AEROSPACE POWER FOR THE 21ST CENTURY

RESEARCH

Future Trends

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The Challenge

Individuals engaging in tomorrow's aerospace domain, whether at the tactical, operational, or strategic levels, will face a future far different than what they experienced in the past. The last century saw aerospace power ascend in the industrial age, when the state of the art was governed by mechanical prowess. The United States held a key advantage in this era given its innovative talent, industrial might, and fiscal resources. However, advancing aerospace advantages in the information age will yield a different set of challenges. Future success will increasingly go to the actor who can best gather data, process it into actionable information, and team with other partners in a real-time fashion.

THE CHALLENGE

The United States Faces Significant National Security Headwinds...

The United States faces significant national security headwinds, the likes of which it has not seen since the Cold War. Whether considering technological challenges, industrial base considerations, or basic fiscal realities, adversaries are rapidly eroding security advantages enjoyed by the US over the last several decades. Aerospace power empowered by the attributes of the information age will allow the US to pursue strategies that will yield effective, prudent policy options amidst these new realities.

Nations seeking to compete against the United States, especially China, are aggressively leaning forward in developing new technologies, gaining mass production advantages, and committing significant funds to defense. For example, when it comes to hypersonic flight, which involves flying over five times the speed of sound, the US is no longer the clear-cut leader. China, Russia, and others have prioritized fielding hypersonic missiles that would easily defeat present US defensive systems. Forward bases, space and cyber facilities, ships at sea, amphibious forces, and other important targets would find themselves exceedingly exposed to such a threat—a truly game-changing development. Competitors have also sought to make gains in military technologies once the sole purview of the US. Investment areas include stealth fighters, stealth bombers, and advanced command and control networks empowered by a broad array of sensors and computing power.

From an industrial mass production vantage, China now stands as the dominant supplier for much of the globe. This portends significant consequences for America's defense sector, with alternate sources for key technologies difficult to find. Computer circuit boards stand at the top of this list. Domestic suppliers have nearly vanished in the face of China's systematic quest to match low pricing with volume production. The situation becomes even more complex when the subject of rare earth metals is introduced into the equation. Just

as a US citizen would find it nearly impossible to purchase a smart phone free of Chinese components, so too does the US military when it seeks to buy the tools necessary for operations in the information age. The key takeaway from this reality is that the US no longer enjoys the production advantage it once enjoyed. The forces it will need to deter, fight, and win tomorrow must be procured today.

Financially, while global economic trends are difficult to forecast, servicing the burgeoning US debt and rising mandatory federal budget spending will challenge the availability of resources for defense and related priorities like science and technology research. In the decade following the Cold War, leaders aggressively cut the scale and scope of aerospace forces. After the attacks on 9/11, defense resources were overwhelmingly focused on land operations in Afghanistan and Iraq. Thirty years later, aerospace forces, the very tools

necessary to address top national security threats, are in dire need of reset. The Air Force has never fielded such a small and old fleet of aircraft in its entire history. A force that averages over a quarter of a century in age, well before the rise of wireless connectivity and ubiquitous processing power, will find itself woefully ill-equipped to survive against modern threats. Concurrently deprived of mass forces, this is a disastrous set of circumstances. Modernization is imperative, but investments must be prioritized prudently to ensure available resources yield leaders the most effective set of available options.

In combining the net effect of these dynamics, the US will face highly capable adversaries that may enjoy the benefits of mass and increased lethality. In many ways, the circumstances mirror those that faced the United Kingdom in 1940 during the Battle of Britain, when Germany attacked England with a superior force than that possessed by the Royal Air Force (RAF). Victory for the British forces hinged upon information. Radar and a robust ground spotter network empowered command and control centers to precisely guide limited British fighter aircraft to intercept attacking bomber formations. Ensuring available defenders were at the right time and place was crucial in boosting mission effectiveness and efficiency. These same principles will prove essential to US aerospace forces in the modern era. Harnessing incredibly capable sensors, processing power, and real-time connectivity will allow the right assets to partner real-time to net desired objective in an incredibly effective, efficient fashion. While this is not a new concept in warfare, modern technology is radically enhancing the potential behind this approach. Cognition and partnering will be the key to victory.

Aerospace Power Affords Key Advantages

In looking at the future national security environment, aerospace power stands forth as a key priority, for it allows commanders to secure desired effects rapidly, while projecting minimal vulnerability. “Flying over, not going through” an enemy force is a tremendously important capability that stands in contrast with surface operations, which move at a far slower pace, are easier to target, and risk playing to an enemy’s strengths when in their respective home regions. As the past two decades in Afghanistan and Iraq showed, a surface occupation is far from easy to execute, nor is it a guarantee to deliver desired results. In many ways, the strengths aerospace power brings to the fight can be summed up in a simple statement: global vigilance, global reach, and global power.

KEY ADVANTAGES

Aerospace Power is a Fundamentally Unique Tool

Aerospace power is a fundamentally unique tool in its multiple forms of application, which can generally be broken down into the following categories: global strike; intelligence, surveillance and reconnaissance; aerial mobility; and air superiority. None of these missions exist in a vacuum. Instead, they are tremendously interconnected and interdependent. In fact, connectivity and processing power is transforming these individual applications into a multidisciplinary mission ecosystem, whereby the attributes of each mission can be combined real-time to yield enhanced effects.

When it comes to unique mission sets, global strike stands as a unique imperative. It allows commanders to hit any target they desire around the globe in a matter of hours. Empowered by intelligence that affords insight into what allows an adversary sustain military operations, air strikes are able to yield an outsized campaign results. Whether striking production facilities, command and control networks, logistics, or fielded forces, any adversary depends upon certain nodes that are especially important to their enterprise functionality. Combat aircraft can strike these targets directly by flying over defending forces. Their speed affords responsiveness, payload allows decisive firepower, and precision ensures prudent application of force. Added to this the survivability of stealth and modern electronic defensive systems, combat strike aircraft are also exceedingly resilient. This mission can be executed by a wide variety of aircraft, including fighters and remotely piloted aircraft. However, long range strike aircraft, commonly known as bombers, are the assets that best combine the attributes of range and payload to decisively execute this mission. However, the Air Force only possesses 157 bombers—of which only 20 are stealthy. This places an extreme imperative upon the B-21 program—an aircraft that combines fifth generation capabilities like stealth and combat cloud functionality with range and payload.

Added to this, fifth generation aircraft like the F-22, F-35, and B-21; sensor-shooter remotely piloted aircraft like the MQ-9; dedicated command and control planes like the E-3 AWACS and E-8 JSTARS; intelligence, surveillance, and reconnaissance (ISR) aircraft like the RQ-4 and U-2; and associated space-based sensors are tremendously powerful information-gathering tools that are able to rapidly gain situational awareness and impact mission operations in a rapid fashion. No other domain comes close to affording such rapid insights into real-time events unfolding in areas of interest. Data links and processing power are especially important in this realm, for these capabilities allow information gatherers to collaboratively partner with a wide range of available assets, including other aircraft, to net mission results in a highly collaborative fashion where the individual strengths of many systems are merged into a connected team unified for a given mission. This concept is known as the combat cloud. Fifth generation aircraft stand apart in this realm, for they

combine the attributes of stealth-enabled survivability, information gathering and processing, ability to project kinetic firepower, and networked teaming into a unified, highly resilient aerospace tool. Growing the fifth-generation portion of the force stands as an important element of growing this mission capability and capacity.

Additionally, aerospace power also affords tremendous capability and capacity from a logistics perspective. The ability to move cargo—whether it be mission supplies or personnel—around the globe in a matter of hours is a crucial advantage for US forces. Aerial refueling is also a key component of this mission, extending the range of nearly every operational aircraft in the inventory. Given that US national security policy fundamentally depends on the notion of addressing threats before they reach American shores, this is a lynchpin capability. Nor is it just for the Air Force. Every service branch and allied partner involved in a given mission is highly reliant on US aerial global mobility aircraft. Current air mobility capabilities and capacity need to be reassessed in the context to the current operating environment. Logistics demands are bound to be far more demanding in an era of peer competition where more supplies will be required and mobility force attrition is a likely reality. The current force does not take these factors into account.

Last but not least, air superiority is a crucial mission that seeks to deny adversary aircraft and offensive airborne weapons systems the ability to successfully target friendly forces. This is a mission imperative, for ships at sea, forces on land, cyber and space installations, and other mission aircraft cannot project power in a viable fashion if subject to a concerted air attack. While fighter aircraft are the principle tools in securing these mission results, it is also important to highlight that long-range strike aircraft can play a vital role in surpassing an adversary's ability to launch offensive aircraft and missiles. Cyber and electromagnetic spectrum tools will also be increasingly important in denying the enemy the ability to find, fix, track, and target friendly forces from the sky. This is a mission that has largely been taken for granted over the last two decades given the threat environment in Afghanistan and Iraq. This malaise was largely responsible for canceling the F-22 production at less than half the stated requirement in 2009, a decision that severely handicapped America's

air superiority capability and capacity. It is a key reason why accelerated procurement of the F-35 and continued emphasis upon the Next Generation Air Dominance (NGAD) program is so important. Peer competitors like China and Russia have not forgotten about the criticality of this mission and have deliberate sought to challenge US capabilities. It is time to reset this force.

The Attributes Required for Tomorrows Aerospace Force

In looking at the qualities necessary to build a capable, effective aerospace force to meet tomorrow's requirements, a few key attributes will be essential: combat cloud functionality, survivability, fleet capacity, and lethality. It all comes down to projecting the right elements of power at the optimal time and place to secure decisive effects. This has been a goal ever since the dawn of combat aviation, but the realities of the information age have aggressively evolved the notion of what it means to project effective aerospace power.

No longer will "things" in the forms of aircraft, munitions, and satellites stand as the dominant factors determining success or failure in the aerospace realm. Success will increasingly go to the actor best equipped to gather data, turn it into operational information, and collaborate in dynamic, real-time fashion through the combat cloud. Information dominance has always been an imperative throughout the history of warfare. What makes this era different is the prowess and ubiquity of sensors, processing power, and collaborative data links. Throughout this evolution, training and personnel performance will stand as an absolute crucial element making the difference between victory and defeat.

TOMORROW'S AEROSPACE POWER

The Combat Cloud, Radically Impacting Aerospace Power

If there is one variable that is radically impacting what it means to project effective aerospace power in the information age, it is the combat cloud. The ability to gather information, process it, and collaborate with other mission partners to yield desired mission effects through teamwork is the central tenet of this concept. It is at the heart of fifth generation aircraft, it ties directly to how remotely piloted aircraft like the MQ-9 function, and it will radically enhance the value of legacy mission assets. No longer will the value afforded by an aerospace system be evaluated by a traditional metric like the flight envelope of a single aircraft, but instead the way in which it can productively team with an enterprise of capabilities to yield results far greater than what can be achieved in a unilateral fashion.

Realizing this goal demands that aerospace systems, both space-based and aircraft, have the ability to gather data, process it into information, and then partner with other mission assets in a multi-domain fashion to net desired results. Connectivity is crucial in this new paradigm, an area that requires investment and progress. Program managers and oversight entities must also look at aerospace systems differently, for the attributes they may have prioritized in the industrial age will now rack and stack differently in the information era. In this vein, funding for processing power may take priority over the ability to pull more Gs.

While the combat cloud is a new concept, the notion of survivability is not. The ability to send aerospace forces into harms way, have them successfully execute their missions, and get them home safe so they can execute the next mission is a goal that ties all the way back to the dawn patrols of World War I. However, given adversary capabilities to harness the attributes of the information age, they too will have greater situational awareness regarding the position and composition of US aerospace forces. Information that was once the highly classified purview of an entity like the National Reconnaissance Office is now available via

Google Maps. Accordingly, attributes like stealth, electronic warfare, and collaborative cyber teaming will be especially important to ensure combat aircraft are able to execute their missions in a sustainable fashion. Understanding what the enemy is doing in a real-time fashion and adjusting tactics accordingly will be incredibly important to maximizing the chance for a successful mission.

When survivability falls short, it is crucial for commanders to fall back upon force resiliency—especially regarding an attrition reserve. Ever since the end of the Cold War, a relatively benign aerospace operating environment paired with budget pressures saw realistic wartime reserves fall by the wayside as “excess.” Congress, senior military leaders, and operational planners must first acknowledge that the present aerospace force lacks this margin. An inventory of 185 F-22s and 20 B-2s speaks to this fragility in current capacity. Nearly every

aerospace mission set can be described as high demand, low density. Said more simply, there are too few air and space craft to execute desired missions under present conditions. Facing advanced threats, the anticipated losses would risk degrading force inventories to the point of operational insolvency. It is crucial to build back these attrition margins through programs like the F-35, B-21, KC-46, and NGAD.

Even without operational losses, it is important to understand that current force structure is not sized for full spectrum, large scale nation state conflict. This cuts to the notion of lethality and it is exactly why in the fall of 2018 then-Secretary of the Air Force Heather Wilson explained: "The Air Force is too small for what the nation expects of us." Nor is Secretary alone in her assessment. During a 2017 hearing, then Senate Armed Services Committee Chairman John McCain declared: "This is a full-blown crisis, and if left unresolved, it will call into question the Air Force's ability to accomplish its mission." The baseline reality is that the Air Force is operating the smallest, oldest aircraft fleet it has ever fielded since its founding in 1947. In fact, the numbers are even worse than what the service faced during the Great Depression, when it was part of the Army. In 1990, the Air Force fielded 3,206 fighters and 737 bombers. Today, it has just 1,731 and 157 of the respective types.

A standard theater-level air campaign involves over thirty thousand aim points—bombing targets. Securing victory demands hitting an overwhelming number of these targets in a rapid fashion to deprive an adversary of its ability to regroup and compensate with alternate means of survival. There is no way the present inventory of the Air Force, Navy, and Marines is equipped to deliver that volume of striking power—especially if you look at how few of the current aircraft are stealthy. In fact, less than twenty percent of the Current Air Force inventory is comprised of fifth generation fighters. The ratio is even worse when looking at a mere 20 B-2s comprising America's stealthy long-range strike force. This must change and it connects back once again to larger buys of relevant aircraft and space systems.