Transforming Aerospace Power

Frank Finelli*

Our Vision can be characterized in one word: Transformation.

—Secretary of Defense William S. Cohen

THE UNITED STATES is pursuing a defense strategy developed during the Quadrennial Defense Review (QDR), stated in terms of "shape, respond, and prepare now." The latter tenet of this strategy implies change in defense capabilities to leverage advances in technology and address operational challenges envisioned for the early twenty-first century. Certainly, aerospace power will have a key role in our future. But the real question to consider is whether this nation will develop the bureaucratic and political resolve to make the necessary investments and key decisions to truly transform aerospace power as Secretary Cohen indicates, or whether we will merely evolve the current state of aerospace affairs. To put the bottom line up front, the United States is destined merely to evolve aerospace power unless we demonstrate, in a joint setting, the capability to overcome vulnerabilities associated with technical shortfalls and operational challenges in areas such as anti-access, target identification, and force protection.

Before discussing the future of aerospace power, we need to define transformation in general and differentiate it from a mere evo-

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lution of the status quo. In short, we can think of transformation as innovation on a scale sufficient to enable a discontinuous change in military affairs. Some people associate this notion of discontinuous change with a revolution in military affairs. The proposed transformation of aerospace power involves not only the pursuit of new technologies but also the adoption of new organizational structures and new operational concepts. The National Defense Panel (NDP) described some attributes of this transformation as it relates to aerospace power: fewer numbers of short-range aircraft; emphasis on short takeoff and landing; multispectral stealth; new approaches to long-range, precision strike; and distributed, survivable, and redundant satellite systems.[1] Others postulate that this transformation includes the increased migration of capabilities to space and unmanned platforms and the adoption of a decisive halt-and-contain-ment paradigm.

Yet, we must address several key issues before increased aerospace investments will gain consensus support within the Pentagon

or on Capitol Hill. First, aerospace power must demonstrate the technical performance to be decisive. Second, the end-to-end operational architecture for the employment of aerospace power must address an adversary's asymmetric exploitation of its vulnerabilities. And third, these decision makers must be comfortable that increased aerospace investment, as opposed to a reallocation of resources across capabilities, is required.

With respect to this latter point, Sen. Bob Smith (R-N.H.), chairman of the Strategic Subcommittee of the Senate Armed Services Committee (SASC), has articulated a view that the US Air Force is shortchanging space power. In short, his assessment is that the technical and operational potential for space-based capabilities is so compelling that *space* should play a bigger role in aerospace power: "I do see an opportunity for us to exploit this period of unchallenged conventional superiority on Earth to shift substantial resources to space."[2] This article complements Senator Smith's views and primarily assesses technical and operational aspects of the *air* side of aerospace power. Correspond-ingly, it provides some background on the case for transformation, describes challenges for the aerospace paradigm, and assesses Congress's perspective on several aspects of an aerospace transformation.

The Case for Transformation

Previously in US history, we have found ourselves unprepared for threats we faced at the outset of war. Our nation rallied to overcome these threats eventually, but at a cost—not only in fiscal terms but also in lives cut short. Today, the United States stands as the sole global superpower in an era when no nation truly threatens our vital interests. But in the near future, technology will enable a different range of capabilities and threats

Too many, too few, or just the wrong kinds of aircraft? Are there too many options and proponents for too little money? What risks are acceptable in fielding tomorrow's weapons while fighting today's wars?

that we must dominate to sustain this global position. So the challenge for us is to transform defense through leveraging technology, changing organizations, and developing new operational concepts to combat these future threats successfully.

However, the United States has yet to gain a consensus about the future path of our military capabilities and the defense policy required to achieve it. The QDR concluded that "our future force will be different in character. . . . New operational concepts and organizational arrangements will enable our joint forces to achieve new levels of effectiveness."[3]

Unfortunately, the QDR did not touch the sticky issue of prioritizing capability initiatives to articulate how and when our future force would be different in character. Although Gen John Shalikashvili, former chairman of the Joint Chiefs of Staff (JCS), crafted *Joint Vision 2010* to guide such a quest, to date, this vision has failed to effectively focus the Pentagon's development efforts, largely because it is being vaguely interpreted to mean all things to all people.[4]

Consequently, Congress is confronted with numerous, competing approaches to future warfare. Some advocate aerospace power's precision strike; others argue for land power's positional advantage; still others argue for a new, rapid dominance that destroys an enemy's will to resist; and the list goes on. These disparate views bring several problems for Congress. First, these approaches require radically different investment policies, organizational structures, and doctrine. Second, these approaches, taken together, are unaffordable and unrequired. Third, we have today no unbiased way to test the effectiveness of these competing approaches. And fourth, all these approaches may not even address the real threats to our twenty-first-century national security.

The military services have already submitted a fiscal program for the years all the way out to 2005. The concern is that this program focuses too heavily on the here and now and imprudently chooses to postpone key investments in pursuit of transforming defense for the future. For example, the services are planning to replace many of their legacy strike systems on nearly a one-for-one basis, without recognizing the capabilities that other services bring to the joint warfight. The defense plan supports the procurement of nearly four thousand advanced tactical fighters, reported to be two to six times more effective than the aircraft they replace; over two thousand advanced attack and armed reconnaissance helicopters; and thousands upon thousands of new, long-range, precision-guided munitions as well as cannon and missile systems. But what is the aggregate joint requirement that justifies all this strike capability? Furthermore, even if we require the capabilities that each of these systems brings, what is the coherent, crosscutting assessment process that determines how many of each of these systems we should procure to support the national security strategy?

In short, one of the primary reasons the JCS testified before the SASC in September 1998 about an approximate $25 billion per year shortfall in the defense budget is that we have a crisis in joint requirements. Despite the Clinton administration's claims to have added over $110 billion to the defense program from fiscal year 2000 through fiscal year 2005, the joint chiefs continue to testify of double-digit annual shortfalls in the defense budget. In short, this requirements crisis fosters an environment wherein each of the services independently pursues a force structure and investment strategy that fields a far more effective conventional military. But we are doing so at a time when the conventional military capability of our adversaries is largely in decline. As it is, we estimate that US defense spending exceeds that of the next 10 nations in the world combined—and many of those nations are our allies.[5]

The demographics of international defense expenditures simply do not support a conclusion that our potential adversaries are investing their scarce defense resources to

buy advanced tactical fighters and tanks by the thousands. Rather, they are pursuing asymmetric capabilities in areas such as anti-access, distributed surface-to-surface strike, space degradation, information warfare, and what Secretary of the Navy Richard Danzig calls weapons of mass disruption. So the real growth in defense requirements most probably deals with combating asymmetric, as opposed to conventional, capabilities. But that is not where we are placing our effort, and this is a mistake.

From this perspective the NDP made a compelling argument that fundamental, not incremental, change is essential. Panel members concluded that we face greater risk in the future than we face today due to the nature, magnitude, and trend of envisioned operational challenges. Furthermore, they assessed that these challenges, when juxtaposed with opportunities driven largely by the revolution in information technology, may be so extraordinary that they could literally drive discontinuous change in the way antagonists will fight us—and the way we choose to fight them.

Consequently, the NDP questioned the course of existing policy and recommended instead that we pursue with priority a policy to transform today's post-cold-war force to tomorrow's information-age force. The panel's recommendation is direct and unmistakable: "The Department of Defense should accord the highest priority to executing a transformation strategy. . . . In the absence of additional defense funding, the transformation could be funded by infrastructure and acquisition reform, reducing the operational tempo associated with nonwarfighting activities, canceling acquisition programs, or reducing force structure and end strength."[6]

The panel's recommendation implies that we should reconsider decisions that commit enormous resources to forces and platforms which may be less relevant in the future. We do not need to focus on known and familiar threats we can already effectively deal with. Rather, we need to identify potential vulnerabilities across the spectrum of our joint-force capabilities and invest in areas that will minimize them or counter an adversary's response to them—either conventionally or asymmetrically.

The Aerospace Paradigm

Aerospace advocates propose that the employment of an increased array of air and space capabilities can leverage technology to address many operational vulnerabilities and ensure our national security with far less risk to forces and at less cost than alternative approaches. This paradigm asserts that the United States can rely primarily on aerospace assets to control an adversary through information superiority, global reach, and precision strike. At the high end of the operational spectrum, it argues that we can decisively halt and contain massive land assaults primarily with bombers, tactical aviation, and missiles. Furthermore, the aerospace approach contends that we can reduce an enemy so significantly that a large ground counteroffensive is never required. At the mid and lower ends, this paradigm advocates that we can employ aerospace power to coerce adversaries to adjust policy or deter them from taking actions in opposition to US and allied interests. This approach has huge implications: increased airpower investment; downsized land forces; and new, joint concepts in which land forces support decisive air operations by herding targets, securing the front, and mopping up the battlefield.

As supporters of aerospace power, we should challenge our thinking about the future viability of such an approach. We should also consider the tactics that our adversaries may employ to mitigate the effectiveness of aerospace power. Correspondingly, before we pursue investing in an aerospace transformation, we have to demonstrate the performance of this approach and understand its associated vulnerabilities. Critics have been suspicious of aerospace's claimed performance before

and since Operation Desert Storm, and they continue to doubt whether airpower can decisively engage the broad range of targets we may face in the future.

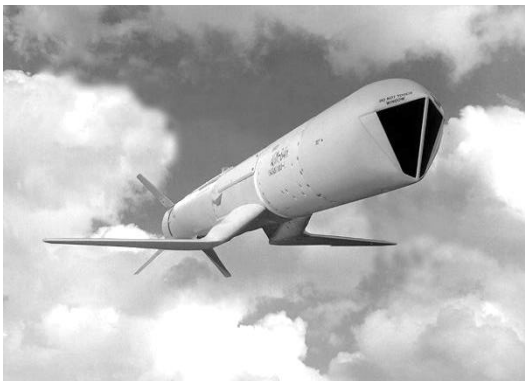
Congress certainly heard the Department of Defense's (DOD) and manufacturers' claims of weapon system performance during the Gulf War. Nonetheless, Capitol Hill focused on the General Accounting Office's (GAO) assessment of airpower in the Gulf, which concluded that these claims "were overstated, misleading, inconsistent with best available data, or unverifiable."[7] But GAO's comments on the limitation of airpower drew the significant attention: "Air power was inhibited by the limited ability of aircraft sensors to identify and acquire targets, the failure to gather intelligence on critical targets, and the inability to collect and disseminate [bomb damage assessment] in a timely manner. Similarly, the contributions of guided weaponry incorporating advanced technologies and their delivery platforms were limited because the cooperative operating conditions they require were not consistently encountered."[8]

Critics acknowledge the finite availability of precision munitions during the Gulf War and the advances that have been made in munitions, sensors, and command and control processes since that time. Regardless, they still contend that employing aerospace power effectively on the open desert of Southwest Asia may be a far more elementary undertaking than destroying and containing disjointed, infiltrating forces in the terrain of Korea or Yugoslavia. More generally, they argue that aerospace power will never be decisive because our command, control, communications, and computers (C^4) and intelligence, surveillance, and reconnaissance (ISR) capabilities will remain unable to differentiate between friend, foe, noncombatant, and decoy in real time. This is the heart of the target-identification challenge.

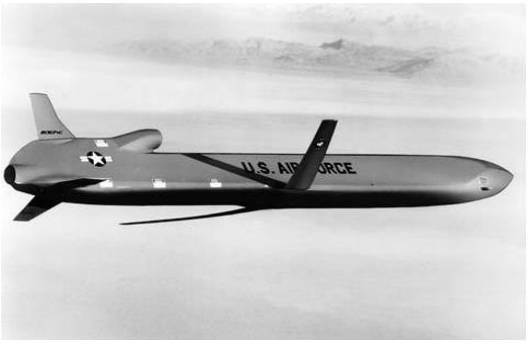
The United States either has in its possession or will soon possess the airpower platforms and munitions to hit any given point on the ground, virtually anytime and anywhere on this planet. But that is not the issue. The issue is ensuring that a viable target is at that location when the effects are delivered. Aircraft and ordnance are only a subset of the operational, end-to-end architecture associated with the employment of aerospace power. In short, until we demonstrate in a joint venue the technical capability to fuse information from the strategic, operational, and tactical sensors of all services and agencies; automatically recognize targets; and dynamically plan missions, we will never be able to defeat a theater-level set of fixed, fleeting, and moving targets with aerospace power.

If an adversary chooses to mass his military formations deep in the battle space and segregate them from his populace, then aerospace power may work wonders. However, an adversary is likely to disperse his force to make us employ our aircraft and precision munitions at uneconomic rates. Furthermore, adversaries may mix combatants and noncombatants within the effective radius of our weapons, thereby placing the United States in a position of causing unacceptable collateral damage. Military writings in nations that are our potential adversaries already emphasize similar tactics to exploit vulnerabilities associated with an aerospace approach.[9]

Yet, these current operational challenges do not even address a wide range of asymmetric tactics that limit the effectiveness of an aerospace approach, some of which have already been employed by Saddam Hussein and Slobodan Milosevic. These tactics include placing civilians within fixed targets, hiding high-value military assets in urban areas, employing multispectral countermeasures to disrupt terminal seekers, and attacking our in-theater air basing. In addition, within the last year, we have witnessed in Operation Desert Fox the anti-access problems described by the NDP that limit the employment of short-range, land-based tactical air (TACAIR). Interestingly, this access limitation originated with our allies and coalition partners—not our enemies.



Above: *The extended-range variant of the US Navy's standoff land attack missile (SLAM ER) and* (below) *a conventional air-launched cruise missile (CALCM). Do differences over guided-weapon design and employment result from reasonable, even prudent, interpretations of the services' expertise and experience or unnecessary concessions to service parochialism?*



Assessment

To date, we have demonstrated neither the required technologies nor the operational processes required to overcome vulnerabilities in the end-to-end architecture for the application of aerospace power. Therefore, it is imprudent to conclude that claims of decisive halt and containment are valid and that we should invest additional resources to pursue this approach. This is one of the reasons that the NDP concluded we should move toward fewer numbers of short-range aircraft and that Adm Bill Owens, US Navy, Retired, former vice chairman of the JCS, testified before the SASC that we have 40 percent too much TACAIR.[10] Further-more, our experience in operations Desert Fox and Allied Force raises scrutiny on the premise that aerospace power, when employed without land power, can adequately influence the policy of our adversaries. This is not to argue that aerospace power is anything other than an absolutely essential element of US joint war-fighting capability. However, it does recognize that an aerospace paradigm has yet to demonstrate a comparative advantage over alternative joint war-fighting approaches in leveraging the opportunity of technology or addressing operational challenges envisioned for the early twenty-first century.

This concern over demonstrated performance and operational vulnerabilities, when coupled with an impression by many senators and representatives that Congress has already allocated sufficient funding to this broader mission area, results in slim prospects for asymmetric increases in investment to transform aerospace power. Therefore, it is appropriate to comment on investment balance across three pillars of aerospace power: TACAIR, global attack, and space capabilities.

Tactical Air

DOD is planning to invest well over $300 billion across the three tactical aircraft programs—the F/A-18E/F Super Hornet, F-22 Raptor, and Joint Strike Fighter (JSF)—despite concerns over the operational challenges addressed earlier. The consensus in Congress appears to be that the Pentagon's planned investment in nearly four thousand short-range aircraft exceeds the level required. But that is where the consensus ends because no simple prescription exists for cutting it back.

Simply put, the air forces of the US Air Force, Navy, and Marine Corps dominate the skies. Nonetheless, we are planning to replace our existing inventory with far more capable and far more expensive platforms on largely a one-for-one basis. Yet, our adversaries already hide their aircraft when

facing a confrontation with US airpower rather than fight and risk them all. Although we see isolated news of foreign TACAIR-development efforts—the Eurofighter, the Gripen, and the Russian Fighter 2000—we have no competitor with the defense resources to invest in an integrated aerospace system with advanced C^4 and ISR. Correspondingly, the valid assessment for military planners to make is not their aircraft against our aircraft but their aerospace system-of-systems against ours.

More fundamentally, however, it is exactly the combination of international defense resource shortfalls and US development of the three TACAIR programs, particularly the F-22, that will lock potential adversaries out from even pursuing an air-to-air or air-to-ground capability. Instead, US TACAIR investments could very well accelerate the development of surface-to-air or surface-to-surface regimes of missiles and lasers, as well as other asymmetric capabilities on the part of our potential adversaries. Therefore, the mere notion of air dominance could fundamentally change to decrease emphasis on air-to-air capabilities, while increasing capabilities against ground-launched effects. How do we even achieve air dominance against an enemy missile force?

Given this background on TACAIR, Congress had largely capped the cost of the Super Hornet and the Raptor to keep JSF development on schedule, particularly the short takeoff, vertical landing (STOVL) variant. But that intent is now challenged because the F-22 is experiencing cost overruns of approximately $700 million, which will break the statutory developmental-cost cap.[11] These overruns are in addition to the approximately $2 billion in cost overruns already absorbed by the F-22 program. Since the Super Hornet and the Raptor compete fiscally against the JSF for resources in the near term, the Navy, Air Force, and tactical-aircraft industrial base desire either to add funding for TACAIR programs or delay the JSF to cover these overruns. But the transformation of Marine Corps TACAIR absolutely requires the timely fielding of a STOVL JSF. Gen Chuck Krulak, commandant of the Marine Corps, testified that "STOVL capability is critical to the Corps and critical to the way we think we are going to be fighting in the 21st Century."[12] Consequently, before proposing to push JSF to the right, the Pentagon and Congress should prudently address the very thorny question of whether the Marine Corps's pursuit of transformation concepts in ship-to-objective maneuver should also be slowed and whether the ser-vice should retain a fixed-wing TACAIR capability.

Global Attack

Despite claims of power projection based in the continental United States (CONUS), global attack is still largely a one-punch phenomenon. Nonetheless, long-range capabilities could become a more relevant piece of aerospace power because they mitigate vulnerabilities in access and leverage an increasingly capable suite of precision munitions. Dr. Andrew Krepinevich, executive director of the Center for Strategic and Budgetary Assessment, testified on 10 March 1999 before SASC's Airland Subcommittee that even countries with austere military budgets could invest in missile capabilities that would hold US forward air bases at risk and jeopardize the employment of tactical aircraft.[13] There-fore, we must develop a balanced set of strike capabilities that can sustain the required volume and character of effects without relying on tactical aircraft from fixed, in-theater land bases.

Operations Desert Fox and Allied Force demonstrate that we do not presently have the capability to instantaneously conduct and sustain global attack. Simply put, long-range precision strike is limited by the capacity of our bomber force and naval fleet and the time associated with positioning naval forces. We can air-refuel critical assets projected from CONUS but have yet to develop concepts regarding aerial rearming or refitting of bombers and replenishing of

at-sea missiles. Such concepts are central to addressing the extensive turnaround times associated with the potential lack of fixed, in-theater basing due to the anti-access problem.

Congress has undoubtedly enjoyed the respite from B-2 bomber debates since the defense authorization cycle of fiscal year 1998. However, many people remain concerned about the absence of a follow-on development program for long-range strike capabilities besides conventional upgrades to bombers. In fact, we hear that the Air Force plans to wait 35 years before replacing its long-range bombers.[14] However, it may be prudent, given advances in weapon technology and the rapid development of anti-access capabilities by our potential adversaries, for US defense planners to take an entirely different approach that accelerates development of new, long-range, precision-engagement capabilities in terms of a B-3 bomber, an unmanned combat aerial vehicle, or some completely different means of strategic strike.

Space

During the Air Force posture hearing on 12 February 1998, Sen. Strom Thurmond (R-S.C.), SASC chairman, commented that with *Global Engagement*'s vision of a Space and Air Force, we expected to see a noticeable shift in Air Force resource allocation toward space capabilities. But no such shift has occurred. The senator asked the chief of staff of the Air Force whether this emphasis on space was rhetoric or whether we would see money put behind it. Gen Mike Ryan's response that *Global Engagement* is "a very long term vision of where the Air Force is going" speaks volumes of near-term commitment to space transformation.[15]

Some people criticize Congress for not doing more in terms of funding space capabilities, but several reasons exist for this state of relative legislative inaction. First, the revealed preference of the Pentagon—as assessed from the white side of the defense budget—is that air is more important than space. However, numerous members believe that DOD has the fiscal and requirements flexibility to take more risk in TACAIR and place a bigger emphasis and investment in space. Consequently, we should not anticipate that Congress will add much in the way of funding for space capabilities when shifting funds may be a more prudent approach. Far more likely, key congressional leaders will continue to push for the establishment of a Space Corps to enhance the bureaucratic position for space capabilities in the Pentagon's fight for resources.

Second, many members of Congress are uncertain what the mix of DOD versus commercial space investment should be. Industry projects the investment of a half-trillion dollars and the launch of between twelve hundred and seventeen hundred satellites over the next 10 years.[16] This level dwarfs military space activity and presents an opportunity for dual use or outsourcing. Hence, Congress may await insights on how successfully the military can use commercial space capabilities before dedicating a larger share of public-sector funding to military space activity.

Third, Congress remains concerned about our ability to protect and control assets in space. We need to learn more about asymmetric vulnerabilities to space and ways of mitigating an adversary's attempts to exploit them. Furthermore, we need to understand these vulnerabilities across the operational architecture for space capabilities—the space-based assets themselves, as well as launch facilities, ground control, downlinks, and so forth. For example, what are we doing to investigate the relative merits of hardened assets, rapid constellation reconstitution, and high-altitude-endurance unmanned aerial vehicles as satellite surrogates?

Global Engagement and *New World Vistas* clearly provide a vision for space's playing a key role in a revolution in military affairs, both as the home of joint enablers and a base of operations.[17] But now the rhetoric appears to have changed from an objective Space and Air Force to an objec-

tive Aerospace Force with integrated and seamless capabilities emphasizing space as a medium of enablers for the joint force commander and national-intelligence users. In and of itself, this change does not indicate that DOD is neglecting space. Regardless, many people are left with the impression that space capabilities are being relegated to an evolution of the status quo rather than being afforded an opportunity to genuinely compete against other aerospace programs for funding.

DOD should investigate how potential adversaries are changing their capabilities in response to our space developments and their access to commercial space products. We should also dedicate science and technology programs to address how we might employ space to do things differently, such as space-based laser or kinetic-energy antisatellite capabilities. Obviously, there are huge policy issues concerning the weaponization of space, but we should not allow them to become an imprudent constraint on research-and-development efforts. Rather, we must build the concepts and capabilities to protect both military and commercial space capabilities and investigate the potential for leveraging the access afforded by space to project power.

Concluding Joint Thoughts

The aerospace-power paradigm is a joint approach, leveraging capabilities provided by all services. But we see glaring inconsistencies in the development of aerospace capabilities in certain areas. For example, the Air Force wants the JSF to be its low-end fighter, while the Navy envisions the JSF as its high-end fighter. Alternatively, the Air Force insists on fire-and-forget long-range munitions such as the joint air-to-surface standoff missile (JASSM), based on concerns over aircraft and crew safety; yet, the Navy demands man-in-the-loop guidance from the cockpit for the standoff land-attack missile, extended range (SLAM-ER) over concerns of multispectral countermeasures. But, given the fact that these two air forces apply combat power in largely the same domain, how can two diametrically opposed approaches both be valid, independent of each other? If a genuine joint requirement exists for both approaches, then fine, well, and good. But if this diversity is merely the manifestation of long-held service prerogatives extrapolated into the twenty-first century, then we need to develop the joint resolve to declare winners and losers and move money where it is needed most to transform aerospace power.

Several key sets of questions remain unanswered concerning the transformation of aerospace power. First, what is the joint aerospace vision for 2010 and beyond, and who is responsible for developing it? Central to this issue is ensuring that the vision addresses the right operational challenges. Second, what roles do the Air Force, the other services, and the commander in chief (CINC) of US Space Command (SPACECOM) play in the development and application of space capabilities? For example, some people have recommended that SPACECOM have a Major Force Program (MFP 12) for space activities. Third, how effective will US Atlantic Command's (ACOM) joint experimentation be in assessing the demonstrated perfor-mance to achieve a relevant joint, common operational picture that mitigates the target-identification problem? This picture may be the key to understanding whether we can employ aerospace power to decisively halt and contain an advancing enemy.

If the Air Force has confidence in the potential of aerospace power, then it should lead the charge in supporting the joint experimentation initiative driven largely by the efforts of retired senator Dan Coats (R-Ind.) and Sen. Joe Lieberman (D-Conn.). Done correctly, joint experimentation can provide a consistent venue to demonstrate the effectiveness of an aerospace paradigm. As such, this venue may be an effective way to win support and silence critics.

The issue of whether airpower can be decisive in war fighting is so critical that it can-

not be resolved through interservice bickering over the results of computer simulations. Congress will await the insights of CINCACOM before supporting interservice budget shifts. If DOD can jointly demonstrate that this aerospace paradigm is viable, then perhaps we should invest in more fighters, more bombers, and much more space capability, while divesting land power or naval force structure. But if these experiments demonstrate that we cannot employ aerospace power to decisively engage the broad array of fixed, fleeting, and moving targets envisioned for a theater war fight, then perhaps we should divest aerospace capabilities.

Given anticipated funding levels, aerospace transformation will be a function of our ability to identify those capabilities that provide true leap-aheads and determine those that are of less value. This is absolutely critical, given the joint chiefs' continuing testimony of annual procurement shortfalls exceeding $10 billion. We must declare winners and losers across platforms, systems, and operational concepts. And we must be committed to accelerating the winners and terminating the losers. Some people will consider the cost of these failures wasteful. Quite the contrary! Continuing to invest in systems whose capabilities will depreciate quickly 10 to 20 years hence would be a true failure.

The real concern is that we will stay locked into a posture that closely resembles the aerospace status quo. These decisions, in turn, preclude us from having the resources and flexibility to make different investment decisions or to address different threats in transforming our force to be capable of dominating the full spectrum of operations in the twenty-first century. ■

Notes

1. For a discussion of force characteristics, see *Transforming Defense: National Security in the 21st Century,* Report of the National Defense Panel (Arlington, Va.: National Defense Panel, December 1997), 43–48.

2. Sen. Bob Smith, "The Challenge of Space Power," *Airpower Journal* 13, no. 1 (Spring 1999): 33.

3. William S. Cohen, *Report of the Quadrennial Defense Review* (Washington, D.C.: Department of Defense, May 1997), v.

4. See *Joint Vision 2010* (Washington, D.C.: Joint Chiefs of Staff, 1995).

5. Calculated from Michael O'Hanlon, *How to Be a Cheap Hawk: The 1999 and 2000 Defense Budgets* (Washington, D.C.: Brookings Institution Press, 1998), 31.

6. *Transforming Defense,* iv and 59.

7. United States General Accounting Office, *Operation Desert Storm: Evaluation of the Air Campaign: Report to the Ranking Minority Member, Committee on Commerce, House of Representatives,* GAO/NSIAD-97-134 (Washington, D.C.: Government Printing Office, June 1997), 19.

8. Ibid.

9. See Robert H. Scales, "Adaptive Enemies: Dealing with the Strategic Threat after 2010," *Strategic Review,* Winter 1999, 4–13.

10. Senate, *Testimony of William A. Owens before the Senate Armed Services Committee Concerning the Report of the National Defense Panel,* 105th Cong., 2d sess., 28 January 1998, S. Hrg. 105-726 transcript, 112.

11. See Louis J. Rodrigues, *Progress of the F-22 and F/A-18E/F Engineering and Manufacturing Development Programs,* GAO/T-NSIAD-99-113 (Washington, D.C.: General Accounting Office, 17 March 1999).

12. Senate, *Testimony of General Charles C. Krulak before the Senate Armed Services Committee,* 105th Cong., 1st sess., 21 May 1997, S. Hrg. 105-197, 163.

13. Andrew F. Krepinevich provided testimony concerning future threats to theater land-basing of short-range tactical aircraft to the Airland Subcommittee, Senate Armed Services Committee on 10 March 1999. For excerpts, see Adam Hebert, "Senior Pentagon Official Denies Fighter Procurement Plans Are Misguided," *Inside the Air Force,* 12 March 1999, 1.

14. "Air Force to Wait 35 Years before Beginning New Bomber Production," *Inside the Pentagon,* 11 March 1999, 9.

15. Senate, *Testimony of General Michael E. Ryan before the Senate Armed Services Committee,* 105th Cong., 2d sess., 12 February 1998, S. Hrg. 105-605, pt. 1, p. 378.

16. Gen Thomas Moorman, USAF, Retired, remarks before the Institute for Foreign Policy Analysis Conference—"The United States as a Twenty-First-Century Aerospace Power"—Boston, 18 November 1998.

17. See *Global Engagement: A Vision for the 21st Century Air Force* (Washington, D.C.: Department of the Air Force, 1997); and *New World Vistas: Air and Space Power for the 21st Century,* 11 vols. (Washington, D.C.: United States Air Force Scientific Advisory Board, 1995).