actions in support of grander objectives. Their careers will need to be partly managed outside their service of origin to nurture joint perspective.

Ideal JMC candidates will be managers of combat actions. Their function will be to coordinate, integrate, and direct weapons systems in battle, not sustain forces or care for troops. Therefore, candidates should be culled from service-identified joint combat arms rather than support career fields. They must be able to comprehend the relationship between tactical actions and strategic outcomes beyond the local level. In other words, JMC candidates must be capable of "playing both chess and checkers."

This tactical and strategic relationship is similar to the model already employed in the special operations community. Special forces operators make tactical decisions with strategic implications. JMCs would fill a similar role in the conventional military arena. Evaluation tools to select JMC candidates may include strategic games with layered and open-ended victory criteria to determine those with a propensity for problem solving and decision making.

Training

The joint force must create institutional processes to build inherently joint battle managers to ensure success in future battles. Current career milestones, however, drive joint experience from a staff perspective, rather than a battlefield perspective. They also occur too late in an officer's career to empower leaders at echelons relevant to tactical execution.

At the tactical level, commanders often lack joint knowledge, education, and experience so training is the key to the human component of the JMC concept. It is the means of growing the competence required to develop trust and make rapid decisions. The joint force needs leaders at the company-grade and field-grade officer levels who possess tactical equivalents to the JFC's joint mission perspective, are aware of cross-domain threats and capabilities, and have deliberate integration skills.

Early in a career, time is usually spent pursuing mastery of a single weapon system. JMCs would require breadth over depth at the cost of a single weapon system or way of war, and they will learn how to put together many weapon systems. JMCs would hone joint command, control, and communication as their weapon system and their knowledge of capabilities on the breadth of joint capabilities rather than depth of individual weapons. Their weapon system will be the battle network rather than any one node.

JMC training would enable access to an ever-growing breadth of multidomain capabilities. This will include the land, surface, subsurface, air, space, cyber, and electromagnetic spectrum effects. More dramatically, global effects are becoming more accessible to local battles. Operationally responsive space is approaching viable cost/benefit balance. The procedures for offensive cyber operations are slowly normalizing as senior leaders gain increased experience and familiarity with them. Still, the misuse of these globe-spanning domains could have grave consequences. Their use, therefore, introduces considerations rarely taken into account in tactical actions in the traditional domains, such as attribution, second-order effects, unintended consequences, interagency, and industry coordination. JMCs will be trained to account for and mitigate such consequences.

JMC training will provide depth in the control systems necessary to generate and integrate the effects from their diverse capabilities. This emphasis on effects will enable a better pairing of capabilities to generate the desired results, and a knowledge of control networks will enable execution of desired pairings. The effective employment of these advanced capabilities will engender new levels of trust and further delegation regarding these options.

Employment

JMCs will operate organizationally at the Joint Task Force (JTF) or Joint Fires Cell (JFC) headquarters level. The JFC will maintain a pool of vetted JMCs that can be deployed as the JFC's representative to manage the execution of the multidomain, multifunctional battle, from whatever node is available and provides the necessary span and breadth of situational awareness and sufficient communications infrastructure. These nodes may include the air operations center (AOC), airborne or ground-based C2 platforms, an aircraft carrier, a JTF strike cell, or tactical operations center. Missions requiring a smaller team of JMCs or a single JMC could operate from an unmanned aerial vehicle control station, the back deck of a B-52 Stratofortress, B-1 Lancer, or the back seat of a fighter jet. This agility will permit forward-deployed JMCs to reposition as the mission evolves or to posture for the next assignment.

JMCs may be assigned to a component or operate independently. All component commanders should be willing to delegate mission relevant authorities to any JMC regardless of that JMC's assigned component. That allows a JMC to orchestrate all relevant resources in pursuit of any component's mission, operation, or campaign objective while fundamentally advocating for actions that pursue joint objectives and priorities.

Next, JMCs will operate using the JFC's delegated execution authorities. JMCs would be responsible for orienting and assessing friendly forces and have tactical control to integrate effects from the air, land, surface, subsurface, cyber, and space domains. These authorities would primarily revolve around positioning maneuver assets, directing sensors, and targeting kinetic and nonkinetic effects. In the air domain, JMCs would assign, sequence, and synchronize targets. In the land, surface and subsurface domains, JMCs would primarily target, deconflict, and integrate cross-domain fires. In the cyber and space domains, JMCs would synchronize the effects packages of cyber and space mission teams. Delegating specific authorities to control these functions will involve significant decision risk—the risk that a bad decision will be made.

For a JFC to delegate, a subordinate must be highly knowledgeable about the capabilities and limitations of assigned forces, the operating environment, and the mission. Using the specialized training and joint experience mentioned above, JMCs will reduce that risk and therefore garner additional trust from the JFC.

Authority over space, cyber, and other nonkinetic authorities are usually invested in specialized headquarters and require significant coordination to employ. When organization, doctrine, and planning allow authority for these capabilities to be assigned within a JFC, they should be delegated to the JMC, not component commands. Also, every effort should be made to simplify the JMCs request for approval chain. This includes minimizing the number of involved echelons and especially removing nonessential, lateral approval, or concurrence.

Joint Mission Control in Action

Imagine a future scenario with a JMC positioned in the battlespace battle-managing a dynamic targeting mission. This JMC can receive imagery cueing to a mobile priority target and respond by directing a reconnaissance platform to sanitize the last known area. With tactical-edge situational awareness, the JMC correlates the target as the same vehicle recently reported by an F-35 Lightning II. However, the JMC sees the F-35 is currently out of weapons. To complicate matters, the F-35 reports the target is on the move. Now, with a comprehensive battlespace picture, knowledge of the problem, and the JFC's delegated joint authorities, the JMC passes the information to a cyber mission team (CMT) who, using a known vulnerability in the suspect vehicle, halts the target when it arrives in range of a Wi-Fi hot spot.[8] Once the JMC receives word from the CMT that the cyber attack was successful, the JMC directs the F-35 to reacquire the vehicle using on board sensors. The F-35 performs a target correlation, confirms the vehicle is halted, and passes coordinates. The JMC orders a fire mission from an Army Tactical Missile System and deconflicts the gun target line. The fires unit reports a time on target to the JMC who then requests an MQ-8 Fire Scout transiting the area to perform low-altitude reconnaissance for battle damage assessment. Finally, the JMC reports the mission success to higher headquarters.

Under today's construct scenarios like this one would take hours to accomplish. Even if the mission was preplanned, the timeline to clear each action through air, land, and maritime component authorities and joint cyber would be significant. These delays include the time it takes to communicate between each echelon, to replicate related messages across disparate communications methods, and the decision-making time required in each step of each process. In contrast, a JMC, trusted with joint and component authorities and empowered by improved communication, could dynamically employ a wider range of capabilities with increasingly internal rather than external coordination and thus greater autonomy and speed.

Ultimately, the JMC enables control to migrate from a single domain into an all-domain construct. To make this evolution possible, the joint force must place an emphasis on identifying, developing, and grouping talented operators; streamline C2 structures; and empower young tacticians to think and decide faster than the adversary. The joint force can no longer rely on the might of technological superiority. To win, the joint force must build a competitive advantage centered around human competencies.

"Look Down, Shoot Down"—Embrace the Inherently All-Domain Perspective

The connective tissue for joint and combined arms is who we are.

—Gen David L. Goldfein, USAF chief of staff (CSAF)

The Air Force is uniquely positioned to take the lead because "this thinking comes naturally."[9] The Air Force inherently understands the concept of a separate command and battle management element with different roles. A USAF commander does not lead his forces into every battle. Rather, a separate and specifically trained and appointed mission commander does. Therefore, the Air Force puts an emphasis on preparing those outside the unit command structure to make decisions. The next logical step is to empower these appointed officers with the authorities to tactically execute.

Serendipitously, the JMC concept outlined above aligns with two of the CSAF's top three priorities: developing joint leaders and multidomain C2. JMCs will be joint leaders and multidomain battle management takes a step beyond the USAF-centric multidomain C2 discussion into the realm of interdependent tactical employment of joint effects.

First, the Air Force must put a priority on tactical communications and C2 upgrades, especially linking existing C2 nodes across services. First among these should be increased network connectivity and bandwidth through line-of-sight IP networking between air, land, and sea nodes to enable more and faster collaboration. The USAF should also accelerate investment in security upgrades for C2 weapons systems and unit facilities to facilitate connectivity to intel sources and cyber and space mission teams that operate at higher classifications.

Second, the USAF should establish comanning linkages between organizations that constitute the theater air control system and the intelligence, cyber, and space communities.

Assigning cyber and space specialists to traditional C2 units now operating at appropriate classifications will enable education and planning for advanced multidomain integration and operations. Conversely, embedding career C2 experts into intelligence, space, and cyber centers will increase awareness of air domain needs, share procedures and priorities for information and control, and inform potential avenues for distributed mission execution. The Joint Surveillance Target Attack Radar System (JSTARS) provides an example of the benefits of such integrated manning. JSTARS crews, that include intelligence officers and Army combat arms specialists, often identify integration opportunities and achieve mission effects that would not have been pursued otherwise.

Third, the USAF should test a JMC-like position at major combat air force exercises as soon as possible. Exercise scenarios should be deliberately designed to require multidomain solutions and venues should be identified where all required multidomain resources can realistically train together (e.g., air defense artillery on an aerial range or JSTARS orbit that support armored maneuver courses). Concurrently, working position descriptions, objectives, and training should be developed. Invite joint kinetic and nonkinetic fires leaders to collaboratively train to, and execute, these scenarios alongside USAF certified mission commanders. For experimentation purposes, joint participants should be prepared to delegate significant exercise authorities to these mission controllers to validate and mature the concept.

Finally, the USAF should lead the joint force in institutionalizing joint mission control. Leveraging the lessons learned from exercises, this would include identifying career fields to fill JMC ranks, developing training requirements, establishing a skills code, and advocating for joint adoption and employment of JMC teams.

This is only the start of a conversation regarding joint mission control. The refinement of the JMC concept must be joint, but the Air Force is uniquely postured to lead the way. In an *Air & Space Power Journal* article, Dr. Jeffrey M. Reilly stated that "Airmen must have a clear and common understanding of maneuver in multiple domains beyond air, space, and cyberspace."[10] The JMC is a step toward a multidomain perspective.

Answering the Call

> *If you can't control it, you can't command it!*
>
> —Gen Hal M. Hornburg
> Former commander, Air Combat Command

Airmen have been charged with providing the backbone of decision making for the joint force, and General Goldfein has accepted that challenge. Work called for the Air Force to support the Third Offset Strategy by "connecting the sensor and effects grids through a C3I grid."[11] General Goldfein recognizes it is time for the Air Force to take up the mantle of next-generation warfare, committing the service to "bring it all together" regarding multidomain C2.[12]

As the youngest of the services, the Air Force has often played the supporting role to those services which can hold physical ground or control waterways. However, as the joint force enters the next era in warfare, moving to the multidomain mindset will mean success is heavily reliant on what the Air Force brings to the fight: advanced technology, flexibility, speed, and rapid mobility. This means the joint force must rethink what the USAF provides. The Air Force will no longer be the *supporting* service; the Air Force will be the *connecting* service.

The Air Force will lead the endeavor to connect and battle-manage all domains simultaneously. The opportunity to lead the way is now. The Air Force led the development of the last war's premiere joint position—the JTAC. Joint command and control down to the tactical level must not be neglected. Competent leaders empowered to make decisions and control joint resources are essential to integrating multi-domain capabilities. ✪

Notes

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Everyone Gets a Vote

360 Assessments and the Human Factors System

Maj Zach Fisher, USAF*

Keep your boss happy. This is the recipe for a peaceful and successful career progression. Airmen keep their noncommissioned officers happy, lieutenant colonels keep their colonels happy, generals keep the secretary of the Air Force happy, and the secretary of defense (SecDef) keeps the president happy. It's a perfectly understandable arrangement; in a hierarchical organization, orders are meant to be delivered from higher and executed down the line. The facility and precision with which those orders are executed determine who the next generation of leaders will be. Simply put, those who best adhere to their bosses' directives stand the best chance of becoming bosses themselves. Nowhere in this chain of logic do the words *peer* or *subordinate* appear. The Officer Performance Report (OPR) is the formal paper trail of officers' careers and reflects the performance in the eyes of their superiors only. By functionally ignoring the assessments of officers by peers and subordinates, the Air Force promotes individuals based on an incomplete profile at best and sycophantic behavior at worst. To change the cycle, the USAF would be well-served by incorporating a form of 360-feedback into its performance reports in the form of the Human Factors System (HFS).

The quick rebuttal to the above argument is "if you take care of your troops, they will take care of you."[1] That particular quote was from a security forces squadron commander 10 years ago, but it could have easily come from any commander you or I have ever worked for. On the surface, it makes sense: Why would people work hard for a jerk? However, there is a critical flaw: jerk or not, those commander or raters will still determine the career paths of their subordinates. Therefore, there is a strong incentive to please even a toxic leader, to make them look good almost in spite of themselves—to say nothing of their internal professional dedication. Your OPR/enlisted performance report bullets will not indicate if your boss was good or bad, but they will determine your promotions and opportunities. In our more cynical moments, my peers and I have reflected on leaders we didn't care for and wondered at what point they lost themselves, drank the Kool-Aid, and so forth. Perhaps they were great officers, and we didn't understand their vision. Perhaps they were just goons who got lucky. Or maybe people are creatures who respond to incentives.

Throughout their careers, officers are taught that awards and stratifications are the indicators that will identify high-performing officers and pave the way for career progres-

*The author wishes to express his gratitude to Maj Gen John W. Brooks, USAF, retired, who provided valuable insight and personal experience on this topic.

sion.[2] Their immediate supervisors and commanders are the ones who provide those awards and stratifications. Therefore, it is in their self-interest to get along and go along, regardless of whether the task at hand is the wisest course of action. This is a tough thing because it rarely takes the form of a dramatic, fork-in-the-road moment. Col John R. Boyd's iconic "To Be or To Do" speech was first delivered as a result of Air Force budget malfeasance that literally violated a congressional mandate.[3] But what's an officer to do when presented with a fork with less than congressional implications? I'm certainly guilty of shutting up and coloring, as are most officers I know. In general, the risk/reward balance at the small unit-level of complying or resisting favors compliance—why challenge the boss over a small decision? By the time an officer has risen to a strategic-level leadership position, the habit pattern of getting along to go along has been firmly entrenched. No matter how many stars are on their shoulders, generals have a boss to please. This is not to say that every leader above a certain level is compromised; simply that our rater input-only OPR system incentivizes pleasing the boss above all else.

It's fair to say that most of us would prefer to identify and remove a toxic leader before we find out on the cover of *Air Force Times*. Without peer and subordinate inputs in the officer evaluation process, identifying poor or toxic leaders before it's too late can be difficult. As stated earlier, most Airmen and officers will execute their duty to the best of their ability, regardless of their boss's performance. Poor officership can, therefore, be camouflaged by quality subordinates and selective statistics. The brief, summary nature of rater input-only OPRs lends itself to a bottom-line mentality that spells out quantifiable results without addressing the manner in which they were achieved. Former 52nd Fighter Wing Command Chief Matthew Grengs concisely addressed the problem: "To an outsider, that particular work center ruled by a toxic leader may look effective, simply because tasks are completed, and deadlines are met. But in the end, such leadership rots away the purpose and motivation of our great force and that damages mission success. But more importantly, it damages people."[4] Especially in larger organizations, a rater may be hard-pressed to have a finger on the pulse of each individual unit/subordinate, thereby making a bottom-line mentality not only quantifiably satisfying but also easier to execute. A pernicious effect of this mentality is that honing in on bottom-line results can negatively affect trust and relationships in an organization.[5] A 2005 Army War College (AWC) paper dedicated to studying toxic leadership echoed that assertion: toxic leaders' superiors were either ". . . oblivious to the toxic behavior, or, more likely, are so satisfied with the results in terms of mission accomplishment that they chose to overlook the human cost of getting the job done."[6] A similar 2003 AWC paper further assessed that ". . . toxic leaders are still all-too-familiar to members of the Armed Forces."[7]

Periodically, the DOD and its subordinate branches have attempted to remedy perceived ethical failings in its leaders. In 2003, Secretary of the Army Thomas E. White charged the AWC with assessing ways to detect toxic leaders.[8] After a rash of very public incidents in 2012, SecDef Leon Panetta ordered a department-wide ethics review.[9] Aside from specialized offices such as the Inspector General (IG) or Equal Opportunity Office that handle specific complaints, the only formalized tool the Air Force has to assess unit

morale and leader effectiveness is the Unit Climate Assessment (UCA). Notably, its governing regulation, Air Force Instruction 36-2706, *Equal Opportunity Program Military and Civilian*, explicitly states that its purpose is to assess their unit's "human relations climate and to make recommendations for improvements."[10] At its conclusion, the UCA report is owned by the unit.[11] At its core, it is an advisory document only. Furthermore, the UCA is only as good as its information. If operating under a toxic leader with a report controlled by the same leader, getting honest feedback is challenging. In his article, *Toxic Leadership*, Col George Reed, USA, noted that the feckless training leader popularized in the series *Band of Brothers* was a known liability, but "characteristically, no soldier officially complained to the chain of command."[12] The word *characteristically* is doing some heavy lifting here, and it provides further evidence that getting formal, honest feedback from subordinates who don't like their superior is difficult. The UCA is a valuable tool but only impacts commanders and doesn't affect their OPR—therefore, its value in improving officer development is limited.

My proposed solution is to incorporate an HFS program into the Air Force's officer evaluation system. The HFS will apply to all captains and above with rating responsibilities. To avoid favor-trading and punitive measures from offended bosses, the HFS will be centralized at a unit's respective IG office with the results provided to raters, direct supervisors, and ratees. That said, the HFS is not in any sense a replacement for attentive supervision—direct supervisors are still the first line of leadership, mentorship, and performance assessment. However, the HFS will not be a mandatory determinative factor for a stratifier—simply an additional data point, designed to offer insight into the officer's performance that the rater would not otherwise have.

The HFS will provide three ratings of a given rater by their peers and subordinates based on three questions:

1. "Is Officer X a good leader?"
2. "Does Officer X put the mission before themselves?"
3. "Does Officer X promote a healthy work environment?"

These questions are designed to produce a general impression of an officer's character, priorities, and capacity to maintain healthy relationships with people in their environment. To be blunt, the questions should indicate if the officer is potentially a toxic leader.

These criteria should be answered with one of three options: yes, no, and I don't know/no opinion (see table). The criteria and responses are simple, and intentionally so: they are supposed to provide a clear, understandable perception of the officer, akin to a thumbs-up/thumbs-down system. An overall sample size would be included in the data; the sample size is contextually critical because not all officers lead similar-sized organizations. A more complicated points-based scale (1 is bad, 10 is best) would be prone to subjective grading criteria (i.e., one person might consider a 5 as bad while others might consider a 1 for similar behavior). Additionally, results could be skewed by a small number of extremely negative or positive ratings.

Table. Perceptions of an officer's leadership abilities

Is XX a good leader?			
	Yes	No	No opinion/don't know
No. of responses			
Total percentage			

The basic point is to identify the ends of the bell curve. Most officers have some peers and subordinates who like them and some who don't, thus generating an average rating. Those officers who are exceptionally well-liked or disliked will stand out. The overall objective is not to promote based on these ratings but to provide promotion and leadership boards with additional data points when considering professional advancement. For example, an operations group commander might be rating their squadron commanders and notice that all seem to be high performers based on traditional OPR metrics. That group commander might then notice that one of the commanders has an exceptionally high favorable/unfavorable HFS and use that data to build their stratifications. In a selection board scenario, the intent is similar. While not determinative, a promotion/developmental education board could use the HFS as an additional assessment measure, either to differentiate similarly qualified candidates or identify uniquely high or low scoring individuals. The nondeterminative nature of the HFS is key here—were it to be a mandatorily scored category, it would risk the integrity of the HFS process (i.e., a unit "ganging up" on a disliked boss). Both the rater and the board would view the officer's record in totality, recognizing that the HFS is only a piece of the puzzle. By applying the HFS to both raters and boards, it accomplishes the intent of recognizing peer/subordinate feedback at both the local and organizational levels.

Unfortunately, responding to incentives poses several challenges to a 360-feedback system as well. In an ideal scenario, all members would do their jobs as best they could without consciously trying to curry favor with their peers and subordinates. Although it has the benefit of increasing organizational buy-in, the danger of employing a 360-degree feedback system is turning leadership into a popularity contest. As with any ratings system, the rater is responsible for analyzing all available data and making judgments based on that information. In the "popularity contest" scenario, a boss who is loved by their unit but doesn't accomplish the mission will likely not progress. The point of the HFS is not to encourage officers to sacrifice mission requirements to the whims of their unit but to identify those who can accomplish the mission while achieving buy-in from their subordinates. Some leaders achieve the mission at the expense of their subordinates, and some leaders achieve high unit morale at the expense of the mission—the HFS will help identify those who can do both.

Another danger is the simple fact that human beings can be capricious, petty, and subjective. Therefore, bringing in peer and subordinate feedback might mean that favoritism could come into play, and that "you get gossip, quantified."[13] The term *gossip* itself has a

negative connotation but in fact serves a useful social function and also ". . . has benefits at the group level, motivating people to act in everyone's best interests, not just their own."[14] Furthermore, we must acknowledge the reality that our current system is already subject to favoritism-—that danger just happens to reside with the rater alone. A recent corporate study found that "56 percent of large company (with more than 1,000 employees) executives with more than one candidate for a promotion already had a favorite. . . three quarters of the survey participants say they have personally witnessed favoritism where they work."[15]

While the Air Force's unique bureaucracy isn't the same as large corporations, its members are not uniquely immune to favoritism. Although the USAF prohibits favoritism, those practicing it are usually unaware that they're doing so. A recent psychological study indicated that promotion decisions can be influenced by subtle "in-group" factors; essentially that one is likely to favor someone they identify with.[16] Recognizing that all humans have the capacity for flawed judgment, it's wise to spread out the impact. If an officer's rater, peers, and subordinates all agree that an officer is doing a great job, it's a safe bet that he/she is not a toxic leader. If an officer's rater thinks the ratee is doing a great job, but that ratee's peers and subordinates disagree, there might be some underlying factors worth exploring. Recognizing that humans are flawed creatures, the HFS would aid raters in developing a more complete picture of their subordinates' performance.

In 2015, the RAND Corporation performed a study of the efficacy of 360 evaluations in the military. The study noted that all services have some form of 360-feedback tool available, but only the Army's Multi-Source Assessment and Feedback (MSAF) program has been implemented in a widespread manner.[17] Of the four methods listed for the Air Force, three are restricted to colonels or generals, and the fourth is optional, with participant-selected reviewers.[18] Most relevant to this article, the study recommended *against* using a 360-type product in evaluations, citing rater confusion and impact to selection boards.[19]

RAND's critiques of a 360 system have merit but are based on a fundamentally different set of objectives and criteria than the HFS. In general, RAND discusses 360 systems as a method of improving feedback and self-development, whereas an HFS is designed solely as an evaluation aid (however, exceptionally positive or negative results would likely drive discussions with individual raters). This is a critical difference because the most common critiques of 360 systems—complexity and time-intensiveness—result from open-ended questions designed to elicit detailed feedback. The HFS's three-question, yes/no design is a fundamentally simpler tool.

As the Army's MSAF program is the only widely-used 360 tool among the four services, RAND sensibly bases some of its critiques on the Army's experience with it: specifically, its complexity and effect on selection boards. Again, we see an inherently different set of objectives between the MSAF and HFS. The MSAF is a periodic assessment designed for leader development purposes only, incorporating a number of products and online training/assessment tools.[20] To improve that development, the MSAF requires dozens of questions and two narrative response questions. Perhaps due to its length and complexity, recent

research from the Center for Army Leadership Annual Survey of Army Leadership revealed that "66% of officers and 74% of warrant officers only initiated the MSAF to fulfill and OER block-check requirement; with self-development either a by-product or not sought after at all."[21] Additionally, the MSAF's numerical, absolute scoring method is prone to individual judgments of what constitutes a "good" score.[22] From a logistical standpoint, the inclusion of the MSAF's mass of data in selection/promotion boards (aside from the box-check indicating it was accomplished) would likely prove cumbersome for that board. RAND echoes that concern, and here again the HFS's simple format and limited scope work in its favor. By minimal effort of the ratee's peers and subordinates, it minimizes the danger of becoming a box-check and increases its chances of providing simple, yet meaningful feedback.

Although the MSAF and HFS have different means and ends, the MSAF's mere existence offers a fantastic case study in demonstrated pros and cons of the 360-type model in the armed services. Aside from its complexity and subsequent "box-checking" danger, the MSAF also allows officers to select their own survey population, resulting in potentially biased results.[23] Again, while this system may be effective as a feedback tool, the HFS's broader methodology avoids that pitfall. A more recent AWC paper echoes that theme and adds that the MSAF (like climate surveys and unlike the HFS) is not designed to identify particularly good or bad leaders.[24] Furthermore, the ". . . MSAF feedback reports are not shared with supervisors. . .,"[25] rendering them less useful from a rating/selection board standpoint.

Most importantly for this article, the RAND study notes that the services could "consider other alternatives for incorporating a broader range of perspectives, including from peers and subordinates, into the performance evaluation system—although identifying specific alternatives is beyond the scope of this study."[26] The HFS is one of those specific alternatives. By providing previously unavailable performance and feedback data without a complex, cumbersome 360-feedback process, Air Force raters can better identify both ends of the bell curve and progress those officers accordingly. Officers will be incentivized to meet this new standard to accomplish their mission while achieving buy-in from their unit.

To be clear, the sky is not falling, and the Air Force is not rife with toxic leaders to the best of my knowledge. I've been spared that particular curse and have consistently served under commanders I respected. However, that shouldn't prevent us from searching for new and better ways to pick the best leaders from a truly talented pool. Some officers are better technicians than leaders, some vice versa, some are good at both, and others at neither. If we're to remain the world's most advanced and capable air force, we must recognize that putting the right people in the right places is an essential ingredient in that mix. It's important that we get it right, and that starts by being honest with ourselves. ✪

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Counter and Cooperate: How Space Can Be Used to Advance US–China Cooperation While Curbing Beijing's Terrestrial Excesses

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The question of whether or not the US and China will clash has been in vogue among scholars, politicians, and pundits in recent years. In *Destined for War: Can America and China Escape Thucydides's Trap*, Harvard University's Graham Allison employs the Thucydides's Trap thesis to demonstrate how Washington and Beijing might arrive at the brink of war.[1] This concept dictates that whether or not a rising power (Sparta/China) intentionally provokes a conflict with the status-quo power (Athens/America), a conflagration will develop because a security dilemma will inevitably occur. As the ascendant nation grows stronger—diplomatically, militarily, and economically—it poses a threat to the status-quo power. The result is that the predominant power is more likely to use force to deter the rising power before it becomes an existential threat.

There's a profound trust deficit between China and the US. This article will propose a two-fold approach to develop trust and preserve the American interest: (1) deter Chinese excesses in the South China Sea (SCS) and (2) employ a multifaceted approach to prevent conflict from extending to space. But before diving into policy proposals, it is necessary to have a foundational understanding of China's current space policies, perspectives, and ambitions.

China's Diplomatic Power

Since People's Republic of China (PRC) President Jinping XI came to power in 2012, China's diplomatic disposition has experienced a profound evolution. Jinping XI is promoting his vision of the "Chinese Dream" and national rejuvenation, the goal of which is to reverse the "Century of Humiliation" that China suffered, from the start of the First Opium War in 1839 and lasting until the Chinese Communist Party (CCP) came to power in 1949. In testimony before the US–China Economic and Security Review Commission, Dr. Alison A. Kaufman, a senior Asia policy researcher with the Center for Naval Analyses, explained that this period provides a key foundational story for the CCP. "Today, this narrative has become a key legitimizer for CCP rule, because the CCP is portrayed as the only modern Chinese political party that was able to successfully stand up to foreign aggression."[2]

The dilemma for Beijing is how to ascend without ensnaring itself and the US in Thucydides's Trap. Previously the PRC abided by former paramount leader Deng Xiaoping's dictum of Tao Guang Yang Hui, which translates to "lay low and bide one's time." The purpose of this strategy was to fight the perception that China is an ascendant threat, incurring preemptive hostilities from outside powers. Today, however, China is much more confident on the world stage. Beijing seeks to promote its vision for the future on the diplomatic front, and space policy plays an important role in this objective. According to James Andrew Lewis, the Center for Strategic & International Studies technology and public policy program director, China's space endeavors are ". . . especially important to show that it has reclaimed its place among the leading nations of the world. China's successes in space reinforce its claims to regional dominance by demonstrating that it is the most advanced among Asian nations, with technology and resources that others cannot match."[3] China's space initiatives play an instrumental role in showing that it has returned to its place as a preeminent regional power. While China's neighbors question US commitment to the Indo-Asia-Pacific, Beijing's promulgation of a multidecade plan for developing space capabilities demonstrates its staying power and ambition.

China's Informational Power

While China's focus on diplomatic messaging travels outward, the informational element of Chinese space policy is mainly directed inward. To this day, the CCP's legitimacy is premised upon a Faustian bargain with its citizens. In exchange for economic results, social improvement, and the respect of the world, the political elite expects loyalty and acquiescence from the public. The CCP's space aspirations play a fundamental role in demonstrating the government's ambitions for China's future. They include landing a rover on the far side of the moon by 2018, landing a Mars rover by 2020, probing asteroids by 2022, sending humans to the moon by 2025, bringing Mars samples back by 2028, sending an exploratory mission to Jupiter by 2029, and establishing a lunar research station manned by robots with occasional astronaut visits by 2050.[4] Shooting for the stars keeps the Chinese people's eyes skyward and away from CCP malfeasance. To borrow Karl Marx's reference to religion, Beijing's space policy is an opiate for the Chinese masses.

China's Military Power

The Gulf War had a visceral effect on Chinese military planners. The rapid neutralization of Saddam Hussein's military demonstrated what decades of Cold War military spending were able to procure for the US armed forces, especially in the realm of command and control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR). The Chinese took this to heart and incorporated *informationized warfare* into their military doctrine in 1993.[5] Increasingly, space has become a central focus of China's national security strategy, which continues to expand outward from an immediate defense of the Chinese homeland to protecting interests overseas and even in space.

In this capacity, the People's Liberation Army (PLA) is pursuing a comprehensive space strategy to allow for it to compete with near-peer adversaries. As the US–China Economic and Security Review Commission states:

> A robust, space-based C4ISR system is often described as a critical component of a future networked PLA. The development of long-range cruise missiles and antiship ballistic missiles for over-the-horizon attacks requires the ability to locate, track, and target enemy ships hundreds of kilometers away from China's shores, as well as the ability to coordinate these operations with units from multiple services. In doing so, remote sensing satellites can provide intelligence on the disposition of enemy forces and provide strategic intelligence before a conflict begins. Communication satellites can provide global connectivity and can facilitate communications between far-flung forces. Navigation and positioning satellites can provide critical information on location and can improve the accuracy of strikes.[6]

Although China's current use of space primarily focuses on Earth, Beijing is rapidly developing its ability to conduct kinetic and nonkinetic strikes in space. Additionally, both China and Russia continue to develop systems and technologies that can interfere with or disable vital US space-based navigation, communication, and intelligence collection satellites.[7] China also has a number of antisatellite capabilities, such as direct-ascent antisatellite missiles, co-orbital antisatellite systems, computer network operations, ground-based satellite jammers, and directed-energy weapons.[8]

China's space capabilities are a key component of their Anti-Access, Area Denial (A2/AD) strategy. This strategy focuses on the ability to prevent outside powers from projecting forces into an area of conflict where China is involved, such as in the SCS, around the Senkaku Islands, or during an attempt to conquer Taiwan. If a conflict occurs, a key objective of the PLA is the ability to push the US beyond the First Island Chain (Japan, Taiwan, and the Philippines) and eventually even beyond the Second Island Chain.[9] We must plan accordingly for such a scenario.

China's Economic Power

As China's interests continue to expand outward from its shores, it seeks to build a military capable of protecting its economic interests overseas. For example, China has participated in counterpiracy operations in the Gulf of Aden since 2008 and recently established a permanent base in Djibouti to aid in this effort and serve as a PLA logistics hub for the region. This base will assist the PLA Navy in extending its reach while also securing sea lines of communication, through which much of China's imports and exports transit. Beijing also has grand ambitions in space, many of which are economical and also require protection. These ambitions include projects to start lunar and asteroid mining, bring the BeiDou-2 Navigation Satellite System network into global service by 2020 and establish a Chinese space station by 2022. Beijing even has preliminary plans for an ambitious space-based solar energy network that will use microwaves to transmit power back to Earth by 2050.[10]

In the *Strategic Studies Quarterly* 12, no. 1 edition, Dr. Namrata Goswami argues that Chinese space exploration must be viewed through the broader framework of the Chinese economy's expanding need for resources.[11] She explains that President Xi sees space

as an environment for scientific innovation as well as an opportunity to revitalize stagnant state-owned enterprises. She goes on to state that ". . . these goals are unique as they indicate a completely different view of space. Rather than just an arena for conquest and showing off, China views space as an environment in which to live, work, and create wealth through habitation and resource extraction."[12] This begs the question: how will China protect its interests in space? Leadership in Beijing will increasingly have to consider how it will secure these important economic assets in a realm where there are few laws or agreed upon codes of conduct.

Although this analysis is not exhaustive, it provides a basis for understanding China's current space initiatives and ambitions. So what kind of policy should Washington adopt to accommodate China's interests, advance our own, and dissuade Beijing from extending a potential conflict into space? An intelligent approach will be two-fold. On one hand, we should foster cooperation where our interests with the Chinese overlap. On the other, we should develop a comprehensive approach for defending our interests, especially in the SCS. The latter issue is of great importance because we must first confront Beijing's transgressions here on Earth to deter China's militaristic expansionism in space.

Proposals for US Policy

Cooperate

China's economic and military rise during the last several decades was made possible by the post-World War II economic order established by the US. However, as a great power, China is unsatisfied with the current US-led order that it did little to help shape. Beijing and Washington are increasingly at odds internationally as their competing interests and visions for the future begin to collide. New avenues for cooperation are desperately needed to foster mutual trust and create an environment where the US and China can coexist with minimal friction. Space presents an excellent opportunity for cooperation between Washington and Beijing. Our two nations will compete in this realm—there is no avoiding that. However, both parties will benefit greatly from having a standardized set of rules governing military and economic activities in space. Hopefully, if these two great powers establish a framework of behaviors and norms for space, the rest of the world will follow suit.

To start, the US should extend an olive branch. As Brian Weeden and Xiao He point out in their article for *War on the Rocks*, "Washington still hopes that Beijing can be a constructive partner for greater international space security. While China still chafes at the largely American constructed rules-based order, it likewise has a clear interest in using its development of space capabilities to promote bilateral cooperation and to play a role the formation of new international regimes."[13] While Russia seeks to undermine international space initiatives, Beijing and Washington should look toward the future and create a bold plan for space governance. This does not mean intimate cooperation, but there should be norms and codes for how government entities and private corporations

should act in space. Weeden and He go on to say that both sides should seek to establish confidence-building mechanisms to help build trust as well as processes for cooperation and deconfliction. On the economic front, private companies crave stability and clear rules. If the world's two preeminent military and economic powers establish clear guidelines early on, potential financiers will have greater confidence to invest the large up-front costs for expensive space-based projects. This leads to the next point that both sides should promote: private sector cooperation in the space domain.

It would be advantageous for both sides if private corporations in the US and China pursue space exploration together. Space-lift capabilities, space stations, asteroid mining, lunar stations, and other endeavors all require significant initial costs. By partnering, American and Chinese corporations could call upon the support of both the Chinese and US governments in seeking out new resources such as solar power, rare elements, and numerous other fields for scientific discovery that would be of great benefit to people everywhere. A private-sector partnership should be plausible as long as intellectual property rights are respected and the governments involved don't micromanage the projects. Deep US–Chinese economic integration is often cited as one reason war between our two nations is unthinkable. Why would the same logic not extend to space?

Despite the potential space holds for cooperation, there is plenty of room for conflict. While high-ranking military officials in both China and the US believe the militarization of space is inevitable, it would be beneficial to agree upon one rule up front: no kinetic strikes.[14] In 2007, China tested an antisatellite missile against one of its failing weather satellites, projecting debris that continues to threaten space-based assets to this day. A kinetic battle involving satellites would create clouds of space junk for which there is no current remedy. Both Beijing and Washington have reason to limit space warfare to nonkinetic means. If a conflict were to occur, there are a number of different ways to neutralize or affect satellites short of kinetic strikes. These methods include radio frequency jamming and lasers that can temporarily incapacitate or even completely destroy satellite-based sensors.

It should be added that spy satellites are important to building trust. Spy satellites allow nation-states to have an understanding of what their rivals are doing, at least partially allaying suspicion of the other party. A similar terrestrial example is the Treaty on Open Skies, which is primarily based around the US and Russia but claims 32 other signatories. According to the Department of State, "the Treaty is designed to enhance mutual understanding and confidence by giving all participants, regardless of size, a direct role in gathering information through aerial imaging on military forces and activities of concern to them."[15] Both sides must recognize the importance of this technology in allaying suspicions and preventing paranoia. An agreement to not target spy satellites (through a kinetic strike, jamming, lasers, or any other means) would be a bitter pill to swallow but would foster greater openness while also mitigating the militarization of space.

Counter

Any discussion that involves the US–China geopolitical rivalry will span far and wide. For brevity, this article will focus on Beijing's actions in the SCS and how space capabilities can be leveraged to advance the American interest. During the last decade, the Chinese have increasingly perpetuated the notion that 90 percent of the SCS is their sovereign waters and territory. Cartographically, this is indicated by the nine-dash line that is ubiquitous in Chinese maps, textbooks, passports, government documents, and essentially anywhere a map of East Asia exists in the PRC. In the SCS itself, this claim has been propagated with land reclamation, maritime militias, militarized islands, an increasingly assertive China Coast Guard, and forceful diplomatic initiatives.

A strategy for leveraging space-based assets to counter Chinese aggression in the SCS should contain three components. First, the US should create a task force focused on the SCS for US allies in the Asia-Pacific to allow for the integration of space assets and information dissemination. Second, we should increase our sharing of satellite imagery with the Association of Southeast Asian Nations (ASEAN) partners to allow them to better understand China's actions in the SCS. Third, Washington should pursue a quantitative increase in high-caliber electro-optical (EO)/infrared (IR)/synthetic aperture radar (SAR) and C4ISR satellites to monitor the SLOCs in the SCS better and resist China's A2/AD strategy.

After World War II, the US implemented a hub-and-spoke approach to alliances in the Pacific, forming strong bilateral bonds with Thailand, the Philippines, Japan, Australia, New Zealand, South Korea, and Taiwan. Unlike the North Atlantic Treaty Organization, there is no broad military alliance for the region. A Southeast Asian Treaty Organization once existed but was ultimately dissolved in 1977. Although most nations in the region chafe at Beijing's aggression in the SCS, forming a broad counter-China alliance would be untenable because of China's economic importance in the region, Beijing's willingness to engage in economic warfare, China's military heft, and doubts over Washington's future ability (and willingness) to maintain an international rules-based order in East and Southeast Asia.

To combat these trends, the US should create a task force for close US allies in the Asia-Pacific to integrate space assets and disseminate information that will aid in countering China's information and military campaign in the SCS. This initiative should focus on creating resilient EO/IR/SAR and C4ISR capabilities that will survive any preemptive employment of the PRC's A2/AD strategy. This includes systems to counter Chinese assets designed blind and incapacitate our satellites using radio frequency jamming, directed-energy weapons, and kinetic strike. Washington should create a framework by which long-term allies such as Japan, Australia, New Zealand, Thailand, and the Philippines can integrate space capabilities. This approach should also incorporate Singapore, a long-term friend but not a formal ally, and India, the world's largest democracy and an increasingly close partner for the US.

Second, Washington should increase its sharing of sensitive satellite imagery with ASEAN partners to allow them to make well-informed decisions in protecting their

SCS claims. The US should aid littoral states by expanding programs to share imagery from our EO, IR, and SAR satellites. Such programs are expensive and ASEAN nations rarely have the capacity or cash to develop such initiatives. Additionally, creating a unified front against Chinese expansionism in the SCS will demonstrate to Beijing that multilateral partnerships will develop to counter any similar actions in the space domain.

Third, the US should invest greater sums in the research and development for C4ISR satellites that can provide crucial intelligence on activities taking place in the SCS. These SLOCs are vital to global trade, fossil fuel imports for key allies, and freedom of navigation more broadly. The best way to prevent deception is with accurate intelligence. The current policy of carrying out freedom of navigation operations in the SCS risks a confrontation that might turn kinetic, such as the 1 April 2001 EP-3 Aries II incident near Hainan Island. Using satellites to capture imagery of China's actions in the SCS, including the deployment of self-propelled artillery and landing bombers on artificially created islands, help bring Beijing's true intentions to light without risking kinetic confrontation.[16]

Conclusion

While at the Johns Hopkins University Nanjing University Center for Chinese and American Studies, I took a class on the politics of Southeast Asia. Professor Yang Guanghai and I had many spirited debates about US and Chinese foreign policy in the region, and on the last day of class, I asked him if our two nations could peacefully coexist in the long-term. Unfortunately, his retort was one that is often heard in modern Chinese strategic thought. "I don't think it's possible because Chinese people fear America will preemptively undercut our rise." On the other hand, I recall visiting a quiet corner of Nanjing that houses the Nanjing Kangri Aviation Martyrs' Memorial, which honors the Chinese, American, and Soviet aviators who fought the Japanese invasion during World War II. The museum details the exploits of the 1st, 2nd, and 3rd American Volunteer Groups (AVG), which would later become the Flying Tigers. At this solemn location, a series of stone tablets consecrate the names and final resting place of 2,601 American Airmen who made the ultimate sacrifice while fighting alongside their Chinese brothers. Time has passed, but their memory lives on. Today, the Flying Tigers are comprised of three A-10 Thunderbolt II squadrons based at Moody AFB, Georgia. Serving in the 75th Fighter Squadron, the successor of the 2nd AVG, I see this legacy daily. It reminds me that the US and China are not destined for war and that we must not let increasing competition in space lure us into Thucydides's trap.

An intelligent space policy for dealing with China should seek to counter Beijing's excesses while simultaneously promoting cooperation between our two nations. Space holds abundant promise for the future, but the militarization of this domain would have irrevocable consequences. It is imperative that we promote cooperation in exploring space while also ensuring we are prepared to confront any Chinese transgressions. ✪

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An Economic Approach to Deterrence

2nd Lt Tucker Hutchinson, USAF

Resurgent and revisionist powers have brought a return to great-power competition. These same powers recognize the combat advantage the US military gains from its space capabilities and are developing doctrine and systems to deny and degrade our advantage in a future conflict. What mix of strategies, policies, and systems are required to strengthen US deterrence in space to dissuade adversaries from extending conflict to this domain?

The deepest urge in human nature is the desire to be important.
—John Dewey

Mr. Dewey was right—humans want to be important. World leaders are humans, too. Power makes countries feel important; therefore, "a central continuity in history is the contest for power."[1] Countries around the world desire power; however, it is China and Russia—the "revisionist powers"—who are currently the most significant threats facing the US. While terrorism has been the threat for the past few decades, the world has now turned back toward power competition. The US will have to understand its enemies and the changing landscape to adapt, deter, fight, and win successfully.

If every country wants to be powerful, why be concerned with China and Russia specifically? To begin to answer this question, an economic discussion is imperative.

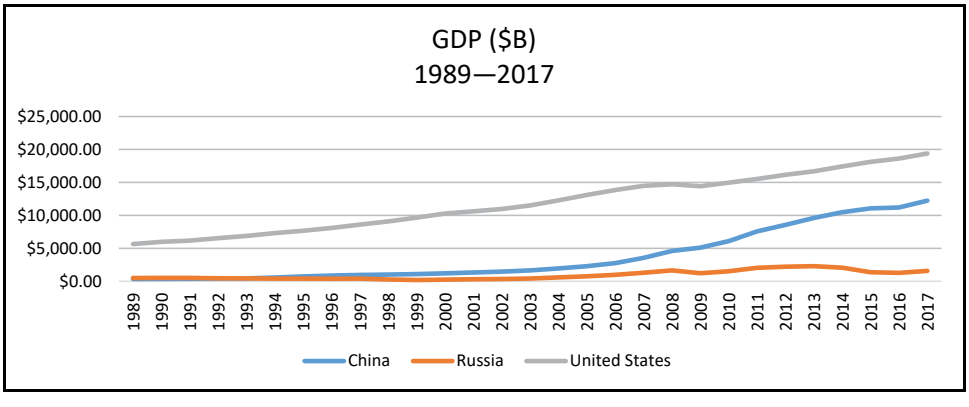

Figure 1. Gross domestic product (GDP), 1989–2017. (*Adapted from* World Bank Group data.)

The best indicator of a nation's influence is wealth. The US is the world's wealthiest nation (see fig. 1). The US GDP was more than $19 trillion in 2017. China's (the world's second wealthiest nation) was $12.2 trillion in 2017, about two-thirds of the US GDP. Russia's 2017 GDP was $1.57 trillion (the 11th wealthiest in the world). China and Russia clearly lag in absolute GDP—why are they on the American radar?

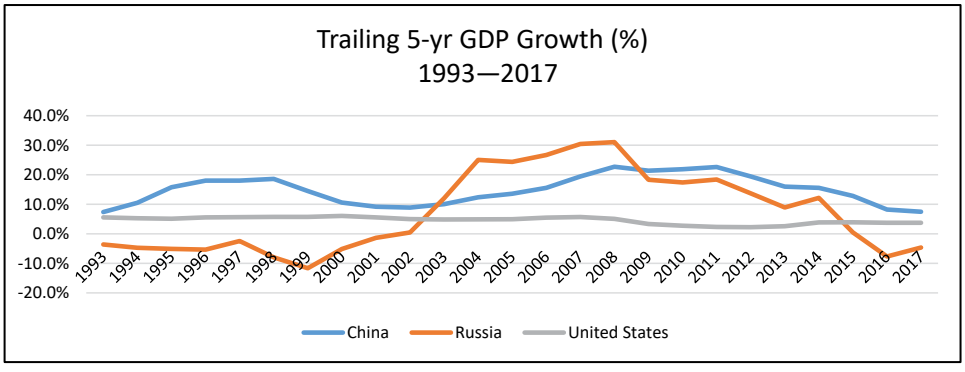

Figure 2. Trailing five-year GDP growth. (*Adapted from* World Bank Group data.)

One economic reason is GDP growth. Figure 2 shows a trailing five-year average of annual GDP growth. From 1993–2008, the US maintained an average of about 5–6 percent. Since then, it dropped off to about 2–3 percent. Compare this with China's average, which has stayed well above the US's and even reached growth above 20 percent. Russia's GDP has been recognizably volatile (even going negative) but has also reached heights above 20 percent (as high as 31 percent). China, in particular, has been dominating the US regarding GDP growth for a long time.

Table 1. World GDP survey rankings

GDP rank	Country	Survey rank	Collective defense arrangement
1	US	n/a	n/a
2	China	129	No
3	Japan	21	Yes
4	Germany	7	Yes
5	UK	2	Yes
6	India	30	No
7	France	4	Yes
8	Brazil	24	Yes
9	Italy	6	Yes
10	Canada	1	Yes
11	Russian Federation	138	No

Table 1. World GDP survey rankings (*Continued*)

GDP rank	Country	Survey rank	Collective defense arrangement
12	Republic of Korea	27	Yes
13	Australia	3	Yes
14	Spain	15	Yes
15	Mexico	42	No
16	Indonesia	52	No
17	Turkey	74	Yes
18	Netherlands	12	Yes
19	Saudi Arabia	126	No
20	Switzerland	11	No

Source: *US Collective Defense Arrangements*, Department of State; and Josh Katz and Kevin Quealy, "Which Country Is America's Strongest Ally? For Republicans, It's Australia," *New York Times*

Note: Survey includes rankings for 144 countries.

China has the second-highest GDP in the world, and Russia has the 11th-highest. China is outpacing the US at an unsettling rate, and Russia has shown signs of an ability to do the same. These facts must be considered in light of the world political context. Table 1 shows the ranking of the top 20 wealthiest countries in a survey about how Americans view the US's relationship with each of the 144 countries (number 1 considered the strongest ally and number 144 the strongest enemy),[2] and whether the country has signed a collective defense arrangement with the US.[3] Of the top 20 wealthiest countries, China and Russia are viewed as the two most hostile to the US. Furthermore, neither of the two countries has entered into a defense treaty with the US (12 of the 17 other countries have signed such treaties). These data deliver three messages—China and Russia are powerful, they (particularly China) are becoming wealthier at a faster rate than the US, and they are not friendly with the US.

US intelligence makes it clear that China and Russia are aggressively pursuing "great power competition." According to the *2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge*, China is using "predatory economics to intimidate its neighbors while militarizing features in the South China Sea" and pursuing a "military modernization program that seeks Indo-Pacific regional hegemony in the near-term and displacement of the United States to achieve global preeminence in the future."[4] Russia is attempting to gain political dominance over its neighbors, using "emerging technologies to discredit and subvert democratic processes in Georgia, Crimea, and eastern Ukraine," and "expanding and modernizing" its nuclear capabilities.[5] China and Russia are taking deliberate action toward gaining more power.

Deterrence begins with an understanding of motives. To effectively deter conflict in space, the US must first understand fundamentally why China and Russia are taking their respective actions. This article will evaluate three sources to understand their motives—(1) the joint policy from China and Russia, (2) where they spend their money, and (3) US intelligence.

On 15 May 1997, China and Russia sent a letter to the United Nations referencing their "Joint Declaration on a Multipolar World and the Establishment of a New International Order."[6] In this declaration, they made clear their intention for a new world order. "In a spirit of partnership, the Parties [China and Russia] shall strive to promote the multipolarization of the world and the establishment of a new international order. . . The bipolar system has vanished."[7] This declaration not so subtly revealed their frustration with US diplomacy, asserting that "every country has the right independently to choose its path of development in the light of its own specific conditions and without interference from other States."[8] One motive is clearly to develop a "multipolarization" of the world. This means an increase in power for more countries, namely China and Russia.

Second, spending habits reveal interests.

Table 2. GDP by end use

GDP by end use	China	Russia	US
Household consumption	39.1%	52.4%	69.1%
Government consumption	14.6%	17.8%	17.2%
Investment in fixed capital	43.3%	21.1%	16.3%
Investment in inventories	1.1%	2.5%	0.3%
Exports	19.7%	25.6%	12.2%
Imports	-17.8%	19.4%	-15.1%

Source: *Central Intelligence Agency World Factbook*, "GDP—Composition, by End Use," *World Factbook*

China spends a distinctively high portion of its wealth on fixed capital (43.3 percent). The starkest example of this investment in fixed capital is the Belt and Road Initiative (BRI). The BRI (see fig. 3) is a massive effort to improve regional connectedness through the construction and expansion of transportation networks. Its primary goal is "to build transportation networks that can help support Chinese export flows."[9]

China's desire to invest in fixed capital shows its intent to achieve economic preeminence in Asia. Expanding its economic clout allows China to achieve power in multiple respects, including greater security. "One of China's motives is to strengthen security on its western flank by helping Central Asian countries prosper—thereby, it hopes, preventing them from becoming hotbeds of Islamist terrorism."[10] A more extensive network of trade partners is certainly a step in the right direction for China's security concerns.

Russia's spending also illuminates its motives. A quarter of Russia's GDP comes from exports. Russia spends significant resources on manufacturing arms and refining its natural resources for sale to international partners. Russia sells both arms and its natural resources to China, one of its most important partners. "Russian oil exports to China more than doubled" from 2013–2016, and Russia became China's number one oil supplier in 2016.[11] "China's economic and industrial success is dependent on access to a steady supply of Russian hydrocarbons and other resources," and Russia's sale of arms "increases China's ability to punch back at the West in the event of a military crisis in the South China Sea."[12] President Vladimir Putin intends to expand Russia's ability to tap into its natural

resources; he has deemed the development of the Russian Far East (representing 36 percent of Russian territory but only 5.5 percent of GDP in 2015), a "national priority for the 21st century."[13]

Figure 3. Mapping the Belt and Road Initiative's progress. (*Reprinted from* Frank Holmes, "China's Belt and Road Initiative Opens Up Unprecedented Opportunities," *Forbes*, 4 September 2018).

The Far East is underdeveloped and underutilized, and Russia is not the only one to realize this. China is involving itself economically in the region, and "Moscow has been skeptical of Beijing's intentions in the Far East, specifically that Chinese economic activities and migration could trigger political influence and eventually territorial claims."[14] Russia wants to maintain geographic, political, and economic control of the region but also understands, albeit cautiously, its dependence on China to develop its coveted region. Apart from being China's top oil supplier, Russia also depends on China for transportation networks. For Russia, the "most significant barrier to attracting foreign capital. . . is the inadequacy of transportation infrastructure in the Russian Far East."[15] Russia needs China's growing transportation network to tap into the resources it holds in the Far East. It is clear that Russia is far more dependent on China than vice versa. Countless countries in the region are "eager for China's financing [and] welcome it as a source of investment in infrastructure between China and Europe via the Middle East and Africa."[16] Not only small countries need China's financing but also Russia—the 11th wealthiest nation in the world. Establishing itself as a provider of financing is where China truly flexes its muscle as the world's second wealthiest nation, and where the source of its power emanates. Ralph Waldo Emerson said, "A man in debt is so far a slave." In this case, the nations are becoming slaves to China. Russia and China are after the same thing—economic power. Wealth ensures security and power, and power, importance. Although their motives are aligned, it is not a balanced relationship—China holds the upper hand.

Third, US intelligence helps highlight Chinese and Russian motives. The *Worldwide Threat Assessment of the US Intelligence Community* bolsters the evidence already examined. The assessment calls out the BRI as a method "to expand China's economic reach and political influence across Eurasia, Africa, and the Pacific through infrastructure projects."[17] It recognizes Russia's use of "aggressive tactics to bolster its standing as a great power, secure a 'sphere of influence' in the post-Soviet space, weaken the United States, and undermine Euro-Atlantic unity."[18] It is important to note the recurrence of multipolarization and ultimately a desire for power. The *NSS* unequivocally states the intentions of the nations—to "challenge American power, influence, and interests, attempting to erode American security and prosperity. . . to make economies less free and less fair. . ."[19] Again, a desire for power— the great continuity in history. Not only are China and Russia pursuing their own power, but they are doing so "at the expense of the sovereignty of others," intending to "shape a world consistent with their authoritarian model."[20]

Looking at all three of these sources of evidence for motives—(1) Chinese and Russian policy, (2) economic analysis, and (3) US intelligence—tells a consistent story. All three sources make it clear that both China and Russia seek power, even at the expense of other nations. China is expanding its infrastructure and becoming the primary lender in Asia, and Russia is playing to its strengths of exporting its goods to the world. An understanding of these motives and methods will prove crucial in developing deterrence strategy.

Space now enters the discussion. What are China and Russia doing in space, and how are these actions presenting challenges to the US? The Sec. 1601 report to Congress, *Space Acquisition and Management and Oversight*, notes China and Russia "are explicitly pursuing space warfighting capabilities to neutralize US space capabilities during a time of conflict" to include "counter-space capabilities such as jamming, dazzling, and cyber-attacks."[21] Both countries are pursing "anti-satellite (ASAT) weapons as a means to reduce military effectiveness."[22] Cyber attacks have proven extremely effective, "as they are low-cost, relatively low-risk, and deniable ways to retaliate against adversaries, to shape foreign perceptions, and to influence populations."[23] These countries are taking deliberate steps to deny the US the ability to fight wars. If the US does not respond and modernize effectively, it will be hindered in numerous areas but namely its war-fighting ability. For the US, "unfettered access to and freedom to operate in space" is a "vital interest."[24] Actions to deny the US the ability to fight wars must be placed into the context of the prior discussion—China and Russia seek power, and the ability of the US to dominate in war fighting directly and substantially restricts their power in a time of conflict. Their actions to deny space are extensions of their intent to create a new international order and power landscape.

Currently, everything explored has laid a necessary foundation for understanding the revisionist powers whom the US needs to deter. But how does the US strengthen deterrence in space? Specifically, how can strategy, policy, and systems dissuade China and Russia from choosing to bring the fight into the space domain?

To deter means "to prevent the occurrence of."[25] Commonly, there are two ways to deter an enemy attack: (1) make it costly to attack ("deterrence by punishment"), or (2)

make it difficult to attack in the first place ("deterrence by denial").[26] A third and fourth method will be added here—(3) to decrease the benefits of attack (the inverse of the first method), and (4) to mitigate the enemy's incentive to attack. Mitigating the incentive is using alternative means to fulfill the driving desire of the enemy so that an attack is a less attractive option to fulfill those desires. Policy, strategy, and systems can all be used as effective tools with these four deterrence methods in mind.

The policy must be clear, unambiguous, and consistent. The US needs to make it clear that it will preserve principles of freedom and peace. In the case of this revisionist power emergence, China and Russia are seeking power over freedom. They are willing to suppress ideas and values for the sake of influence and control, and the US needs to make it clear that this will not be tolerated. At the same time, however, the US needs to strive toward an understanding and partnership with its competitors. A policy that falls too far on one end of the spectrum will fail—too harsh, and war is likely; too soft, and freedom and peace will not be preserved.

The US must pay particular attention to its economic policy, as both China and Russia strive to achieve power through economic growth. Economic policy must remain open to the greatest extent possible. Of course, when China operates through unfair trade practices, the US must call it out for what it is and punish the action accordingly. However, within the realm of legal practices, the US will hurt itself by restricting competitive and open trade. A restrictive economic policy may induce American corporations to produce more, but it creates an inefficiency in the global economy. If the US cannot naturally compete in certain industries, it should either ramp up the industry or strategically import. A restrictive policy will ultimately hurt the economy and relations with an already hostile nation. Open economic policies will strengthen US–Chinese–Russian relations and allow China's and Russia's desire for economic growth to be fulfilled. When they compete in the global economy fairly and legally, they should be rewarded and deserve the growth. When they compete unethically, they should be punished. US economic policy should make this clear. Rewarding fair economic competition may at least partially fulfill Chinese and Russian desire for power, making attacks on space assets a less desirable method of attaining that power (the implementation of the fourth deterrence method).

As discussed, Russia depends completely upon China for economic growth. First, Russia relies heavily on Chinese financing. The US must find ways to encourage Russia to turn to American lending rather than Chinese lending, especially in the Russian Far East. The lender always has influence, and China's growth in Asia has placed it in a position of power over Russia. If the US can replace China as Russia's primary lender, it can exert legitimate influence and build a strategic partnership. The difficulty will be in partnering with Russia without enabling their suppression of surrounding Eurasian states, but the US has to first establish influence before hoping to discourage such suppression. Second, Russia relies on China as a customer. The US should, therefore, buy more Russian exports. If the US replaces China in yet another area of economic dependence, it will exert influence. Both lending to Russia and consuming Russian goods can be executed with clever caution in order to shift the international political climate. Bringing eco-

nomic power to Russia while replacing China as the provider of that power may prove to be another effective implementation of the fourth deterrence method by incentive mitigation.

US space policy must clearly communicate that counterspace actions will not be tolerated. An adversary must understand that the costs of an attack or of an attempt to deny our capabilities are very high (first deterrence method). Nonetheless, a policy can only go so far and must be supplemented. Strategy and systems will put meat on the bones of deterrence policy. Strategically, the US must be prepared to respond with devastating consequences for an enemy who is willing to deny space capabilities. The first part of a strategy is to clarify which actions will trigger response and which will not—choosing battles wisely. The second part is fielding capabilities equipped to respond. Systems equipped to respond to ASAT weapons, for example, must be fully matured in light of the current threat, or strategy is hollow. Combining strategy with potent systems will reinforce policy and ultimately allow the US to deter attacks on space systems—the costs will simply be too high. In addition to fielding systems capable of responding to attack, systems that deny the ability to attack are equally important (second deterrence method). The intelligence and acquisitions communities must work in lockstep to understand what it takes to deny the enemy's ability to engage in counterspace activities. The US must prioritize rapid technology maturation and acquisition—not only in rhetoric but in a budget.

The US must also diversify its space assets, making each asset less costly if its capability were to be lost. During the US space program's infancy in the 1960s, a launch was very expensive, and it made perfect sense to load as much capability onto the satellite as possible. Today, however, launch services are becoming profitable for corporations, driving costs down significantly. This is advantageous to the government—it allows the US to launch more assets and avoid putting all of its eggs in one basket. If an enemy chooses to deny an American asset that is one of only two assets able to execute a specific mission, then the nation is in trouble. If it is one of 20 assets, then the redundancy and diversification protect the mission. If an enemy knows that its attack will not be very detrimental to the US, it is less likely to attack (third deterrence method). The US must continue to focus on driving down launch costs in order to diversify on-orbit assets.

A final piece of strategy will be to bolster alliances. The US needs to convince its allies of the urgency of the threat and encourage research, innovation, and rapid development of capabilities with the common goal of deterring China and Russia from extending the war into space. This will entail US leadership consistently engaging allied leadership and providing funding where reasonable. The US should look particularly at allies who have the ability to either shift power away from China or Russia or to strategically make the revisionist powers feel more in control without enabling true growth. For example, if a country can become a more significant consumer of Chinese or Russian goods but also a lender for smaller countries targeted by Chinese or Russian influence, it will prove to be a very strategic ally. A sense of economic growth can steer both China and Russia away from war by establishing a certain contentment with perceived power shifts in their favor (fourth deterrence method). Neither China nor Russia ultimately desires war—each desires

power. Extending conflict into space is a means to attain that power, but if the US can strategically fulfill the desire for power economically, war is less likely. US leadership must take into account these dynamics and leverage allies accordingly.

Thoughtful economic and space policy, rapid technology development and fielding, asset diversification, and goal-oriented alliances will empower the US to (1) make waging war in space prohibitively costly, (2) deny adversary capabilities, (3) reduce the rewards of an attack for the enemy, and (4) mitigate enemy incentives to attack. This mix of policy, strategy, and systems should focus primarily on systems because, at the end of the day, an enemy may decide irrationally to attack. If that day comes, the US must be prepared, and no policy or strategy will prove effective without capable systems. The US must modernize its space technologies by leveraging its international partners and industry. The importance of systems cannot be overstated. Prudent policy and strategy will serve first as buffers to the use of systems and then an implementation plan for the systems, but when power dynamics come to a head, systems need to perform.

World leaders seek importance, and China and Russia are challenging the longstanding role of the US in the international playing field. Economic motives and strategy cannot be ignored and provide deep insight into effective deterrence. Policy, strategy, and systems must be used in concert, but ultimately it will be superior systems that dissuade adversaries from war fighting in space. The US should crave this competition presented by revisionist powers and use it as fuel for improvement. When it does, the US will emerge yet again as the clear leader in preserving peace and freedom, as it always has and always will. ✪

Notes

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So Far from Home: Royal Air Force and Free French Air Force Flight Training at Maxwell and Gunter Air Fields during World War II by Robert B. Kane. New South Books, 2016, 152 pp.

Robert Kane's study explores the training of British and French pilots and other aircrew members at the Maxwell and Gunter Fields in the Montgomery, Alabama area during World War II, and, in so doing, opens a window into a relatively underappreciated but relevant aspect of US aid to Allied powers through the Lend–Lease policy. Kane identifies the Goodwill Act of 1938 as the origin of American interest in training foreign pilots, and Lend–Lease allowed a vast expansion of the concept and the inclusion of more pilots, especially from Britain, France, and China.

Appropriately, the early section of the book provides a primer on the emergence of Lend–Lease, since it was Lend-Lease funding that was arranged to defray Army Air Force (AAF) expenses in conducting the training. One of the early hurdles in establishing the aircrew training program under Lend–Lease auspices was that " 'training' was not a weapon, a piece of equipment, a munition, or defense information as specified in Section 2 of the Lend–Lease Act." This obstacle was overcome by a liberal interpretation of the still-fresh Lend–Lease Act by Attorney General Robert Jackson (p. 19). British pilots represented the lion's share of those foreign nationals trained under the project, and about half of the Britons trained in the US were trained directly by the AAF, while the remainders were trained in contract schools.

Following a replacement training phase that was renamed "Pre-Flight School" in early 1942, crewmembers were given nine weeks of primary education in flying and landing light aircraft, followed by nine weeks—including night and formation flying at a basic training school— followed by 11 weeks of advanced training to perfect skills in formation flying and to learn aerial gunnery. British elimination rates were closely comparable to elimination rates for aspiring US pilots, although contemporaries apparently considered the initial elimination rates to be high. Although French students brought language challenges and required the introduction of translators, Free French policies for selecting personnel for training compensated for this challenge by sending particularly eager and diligent students to the US for pilot training.

Kane makes special use of the historical records in the Air Force Historical Research Agency located at Maxwell AFB, as well as area newspapers, to provide a picture of the formal training and also conditions for the trainees and relations between them and the local population. The author finds that cultural differences, both for the British and the French trainees, did arise but they generally represented more in the way of novelty than difficulty. The book momentarily observes that French cadets "could not understand why Americans like American jazz, given the dislike of some Americans for blacks (p. 74)." There is no other reference to race relations or the foreign trainees' impressions of the issue anywhere else in the book, although it is difficult to imagine that the foreign trainees did not take note of contemporary segregation policies.

The author acknowledges that trainees came to the US from more than two dozen other countries in addition to heralding from Britain and France. Kane explains that he chose to focus his study on British and French training, however, because the 12,300 and 4,100 of these respective nationals constituted three-quarters of all the foreign aircrews trained in the US. The training effort for British pilots provided "a bridge between the start-up of the flight training" method of the larger British Commonwealth Air Training Program (p. 79) and the more modest number of French pilots trained nonetheless represented "undoubtedly 'a substantial fraction of the existing French Air Force'" by the close of the war (p. 76). While interested readers will be disappointed that more information is not provided about the other foreign nationals, including 2,000 Chinese and 1,500 from various Latin American countries who were granted wartime training in the US, Kane offers a brief section at the end of the book that describes more

modern professional military education for foreign pilots, and the book is supported by nine helpful appendices.

In conclusion, in its study of British and French experiences in the Maxwell AFB area, *So Far from Home* sheds some important light on the topic of foreign pilot training in World War II. As such, it deals with the history of Lend–Lease in a way that is too seldom done, and it touches on interesting and important issues related to the maintenance of international coalitions through avenues such as training and professional military education.

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A Great Place to Have a War: America in Laos and the Birth of a Military CIA by Joshua Kurlantzick. Simon and Schuster, 2016, 336 pp.

The author, Joshua Kurlantzick, takes his title from a quote by the deputy director of the Central Intelligence Agency (CIA) in 1966. If this was indeed a serious observation, it is never explained. However, the book's subtitle introduces its actual focus: Laos was the first of many CIA-run wars, followed in subsequent decades by others in Central America, Africa, and the Middle East. After 15 chapters on CIA station chiefs and operatives and their support of the charismatic Hmong leader Vang Pao in Laos, the author provides a litany of the later conflicts in just one chapter. In other words, you buy the (lengthy) premise, you buy the (much shorter) conclusion.

The book is rich with narratives gleaned from interviews with CIA station chiefs, colorful CIA agents, antiwar activists, and even Vang Pao himself. The author paints a vivid picture of the clashes between the various US Ambassadors to Laos and the CIA as each tries to influence the war on the ground. Eventually, both have to resort to more and more airpower to stem the North Vietnamese advance.

However, he fails to frame the conflict with even a simple map of Laos, much less a map of the book's primary setting, the Plain of Jars (PDJ). The reader must rely on the author's word pictures about distances, places, or search for a map to fully understand what went on there. He mentions the rest of Laos only in passing: ". . . US planes flew attacks on targets that had little to do with the Hmong's survival against North Vietnamese supply lines. . ." An annotated map would have shown that those "supply lines" were in fact the very extensive Ho Chi Minh Trail along Lao's eastern border, stretching into South Vietnam and Cambodia.

The US Air Force gets short shrift in this narrative, as its story gets muddled by contradictions and a decided lack of primary sources. The author observes that ". . . the American bombing runs almost never paused," on the PDJ, but notes there were numerous periods of monsoon weather that made air support impossible there. Early on, he trots out tired, meaningless clichés gleaned from secondary and tertiary sources disguised as statistics. He cannot resist using the worn "one bombing mission every eight minutes for over ten years" metaphor to create an image of constant bombardment, and he quotes cluster munitions dud rates even though he has no primary source for such data (hint: no one does). He also asserts (twice) that the PDJ was "the most heavily bombed part of Laos," despite a 1975 Congressional Report that indicated more than five times greater tonnage was dropped along the Trail than in and around the PDJ.

A Great Place to Have a War provides little new scholarship about the Laotian war, but is eminently readable as a study in personalities such as US Ambassador William Sullivan and Pao. When the author tries to explain military operations, he is hamstrung by the opinions and prejudices of others. Military readers should enjoy the narrative, but look elsewhere for hard facts.

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Apollo Pilot: The Memoir of Astronaut Donn Eisele by Donn Eisele. University of Nebraska Press, 2017, 184 pp.

The 1961–75 National Aeronautics and Space Administration (NASA) Apollo space program brought to the fore unparalleled technological advancements and human ingenuity. For many, this is perhaps best highlighted by Neil Armstrong's "That's one small step for man, one giant leap for mankind" with Apollo 11. With these triumphs came great losses, such as the tragedy with the Apollo 1 fire on its launch pad and failure with Apollo 13 inability to land on the moon.

The entire Apollo mission sparked scientific and economic innovation within the United States and the excitement of the world. For those born after that era, it is difficult to have a similar point-of-reference for what was undoubtedly a series of watershed moments in a time of social and political turmoil. It is important to remember that what is often overlooked are the contributions of the other Apollo missions than those noted above during its 14-year history. Although they may not have the historical impact as the first steps on the moon, the efforts of the thousands of men and women who took part in developing and implementing this project were critical to those steps and the program's overall success.

Apollo Pilot: The Memoir of Astronaut Donn Eisele is a memoir by Col Donn Eisele, a former astronaut and Air Force pilot, and focuses on preparing for and experiencing spaceflight with the Apollo 7 mission. This mission, which included Wally Schirra and Walter Cunningham, offered a series of firsts for NASA; for instance, it was NASA's first manned Apollo flight and first manned flight with the Saturn IB rocket. In addition, Apollo 7 served as the first manned NASA flight to feature a live TV telecast. Those "firsts" aside, *Apollo Pilot* gives us a flavor of Colonel Eisele's perceptions and observations of his life before and during the mission.

A light and easy read, it is a fast-paced account of Colonel Eisele's life, including his perspectives of his time as a young man, joining the military, being selected as an astronaut, preparations for spaceflight, and the immediate aftermath of his return. The book itself offers a foreword by Francis French, an afterword by Susie Eisele Black, and a historical overview by space historian Amy Shira Teitel. Ms. Eisele Black, Colonel Eisele's second wife, gave Mr. French, a director of the San Diego Air and Space Museum and author, access to his personal papers and affects after the colonel's death. The result is a presentation of Colonel Eisele's voice; we can imagine his words, and those around him, through his remembrance of moments both monumental and mundane. *Apollo Pilot* offers several charming observations: there are discussions on the intricacies of astronaut health examinations and the sheer majesty of viewing the earth from orbit, and there are moments of self-reflexivity on his role in the program and, by extension, history. We are fortunate to hear his words, and those of others, with the timing and tenor of how people during that time talked and viewed the world around them.

What Colonel Eisele's story lacks is further contextualization of the times in which his story occurred. As someone removed from that time in history, readers such as myself would have benefited greatly from a contemporary reflection of the social and political issues at the various points of time in the memoir. Mr. French and Ms. Teitel's chapters, while helpful in framing the discussion, leave this reader wanting more as to how Colonel Eisele's story fit into that historical moment in time. Readers were left to fill in many gaps with Colonel Eisele's own observations or suggestions. Ms. Eisele Black's afterward provides some personal context but reads largely as her dissatisfaction with how she and Colonel Eisele were treated by the NASA community after he divorced his first wife. This divorce, due to his extramarital affair and marriage to Ms. Eisele Black, may be inconsequential today to a career but dirtied the heteronormative discourses surrounding wholesome, all-American family men who served as NASA astronauts. Indeed, Colonel Eisele himself discusses at length the personal and political ramifications of his compatriots'

martial affairs. Again, we are in no position to fault a man for his personal decisions 40-some years ago, but its implications cloud Colonel Eisele's account to a minor degree and Ms. Eisele Black's to a large part.

As with many memoirs, we are given several pictures of the author and the events depicted in the text. However, *Apollo Pilot's* editors do not fully note who is who in many of the group photos. Colonel Eisele is identified in some but in group shots with his fellow astronauts Schirra and Cunningham, the individuals are not identified by name. This is a minor observation but is noticeable in its absence. Another odd convention is not capitalizing "Air Force" when referring to the service; such use makes it stand out and muddles its use in the text. Granted, these are very minor issues but they do stand out as odd copyediting choices.

Apollo Pilot offers its readers a taste of the grandeur surrounding our nation's history that can leave readers wanting more. The book hints at the epic-scale of a national program designed to inspire the world—while only briefly noting its service as a foil to the Soviet Union's own space program. While lacking in some regards, *Apollo Pilot* is successful in opening the door to an underappreciated part of a remarkable story and serves as an entrée into the history of the American space program.

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Ecologies of Power: Countermapping the Logistical Landscapes and Military Geographies of the U.S. Department of Defense by Pierre Bélanger and Alexander Arroyo, MIT Press, 2016, 448 pp.

Pierre Bélanger and Alexander Arroyo's analysis focuses on the aspects of DOD operations that are constructive and visible in the process contravening the fashion in war studies of foregrounding (to the extent possible) covert operations, state secrecy, and the destructiveness of military force as emblematic of modern war.

As a landscape designer and critical geographer, respectively, the authors are primarily interested in how the US military's global logistical chain, and the technology-laden operational approach it supports, produce spaces: the various ways in which the parcels of our world are defined and made different. The focus of the text is therefore not on warfare as such, but on the various political, economic, and material factors that coalesce together to set the terms under which contemporary conflict occurs and shape the form it takes; war, along with various other social and political aspects of our world, are the products of complex, interlocking ecologies. This foundation, engaged as a complex arrangement of factors that are both material and social, give rise to both the operational considerations of modern warfare *and* the threats which hallmark it. Although the text is designed to elicit reflection on how conflict constitutes itself, rather than provide the ultimate "closure" of an argument, the agenda it sets for itself is nonetheless ambitious. The text accomplishes its goal of creating opportunities for the reader to question why modern warfare is approached the way it is on the part of both the DOD and its enemies, but its lack of engagement with the literature on warfare itself hampers the effectiveness of the argument.

The key weakness of the text is that it does not define what war *is*, even though a key aspect of the text is to disrupt prevailing understandings of what warfare is and how it constitutes itself. The problem is that the text asserts, without elaborating, that how we think about warfare today is bereft of particular kinds of nuance. This is an element of its genre—a spate of critical work that seeks to unsettle ideas about complex phenomena like war and replace them with broader, less deterministic and more dynamic ways of thinking. Even so, without clearly defining what exactly is being disrupted, the text comes to rely on a series of seemingly arbitrary differentiations that is apt to strike those familiar with military affairs as either unproductive or unoriginal. For example, the chapter on improvised explosive devices (IED) illustrates how operations in

both Iraq and Afghanistan are heavily shaped by the transportation networks upon which International Security Assistance Force (ISAF) and coalition forces either rely upon or are required to create as part of ongoing stability operations. It would seem, according to the layout of the text, that Bélanger and Arroyo do not consider these operations part of modern war fighting, a fairly odd assertion that would be better served had it been placed in the context of contemporary war studies. Further, the chapter discusses the various tensions created in Afghanistan by the ISAF's support of agricultural reform, which is linked back to IEDs, and the resurgent Taliban. Again, it is seemingly arbitrary to insist that this is not war, nor part of war, in the current context. Further, the idea that weapons systems are a function of their context is all but a cliché without more elaboration on the theme. When the text turns to an analysis of communications related to ongoing unmanned aerial vehicle (UAV) operations, the insistence that this is not warfare becomes all but untenable. To recapitulate, Bélanger and Arroyo's text is designed to disrupt the assumption that modern conflict is separate from global economic flows, sociocultural context, and other aspects of our world, but it is not sufficiently clear what, and how, it is accomplishing this without a clearer articulation of war as understood in a more conventional sense.

Defining its disruptive focus in more specific terms would have allowed the rather impressive elements of the argument to carry more force and perhaps have more impact on practitioners. For example, the chapter on nutrition, namely the prevalence of chocolate milk as a staple of combat soldiers' diets in theater, is excellent. By tracing how chocolate milk has become an essential part of combat nutrition, Bélanger and Arroyo bring to light the contingency and impact of otherwise seemingly banal elements of the Western way of war. Providing soldiers chocolate milk is not merely pragmatic, but is supported by a massive logistical infrastructure summoned into existence by cultural preferences and the political economy of defense procurement. In this way, the chapter successfully disrupts the idea that everything we provide our Soldiers is a necessity in the strictest sense, opening the door to reflection on why we chose to provide other things and sustain the massive logistical networks required to provide them.

Ecologies of Power is an interesting text that accomplishes some of its goals. However, its avowed goal of studying those elements of the modern DOD that are unrelated to direct conflict rests on an incomplete analytical apparatus. The focus of its disruptive energies is not clearly articulated, and as a result many familiar with military affairs are unlikely to respond in the way the authors intend. Even so, it's truly an original form of engagement with the question of modern warfare providing a productively disruptive rejoinder to the common sense of military affairs, as evidenced by its military history of chocolate milk.

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Wings of Valor: Honoring America's Fighter Aces by Nick Del Calzo and Peter Collier. Naval Institute Press, 2016, 264 pp.

The American public has been fascinated by aces—aviators who have downed at least five enemy aircraft—since the term first came into use during World War I. As of May 2015, only 76 American aces still lived. In this book, author Peter Collier and photographer Nick Del Calzo have given us a lasting tribute to these men. According to Del Calzo, who took most of the accompanying portraits, their goal "was to pay homage to and immortalize America's fighter aces and their aerial combat achievements, which represent a significant historical period in military aviation history" (p. xi). This is important because the ace is "an endangered species. American air superiority has become so complete and the technology of unmanned aircraft so crucial to military strategy that it is hard to imagine a future air war that will produce a new generation of Aces" (p. 2). As a testimony to their dwindling numbers, many of the 82 men, all members of the

American Fighter Aces Association, featured in this book have passed away since their interview or photographic session.

This is a handsome large-format (9 x 12-inch) coffee table book. Each man is given a three-page spread that includes a biography and account of his aerial exploits. A wonderful photographic portrait of the man completes each entry. These portraits are the most striking features of the book. Many of the recently taken images are juxtaposed against older images of the man in uniform or with his airplane. The men face the camera confidently; many are well-dressed and sporting military or aircraft lapel pins, and some display their medals. Each portrait exudes pride and strength. While it is impossible to do justice to each ace featured in the book, an overview is appropriate.

The men scored their aerial victories in World War II, Korea, or Vietnam, with some scoring in more than one war. That the men were successful leaders is evident by the higher ranks achieved by most of them; a few achieved flag-officer rank. The US Army Air Forces, USAF, USN, and USMC are all well-represented in the book.

Many of the men were wounded, some severely, and several were shot down. Some were taken prisoner. James Low (USAF), a Korean War ace, for example, was shot down while flying F-4s over North Vietnam; he spent a year in the "Hanoi Hilton." One pilot, Barrie S. Davis (USAAF), actually met the man who shot him down 66 years earlier. At least three of the men, John T. Crosby (USN), Willis E. Hardy (USN), and Jeremiah J. O' Keefe Sr. (USMC), achieved the remarkable feat of becoming an "ace in a day," having shot down five enemy aircraft in a single day. On the opposite end of the spectrum, Charles G. Cleveland (USAF) had to wait 55 years for his final "kill" to be confirmed before officially became an ace. Alexander Vraciu (USN) already had 12 Japanese aircraft to his credit when he downed six more in an eight-minute span on 19 June 1944.

But it took time and experience for the men to develop and hone their aerial combat skills. Consider the experience of Clarence A. Borley (USN) after flying his first combat mission during what became known as the Great Marianas Turkey Shoot:

He headed back to the carrier and saw his exultant squadron mates congregated on the deck of the carrier, nearly all of them having shot down at least one Japanese aircraft. Borley was chagrined: "I had to confess to my utter shame that I had not fired a single shot. . . . In the excitement and confusion of my first aerial combat, I had forgotten to charge my guns" (p. 26)!

It's not surprising that these men earned a large number of medals for bravery; indeed, at least four of them, Jefferson J. DeBlanc (USMC), Joseph J. Foss (USMC), Robert E. Galer (USMC), and James E. Swett (USMC) received the Medal of Honor for their heroic feats. Many readers will be interested in the story of Fred F. Ohr (USAAF), a Korean-American whose surname was originally Wu. Ohr battled occasional bigotry to become the nation's first Korean-American ace. A sense of humor comes through for some of the men. According to Henry Meigs II (USAAF/Kansas Air National Guard), "Flying is the second-biggest thrill in life. The first is landing" (p. 155).

Action is not limited to the air. Some of the men endured terrible ordeals after being shot down. Steve N. Pisanos (USAF) worked with the French Resistance behind enemy lines. Billy G. Edens (USAF) was shot down four times, finally enduring a savage captivity in Germany. Other men floated in rafts, helpless, until they were finally rescued by friendly forces.

The foregoing is, of course, just a sampling of what is in this book. The format allows the reader to read one or two biographies at a time; there is plenty of action and history to keep aviation enthusiasts informed and entertained.

After reading this book, perhaps the reader will agree with Clarence F. Anderson (USAF), who, speaking of the 357th Fighter Group, the unit in which he served during World War II,

said, "We weren't like other people. . . at least not in our own minds. We were bolder, smarter, more spirited" (p. 7). There is no doubt that these men had something extra, something special.

(**Note:** For the men mentioned above, their service affiliation at the time of their discharge is given here.)

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The History of Human Space Flight by Ted Spitzmiller. University of Florida Press, 2017, 633 pp.

There's a lot to cover in a book claiming to capture "The History of Human Space Flight." With that lofty goal in mind, Mr. Spitzmiller does an admirable job. The book stretches from the eighteenth century ballooning into the present day of the human-inhabited International Space Station and tacks on a minor chapter, "Where Do We Go Next?" Most of the anecdotes from the missions are pulled from reliable sources and listed in a sizeable bibliography in the book's back matter. The chapters are divided by subject, but any knowledgeable reader will also recognize the chronology inherent to the technological developments in space flight.

One of the unique approaches to this text, aside from the seamless inclusion of eighteenth century ballooning and the "preastronauts" is the author's use of "sidebar" text boxes to explain concepts as you go. By including them in-line with the text, the additional text saves the reader from having to wade through a glossary or appendix while reading.

The standard fare of the Golden Age of Spaceflight is present—Mercury, Gemini, and Apollo are given good representation, just as the Soviet spacecraft (e.g., Vostok and Soyuz) and Salyut space station are likewise presented as a corollary. A required introduction on the design of reusable spacecraft is present, showing contributions from lifting-body technology and a footnoted X-20 DynaSoar. The early years of the shuttle program are covered adequately, as a lead-in to the Hubble, Mir Space Station and International Space Station missions that helped define the program.

The Cold War competition between the US and Soviet Union dwarfs the entire book and rightly so. But in the decades after the post-Cold War thaw, the newest entrant to human space flight—the People's Republic of China (PRC)—is given a scant four pages and one photograph. While the number of PRC missions have been few in the last decade, once the "sleeping dragon" awakens their contribution will presumably march parallel to the strides taken by the US and Russian programs, opening up a tricountry competition toward space exploration and exploitation. More attention on their program is needed.

If there is any thesis-level fault in Mr. Spitzmiller's text, it is within the concentration on the US's "public" space program, and neglecting the push by the National Reconnaissance Office (NRO) in the human space flight program. Inside the book, there is one identified reference to the NRO, in supporting the first shuttle launch (p. 514). Details surrounding the Manned Orbiting Laboratory (MOL) and its 71-inch optical camera have been declassified since 2015, though the crews and space hardware had been publicized decades before. Where most of Spitzmiller's text talks about human endurance and research in the public space program, the MOL program was specifically designed as a "manned spy satellite," a radical departure from previous flight adventuring objectives (e.g., Gemini for rendezvous and Apollo to the Moon). While the plan for a crewed spy station was a tacit agreement with the Soviets after MOL, the idea was buried by the US but briefly flirted with inside early shuttle planning documents. The Soviets, however, launched their Almaz series of military space stations.

Additionally, the direct influence of the NRO on the shuttle program is also ignored. Spitzmiller states, "The Air Force wanted a [60-foot] long by [22-foot] wide payload bay that allowed up to 50,000 lb. to be delivered to LEO." (p. 490). These dimensions were comparable to

the KH-9 HEXAGON reconnaissance satellite, which came on-line in 1971, just as the shuttle design was being discussed. Dr. Hans Mark, director of the NRO (1977–79), stated quite bluntly in an oral history transcript, "The shuttle was in fact sized to launch HEXAGON. The size of the payload bay was determined by HEXAGON." The Military Spaceflight Engineer program is similarly excised from the shuttle program overview. Knowledge of the institutional momentum inherent in the NRO's history is paramount for any military space professional. Ignoring their influence and contribution just does a disservice to future researchers trying to rectify the nation's "three" space programs—NRO, military, and civilian.

Minor factual errors persist in the text, but some are artifacts of space history reporting, not of Mr. Spitzmiller's own research. For example, the designation of Dr. Guy Bluford (colonel, USAF), as the first African-American in space (p. 519) versus the first African–American astronaut for example, was only altered in 1997. The "first" mantle was bestowed upon deceased MOL astronaut Maj Robert H. Lawrence Jr. after intense administrative review and organizational acknowledgement.

One area recommended, if the book receives a second printing, is an appendix (or appendices) with tabular listing of *all* human space flight missions and deceased space farers. A listing of mission names, dates, personnel aboard, and mission goal would help readers cross-reference information quickly. The shuttle era and its 135 missions would receive greater appreciation from readers with such a listing, comparing them with previous crewed missions. These minor errors and oversights aside, Mr. Spitzmiller's book is a worthy addition to any space professional's personal library, and would be an excellent text in any undergraduate space history class.

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Flying Man: Hugo Junkers and the Dream of Aviation by Richard Byers. Texas A&M University Press, 2016, 264 pp.

Richard Byers successfully categorizes Hugo Junkers a German engineer and aircraft designer, into the role he played in the development of aviation versus that of assisting the Third Reich. The latter was a more common portrayal resulting from the vast numbers of Junkers-titled aircraft the Luftwaffe used during World War II. The Australian-born European history professor illuminates the constraints levied on Junkers due to the large cost of advancing aviation technology combined with a tepid demand for a maturing commercial aviation concept. At the time, an airplane ticket cost four times more than a train ticket, with the latter being a more reliable and comfortable option (p. 73). Further, Junkers's intransigent personality negatively affected his business decisions.

Byers explains how the Junkers's model, led by its creator, fared in evolving a nascent aviation capacity during unstable economic times. The model prioritized research and development using patent revenue as a primary source of income. Doing so enabled small batch production and a reduced dependence on sales for organizational survival (p. 4). The model did not generate the private income needed, forcing Junkers to pursue government funding and subsequently become beholden to government priorities. Unfortunately, he felt the government trended in the wrong direction, placing him in the delicate position of maximizing government funds while pursuing his own agenda. Surprisingly, despite his obstinate nature and retention of reckless subordinates in pivotal positions, Junkers succeeded at this undertaking until the German government lost patience and pressured him into renouncing all claims to his aviation patents. He died shortly after that in 1935 at the age of 75.

Flying Man is a worthy read, but Byers occasionally offers conclusions beyond his research. For example, he concludes that Junkers's tale demonstrates the erosion of individual power and initiative within the aviation community as technology matured and became a viable instrument for the state (p. 5). Perhaps, but it was Junkers who ran out of funds—forcing his collaboration with the German government to remain solvent. He also proposes that Junkers built the flower bed from which Soviet aviation blossomed (p. 64). Maybe. Byers provides enough evidence to make that assertion plausible, but not proven. Still, Byers succeeds in authoring a scholarly work that examines Junkers's life for non-German audiences and showcases his considerable contribution to German aviation development—which clearly did not include equipping the Third Reich with Junkers's aircraft.

The prospective reader should be aware of two points. First, the work is advertised as a scholarly biography covering the entirety of Junkers's life—and it does. But Byers spans Junkers's first 50 years in a mere six pages, with the rest of the volume covering his final 25 years. Second, a "concern" as it relates to Europe, and especially Germany, is a business structure whereby a number of separate plants are subservient to a parent company from an economic—not action-execution—standpoint. Byers uses this denotation for concern often, expecting the reader to seamlessly follow.

This book will suit the aviation enthusiast as it gardens well an area previously only lightly tended. As well, any acquisitions professional, whether a builder or buyer, will have empathy—both favorable and unfavorable—for Junkers and the obstacles through which he maneuvered. Lastly, the balance and tension between private industry innovation and government marshaling of private industry inventions will resonate. Hugo Junkers endured that precarious relationship, helped pave a definitive path for German aviation, and did it while remaining beholden—albeit precariously—to the Junkers model.

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