MASS *and* SUPREMACY

A Comprehensive Case for the F-35

Thomas Donnelly
and Phillip Lohaus

AMERICAN ENTERPRISE INSTITUTE

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Contents

Acknowledgements	iv
Executive Summary	1
Introduction	3
1. Building Partner Capacity	6
2. Addressing Anti-Access	13
3. The F-35 and the US Marine Corps	22
4. The F-35 and Military Modernization	28
Conclusion	35
About the Authors	41

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Executive Summary

This paper will present a series of arguments for increased and sustained funding for the F-35 Lightning II Joint Strike Fighter. Beyond question, the program is the key index of weapons modernization for US forces for at least the coming decade, so much so that it will also be a reliable indicator of America's commitment to maintain global military preeminence. There are many positive reasons why this is so—the sheer size of the F-35 fleet would make it the centerpiece of any large-scale conventional air campaign; its reconnaissance and strike capabilities and ability to act as a "node" in a larger "network" of joint systems make it much more than a stealthy tactical aircraft; and its durability and ease of maintenance will create a capacity for large-scale, "everyday" stealth.

But there are also other, less happy reasons why the F-35 is so necessary. These have less to do with the qualities of the Lightning II and more to do with the unavoidable fact that there is no real alternative. The challenges of building the F-35 are partly a consequence of the sheer complexity of the system, but even more so the government's chaotic management of the program, and, most of all, irregular funding.

The challenges faced by the F-35 project can be understood in the context of a larger failure to modernize—much less to "transform"—the capabilities of US military forces. In sum, there is no modernization alternative other than stretching a few more miles and flying hours out of legacy aircraft of increasingly limited value. Fortunately, the Lighting II is an extremely capable plane. But no technology remains forever on the cutting edge; maximizing the value of the F-35 investment demands quick fielding and higher rates of production.

In this paper, we will make four broad arguments for why the F-35 is the right solution:

Building Partner Capacity (BPC). BPC has become a Pentagon cure for many ailments, and in the context of the George W. Bush administration's *2006 Quadrennial Defense Review Report*, BPC meant expanding and upgrading Iraqi and Afghan security forces and indigenous allies in irregular war. But the principle probably holds greater strategic benefit when applied to the new conventional challenges of the coming era: responding to China's military modernization, the need to maintain a convincing conventional deterrent (or "compellent") against a potentially nuclear-armed Iran, and the need to jumpstart a deeper and wide-ranging defense relationship with India. Thus, the F-35—always structured as an international program—would be the centerpiece of three strategic coalitions: in East Asia, the Persian Gulf, and South Asia and the Indian Ocean.

Anti-Access and Area Denial (A2/AD). The A2/AD problem—which now has an even deeper grip on Pentagon imaginations than does BPC—is a product of Chinese military modernization, but one that is also reflected in Iran and elsewhere. The rest of the world was mightily impressed by US power-projection capabilities during the wars of the post-Soviet era, and the rest of the world is gradually finding—principally in the form of massive fleets of cheap and accurate ballistic and cruise missiles—ways to hold in-theater US forces at risk. The "accuracy revolution," until now the sole property of the United States, is rapidly going global.

For most observers, the solution lies first of all in longer-range systems. While long-range weapons are increasingly worth the premium they demand, simply responding to the A2/AD phenomenon as an operational problem is a fool's errand. Direct operational responses must be supplemented—indeed dictated by—a larger and more strategic approach that

combines mass with range, and sustainability with rapid reaction. These are capabilities that, for the foreseeable future, reside exclusively with the F-35.

The Future of the US Marine Corps. After being entrenched in Iraq, Afghanistan, and irregular warfare missions since 9/11, the Marine Corps is now rightly reconsidering what unique role it can and should play in overall US defense posture. At the same time, the renewal of the Corps' sea-based capabilities has suffered: not only was the faster, longer-range Expeditionary Fighting Vehicle program terminated (a decision almost certainly resulting in the expensive kicking of the can down the road), but the short-take-off, vertical-landing "B" model of the F-35 has been on programmatic "probation," and is a favorite target of Pentagon budget cutters and alleged defense reformers.

If the Marine Corps is to remain relevant—not just in the Indo-Pacific, where such sea-based forces are uniquely valuable—in less-than-benign battlefield circumstances, the Corps requires the firepower and other virtues of the F-35. In many scenarios, Marine amphibious ships with the F-35 may be more useful than a large-deck US Navy carrier with F/A-18 Hornets. Conversely, without the jump-jet F-35, Marine operational concept will be incomplete and still expensive.

The Overall Need for Military Modernization. The F-35—as an industrial-scale realization of the "fifth generation" of aircraft and other systems envisioned near the end of the Cold War and immediately after—was always intended to be the largest project of its era. It is now one of the few remaining opportunities to bring those technologies into use. Early-generation stealth aircraft like the F-117 Nighthawk and B-2 Spirit have passed their primes (and, of course, at 21 bombers, the B-2 fleet was tiny), and the Lighting II's partner, the F-22 Raptor, was terminated after 187 planes were procured, rather than the 750-plus that were anticipated.

The Army has failed to acquire a major new system, and the Navy's record for submarines, surface combatants, and advanced aircraft is nearly as dismal. Hundreds of billions of dollars were spent (albeit not fast enough) for one-off systems like the Mine-Resistant Ambush Protected trucks, low-end remotely piloted vehicles, body armor, and other short-term procurements in the post–9/11 wars; these were necessities, but not the foundation for the forces of the future. If the F-35 program is further truncated—indeed, if it is not accelerated and sustained—the United States will essentially have skipped a generation of military modernization.

Introduction

On December 22, 1994, the US Department of Defense (DOD) announced its awarding of 24 contracts under what was then known as the Joint Advanced Strike Technology (JAST) program, merging the JAST effort with another program, the Advanced Short Takeoff and Vertical Landing project, which would replace the Marine Corps' aging fleet of AV-8B Harrier IIs. At the time, the Clinton administration—which had just been delivered a stunning rebuke in the midterm elections, and was preparing to deal with a new generation of budget-cutting Republicans in the House of Representatives (then led by Georgia Representative Newt Gingrich)—had three purposes in mind.

The Pentagon announced that the first purpose was to "reduce the cost for the next generation of joint-strike warfare weapon systems for the Navy, Air Force and Marine Corps" while getting that generation into the field as fast as possible.[1] The second was to increase the number of American planes in allied air fleets in the hopes of reproducing and expanding the international success of the F-16 program; to DOD, the "stage was set for wider dialogue with allies on defense cooperation of fighter aircraft." And, finally, Secretary of Defense William Perry, one of the moving forces behind the B-2 bomber, wanted to maximize the US military's advantages in "stealth" technologies, something he considered a set of game-changing capabilities, preserving US air dominance for decades to come.

Almost 20 years later, the purposes are ever-more-urgent requirements. The current US fleet of "fourth generation" aircraft, despite constant upgrades, are reaching the limits of their design life. For America's allies, the situation is even direr: for European defense budgets, the collapse has also meant the implosion of the European fighter-making industry. Nor is there any alternative for US partners in the Pacific or the Middle East. For them, it is F-35 or bust. And in an era where America's adversaries are not only investing in improved air defense, but other forms of "anti-access" and "area-denial" capabilities intended to limit the effects of US power projection, the idea of lots of stealth—measured not only in the number of platforms but in rates of availability—has never been more attractive.

Yet, the very size of the F-35 effort and the dilatory pace of the program make this very necessary project extraordinarily vulnerable as DOD faces steeper budget cuts. Indeed, while past F-35 reductions have compounded the effects of the inherent schedule, technological, and management problems, the program is under fire on all fronts. Liberals who oppose most forms of defense modernization decry the cost. "The plane is unaffordable," thundered Winslow Wheeler of the Project on Government Oversight.[2] At the other end of the spectrum, defense "transformationists" like Mark Gunzinger, a former Air Force officer now at the Center for Strategic and Budgetary Assessments, complain about the opportunity costs. They want the military services to continue to "skip a generation" of systems and design a new fleet of longer-range aircraft. For its part, DOD seems to want to delay the program even more. Going into full-rate production would amount to "acquisition malpractice," asserted Frank Kendall, the Pentagon's chief procurement officer.[3]

Alas, Kendall has an ant's eye view of the universe. Even though the program's total costs are estimated to be almost $400 billion, and the numbers of aircraft reduced from 2,866 to 2,457, two fundamental facts reflect a changed reality: first, a decade of investment has made the F-35 more than ready to enter service and fulfill the many roles intended; second, and equally sobering—there is no real alternative on the horizon.

Critics of the program not only overlook the present need for a revitalized aircraft fleet; they also fail to understand the foundational role of the F-35 to the future of American air power. In a recent interview, General Michael Hostage, commander of the US Air Combat Command, characterized the future of air power as evolving away from a focus on individual aircraft, and toward an integrated, full-force capability dubbed the "combat cloud."

The "combat cloud" would not only increase command and control efficiency. Because it would use secure networks to integrate all available platforms—both manned and unmanned—it would also allow for the extension of American air superiority into currently contested air space.[4] The superior stealth technology and the modular, upgradable design of the F-35 are foundational elements of this concept. In Hostage's words, "The full impact of the F-35 comes with its fleet operations capabilities for the enablement of the air-combat cloud."[5] Without sufficient numbers of F-35s, the ability of the US Air Force to evolve to meet future challenges may be at stake.

It is no exaggeration that the future of US military power—and American military preeminence—rests on the successful progress of the Lightning II program. The key to that progress is stable funding, and the longer Kendall and the Pentagon postpone reaching efficient rates of production, the higher F-35 costs will rise. But not just dollar-and-cents program costs—the F-35's greatest value is derived from its role in US grand strategy. That is, a good deal of the value of the F-35 comes from understanding its overall value as a fleet and in the context of the future of US air power in general. Too much of the conversation and almost all of the controversy comes from losing this critical perspective.

This study will try to rectify this balance by recalling the virtues inherent in mass—a quality too little considered in an era more interested in "long-range precision strike" and "persistent surveillance." If the F-35 program is brought to efficient procurement rates in a timely fashion, it will give the United States a capability it has never had: a large fleet of stealthy aircraft that is highly sustainable—not just stealth strike in tiny doses, but lots of stealth every day. Adversaries will be vulnerable in many places, in large numbers, all the time, for a long time.

The value of F-35 mass is multiplied many times over—both operationally and strategically—when the international composition of the F-35 program is considered. This is particularly true in the Indo-Pacific region, where Chinese military modernization has not only sparked competition with America and its allies, but forced others in the region to seek deeper US ties and to look for ways to improve defense capabilities.

In December 2011, Japan chose the F-35 as the winner of its "F-X" competition, initially purchasing 42 aircraft, and, likely, over time, procuring 100 or more. South Korea has similarly engaged in large-scale efforts to replace its fighter fleet. Australia has long been a "Level 2" part of the F-35 partnership, and has plans to acquire 100 planes; Singapore, along with Israel, has a "security cooperation" agreement for the F-35, and is expected to need another 100 aircraft. In sum, traditional US allies in the region could be expected to fly another 400 to 500 F-35s. And, at some point, India will have to consider a fifth-generation fighter.

Unfortunately, neither DOD as a whole nor the three services buying the F-35 seem capable of making the comprehensive case for the program. A May 8, 2012, US Senate Armed Services subcommittee hearing on tactical aircraft programs followed what has become a typical, myopic course. Only after a thorough airing of programmatic details about procurement lots, flight testing, and budgetary alterations was there any discussion of international implications.

The point was first made by the retiring subcommittee chairman, Senator Joseph Lieberman, who observed that partner "participation is important to the fiscal viability of the program."[6] There was no discussion or assessment of the effect the F-35 will have on US military capabilities, operational concepts, or doctrine. Discussion of the alternative changes—and savings—coming from other elements of the tactical aircraft fleet or force was likewise absent. The Pentagon continues to discuss the F-35 simply as a newer kind of F-16 Fighting Falcon or F/A-18 Hornet.

TABLE 1
F-35 VARIANT COMPARISONS

				
	F-35A	**F-35B**	**F-35C**	**F-35I**
Primary US Customer	USAF	USMC	USN	n/a
Primary Foreign Customers	Australia, Netherlands, Italy, Turkey, Canada, Norway, Japan	UK, Italy	UK	Israel
Take off/Landing Capability	Conventional	Short/Vertical	Conventional	Conventional
Length	51'5"	51'2"	51'5"	51'5
Wingspan	35'	35'	43' (wings spread) 31'1" (wings folded)	35'
Weight: Platform (lbs)	29,300	32,000	34,800	29,300
Weight: Maximum Fuel (lbs)	18,250	13,500	19,750	18,250
Weight: Maximum Payload (lbs)	18,000	15,000	18,000	18,000
Weight: Maximum Total (lbs)	65,550	60,500	72,550	65,550
Speed (Mach Level)	1.6	1.6	1.6	1.6
Speed (g rating)	9	7	7.5	9
Radius of Operation (ROO)	590 nm	450 nm	600 nm	590 nm
Estimated Per-Unit Cost (at full production)	$108.5 million	$135 million	$126 million	$126.6 million
Bottom Line:	Most widely ordered variant; least expensive; excellent range	STOVL capability and low weight maximize versatility; smaller range	Designed for carrier-based operations; superior range; lower cost than F-35B	Designed specifically for Israel; essentially an F-35A with an Israeli electronics platform

Sources: *Jane's, Lockheed Martin, Defense Industry Daily, Ottawa Citizen.*

Photo credits: (l to r:) Air Force photo by Senior Airman Julius Delos Reyes, Flickr user MultiplyLeadership, US Navy photo courtesy of Lockheed Martin, photo courtesy of Lockheed Martin.

1

Building Partner Capacity

By many measures, US armed forces are imperfectly suited to the clear demands of the emerging security environment. A full discussion of defense strategy, force structure, and requirements is beyond the scope or the needs of this study. Yet a full appreciation of the value of the F-35 does demand an analysis of the purposes and possibilities for alliances, partnerships, and coalitions that can buttress traditional American defense goals under changed circumstances. The F-35 can and indeed must be a key tool for building partner capacity in the coming decades, giving structure and substance to long-term US strategy.

The phrase "building partnership capacity" (BPC) was formally introduced into the Pentagon's lexicon through the *2006 Quadrennial Defense Review Report*, the final review conducted under Secretary of Defense Donald Rumsfeld. While the basic idea—helping to organize, train, and equip non-US forces who are part of, or might be a part of, a coalition—is a broad concept and hardly a new one, in 2006, the focus was on the near-term capacity-building of Iraqi and Afghan security forces.

The idea was given an additional push during Robert Gates's tenure in the Pentagon, not only in the context of the "Long War" against terrorism and insurgents, but in the recognition that the BPC approach might be relevant in other circumstances. Thus, the *2008 National Defense Strategy* noted the need to "work with longstanding friends and allies to transform their capabilities." Nonetheless, Gates had limited hopes: "[C]omplex counterinsurgency and high-end conventional operations are likely to draw on fewer partners with the capacity, will, and capability to act in support of mutual goals."[7]

In the context of China's broad and accelerating military modernization, Iran's aspirations for a deterrent to American military power in the greater Middle East that begins but does not end with nuclear weapons, and the prevalence of conflicts with limited aims such as the 2011 Libya war, the need for large-scale, "high-end conventional" forces is likely to increase. Gates was correct to assess the present capabilities of current—and likely future—US coalition partners as limited. But this must be changed. To begin with, even as a tactical and operational matter, existing limits to US unilateral actions are problematic and will be exacerbated as the size of the force shrinks.

This would remain the case even if the ongoing US defense decline were reversed; it will be hard to maintain the relative level of American military supremacy of the immediate post–Cold War era. To put it simply, the United States does need its old allies to improve their capabilities, but more immediately, it must build partnerships with countries that can bring a greater range of high-end capabilities to bear. This is likewise true as a matter of strategy and international politics, as will be discussed throughout this paper.

In the absence of formal alliance structures, the United States must embrace a "bottom-up" approach to partner building, one that stresses interoperability, common platforms and systems, and defense industrial cooperation—all of which work in favor of programs such as the F-35. To better understand this approach, consider three illustrative coalition scenarios.

The China Deterrence Coalition. To begin with, the United States must create a coalition that responds to China's rise as a great power. American policy toward China has long been and remains a muddle, lurching between the poles of "engagement" and "containment," even passing through the hybrid of "congagement."[8]

But if the policy has been confused, US policy strategy has consistently moved toward de facto deterrence, seeking to raise the costs of any Chinese attempts to shift the East Asian balance of power

either by intimidation or through a lightning military campaign to intimidate, punish, or invade its neighbors. This is the essential impulse behind the changes initiated in the Clinton administration, continued in the George W. Bush years, and now reflected in the Obama administration's "pivot" to East Asia.

Though slouching, this evolving American posture in the Western Pacific bears a number of similarities to Cold War posture in Europe. Like that long-term military standoff, there is a healthy element of paradox in the deterrence balance vis-à-vis China. It is being played out in the context of a nuclear balance that resembles the 1950s in uncertainty—thanks in part to recent arms-control agreements with the Russians—but also because there has been very little consideration of what a robust nuclear deterrent for China would look like.

Yet even if the "balance of terror" with China were to become better defined, many of the Cold-War-like conventional-balance calculations would remain. As in Central Europe, the United States considers important allies "front-line states," lacking strategic depth; strategically, the United States cannot afford to trade space for time—or, more accurately, be perceived to do so. As along the old "inner-German" border, America must make a serious effort to defend "forward," even if there is a tactical and operational penalty to be paid. And like the North Atlantic Treaty Organization (NATO), the China "deterrence coalition"—with anchors now in Japan, South Korea, Singapore, and Australia—must substitute capital and technology for manpower.

But the strategic environment in East Asia also has unique features. In Asia, there is no formal, multilateral treaty alliance comparable to NATO, and, of course, no shared military assets or well-rehearsed coalition command and control mechanisms. The United States has always preferred—as have Asian nations with long memories and unresolved animosities from World War II—a series of bilateral, "hub-and-spokes" arrangements in the Pacific. The Chinese are following a strategy similar to that of the Soviets, and absent a dramatic change in regional power dynamics, it is unlikely that the United States will be able to create an alliance as authoritative and binding as NATO in Asia.

What cannot be imposed from the top down can, however, be built from the bottom up. And in fact, a process of this sort is already underway in the US Pacific Command (PACOM). Admiral Robert Willard, former PACOM commander, sees the theater as "afford[ing] immense opportunities, particularly through strong ally and partner associations [that] contribute to advancing military self-sufficiency and security contributions by our partners in the region."[9]

But Willard and other combatant commanders have limited tools for real and lasting partner building—their horizons are limited to officer exchanges, exercises, and the like. Even the mother of all multilateral maritime exercises—the biannual, month-long Rim of the Pacific (RIMPAC) event—pales in comparison to the Cold-War-era Return of Forces to Germany exercises, or the traditional Bright Star exercises involving US and Egyptian forces. The 2010 RIMPAC brought together 14 navies, but only about 40 ships and 170 aircraft.

There is also a long history of bilateral defense industrial cooperation between the United States and its Asian allies. Indonesia, Singapore, South Korea, Taiwan, and Thailand fly F-16 aircraft; Australia and Malaysia have bought F/A-18s; Singapore, Japan, and South Korea the F-15 Eagle. However, these sales have been ad hoc purchases of aircraft originally designed for American services. They do not reflect intentional policy or strategy of the United States. They do, however, indicate the strategic preferences of US allies. In short, they are the product of existing alliances and partnerships.

In contrast, the F-35 program should be regarded as a cause and effect of the kinds of coalitions needed to add substance to the "pivot" policy. The "demand" signal from the region is strong—though also clouded by cost concerns and uncertainty over the course of US procurement. Australia has played an important role in developing the F-35, and has plans to buy 100 of them.

As previously mentioned, in December 2011, Japan selected the F-35 as the winner of the F-X competition to

replace its aging F-15s. The initial buy was for 42 aircraft, but to replace 140 F-15s, Japanese Self-Defense Forces will need at least 100 F-35s. In announcing the selection, then–Japanese Defense Minister Yasuo Ichikawa observed that "the security environment surrounding future fighter jets is transforming. The F-35 has capabilities that can firmly respond to the changes."[10]

Beyond the cost-sharing advantages of producing several hundred more F-35s, the virtues of the F-35 program as a de facto alliance-building process are plain.

Similarly, Oh Tae-shik, program manager of the South Korean Defense Acquisition Program Administration, says that they "will evaluate stealth capability as one of the key aspects, giving an advantage to an aircraft with a lower [radar] observability"—and the F-35 is just such an aircraft.[11] The initial procurement calls for 60 aircraft, but South Korea has maintained a front-line fighter fleet of more than 100 planes for several generations. Singapore has also been a part of the F-35 design and development effort, and is expected to acquire at least 40 to 60 Lighting IIs.[12]

Looking further over the horizon, there is a huge prize to be had in partnering with India. The Indian civilian defense establishment is weak and fractured, yet increasingly motivated to modernize its forces. As Indian operational understanding and concepts mature—and as their strategic attention increasingly shifts from dogfighting with Pakistani F-16s to threats from Chinese strikes—there is every reason to believe that the Indians will reconsider the value of a big investment in fourth-generation aircraft and, like the East Asians, focus on stealth and the characteristics of fifth-generation planes like the Lightning II.

Beyond the cost-sharing advantages of producing several hundred more F-35s, the virtues of the F-35 program as a de facto alliance-building process are plain. A common aircraft would set the stage for a common set of operational concepts, tactics, logistics, and weapons. It would also foster an international defense industrial base from which allies could commonly draw. The need for a coalition concept of operations, for example, is increasingly critical in light of the development of "AirSea Battle" in the United States (this point will be discussed further in the next section).

It should be noted, however, that the "AirLand Battle" doctrine of the 1980s was a NATO doctrine as well as a US doctrine, and permitted the development of complementary capabilities and forces across the alliance. If AirSea Battle remains a US-only initiative, not only will it have less operational utility, but it will introduce a new element of strategic weakness. A coalition whose members fight in very different ways is dangerously vulnerable.

Common platforms and systems make tactical integration much easier as well. Indeed, the wars of the past two decades have underscored the widening gap in tactical proficiency between the United States and its foreign partners. The US introduction of fifth-generation aircraft represents an even larger fork in the road: if America's allies do not take the same path, the gap in coalition capabilities could become crippling. Conversely, sharing the F-35 would close much of that gap.

An even greater force multiplier would be logistics commonality. In recent years, small NATO nations have begun to pool resources to sustain their F-16 fleets, and in Afghanistan, the Dutch took on what amounted to a common sustainment mission for coalition F-16s at Kandahar Airfield in Afghanistan, which allowed smaller nations to make larger contributions to International Security Assistance Force air operations.

A common F-35 would allow for both more robust and more flexible logistics and sustainment—and with fixed sites such as airfields and ports held increasingly at risk, these are two keys to a credible conventional-deterrent coalition in East Asia. "Distributed" logistics will not just be efficient, but also militarily effective. Finally, broadening the F-35 defense industrial partnership would cement the bonds of any coalition. Because of the long-term

nature of multinational procurements—and the large sums of money involved—they can be even more reliable instruments of security partnership than treaty alliances; the penalties for failing to meet program obligations would be serious across the coalition, and thus the incentive to meet the obligations would be great.

The success of the coalition-creation process in East Asia depends on the success of the F-35 program. As evidenced above, America's most important partners in the region are already part of the program or are poised to become so; nor is it impossible, down the road, to think that India would consider the prospect. Yet, these partner commitments are contingent, most of all because the partners are uncertain about America's own commitment.

Friendly forces want high levels of interoperability with US forces, but if the US program does not achieve sustained and economic rates of production, they will look elsewhere; from Japan to South Korea to Singapore to Australia, all the major East Asian air forces face problems of aging fleets that are nearing the end of their useful service life. Absent the F-35, this situation could leave these nations, as well as the United States, ill-prepared to either deter or face a direct challenge from a competing power in East Asia.

The Iran Containment Coalition. If the American approach to China is characterized by consistent strategy and confused policy, the approach to Iran is roughly the reverse. Although Tehran has yet to field a nuclear weapon, since the 1979 Iranian Revolution, the United States has sought to contain, hoping to limit Iran's effect on the region and on energy markets.

By contrast, America has had to do a lot of strategic improvising as circumstances have changed. The latest twists in the story—including the Obama administration's enthusiasm for "cyber campaigning" coupled with its deep reluctance to help depose Iran's closest but most vulnerable proxy, the Assad regime in Syria—only reinforce the past pattern.[13] The United States has shown no appetite for any policy of "rollback" or "regime change," other than waiting for the Iranians themselves to overthrow the Islamic Republic.

This long-term policy of containment has required US military forces and allies to conduct an extraordinarily wide range of operations, from counterterrorism and espionage to substantial conventional campaigns. Nonetheless, the United States and its allies have long preferred to maintain an overwhelming conventional force edge. Marine General James Cartwright, until recently the vice chairman of the Joint Chiefs of Staff, reconfirmed this preference shortly before retiring. According to Cartwright, ensuring that "conventional can substitute for nuclear" deterrence was his first priority.[14] The ability to contain and deter Iran with any degree of confidence, as we have argued at length elsewhere, depends on the willingness to maintain offensive capabilities that could threaten that which the regime values most—its survival in power:[15]

> The size and composition of a force capable of credible regime change . . . can only be imagined in the most general, qualitative terms. It must be large, both as measured by firepower and troop strength. The credible threat will be based upon the perceptions of the Iranian leadership that it faces an imminent air-land invasion.[16]

Equally, the credibility of a deterrence force for Iran will be measured in coalition terms. This is not simply a geopolitical requirement; it is also a physical and military reality: absent access to bases in the region and active participation by regional partners, the threat of regime change will be empty. Again, the paradox of a deterrent posture is revealed: avoiding war demands serious preparation to conduct a large campaign.

As in East Asia, over the years, the United States has cobbled together a de facto coalition that dare not speak its name. This has come to include Israel, Turkey, Saudi Arabia, and the Arab states of the Persian Gulf—all of which have air forces that fly F-15s and F-16s, and all of which are likely F-35 candidates; Turkey and Israel are part of the international program already, with Israel already having ordered 20 jets.

While it is unlikely that such disparate American allies and partners could ever conduct a combined

coalition campaign, it is also the case that over the past generation, loose-knit arrangements have enabled a remarkable projection of US power for many purposes that would have previously seemed unlikely. It would be possible to reap many of the same operational and tactical benefits to be had in East Asia: common operational concepts, tactics, armaments, and—again critical—logistics and sustainment.

Limited-War Contingency Coalitions. Structuring a long-term China-deterrence coalition is a relatively straightforward proposition, and perhaps the most important task for US military forces and strategy; Iran scenarios, though politically complex, are quantifiable. It is equally apparent that unexpected, limited-aims contingencies will remain a constant mission for US and allied forces. This is especially likely to remain the case across the Greater Middle East (the Muslim world extending from West Africa to Southeast Asia).

Though US forces are just as certain to be operating in coalitions with other nations, it is difficult to predict with precision future partners. In short, there are huge rewards associated with building common capabilities in advance and retaining as much operational and tactical flexibility as possible in the course of the conflict. The composition of and requirements for coalition forces may well shift as the campaign progresses, as might the operational role played by the United States itself.

The recent Libyan civil war makes a rich case study of the many dynamics of this sort of operation. From the beginning of the US-led Operation Odyssey Dawn on March 19, 2011, until the Twitter feed 222 days later by NATO Commander Admiral James Stavridis that signaled the end of Operation Unified Protector, the war that terminated the reign of Libyan strongman Muammar Gaddafi was fought by a constantly shifting, kaleidoscopic coalition of varied interests, commitments, and capabilities.

Stavridis and US NATO Ambassador Ivo Daalder "hailed [the operation] as a model intervention" and clear proof that the "[Atlantic] alliance remains a source of stability."[17] But they also confessed:

> [m]ultilateral coalitions built on an as-needed basis . . . have no common doctrine for conducting military operations, no common capabilities or command structure for quickly integrating national forces into a cohesive campaign and no standing mechanisms for debating and then decide on an agreed course of action.[18]

Even more striking were the challenges of the sustained campaign that combined the efforts of fourteen NATO members and four other nations. The US decision to retreat into a support role once the initial air-defense suppression and strikes on fixed targets were complete made conducting the lengthening operation a challenge and made the outcome unclear at times. France and Great Britain carried the load of the air strikes, but both nations found themselves occasionally short of munitions and frequently compelled to juggle different types of aircraft with divergent capabilities.[19]

Perhaps the most comprehensive study of the Libya air campaign in the public domain was conducted by Christian Anrig for the winter 2011 issue of *Air & Space Power Journal*. His description of the British Royal Air Force's efforts are illustrative of the many challenges that a relatively small yet diverse fleet has when it comes to sustained operations:

> The RAF's contingent changed over time. Originally, the UK fighter force consisted of 10 [Eurofighter] Typhoons in the air defense role and eight Tornado GR4s in the attack role. . . . Two days after the start of the air campaign, on March 21, 20011, RAF Typhoons patrolled the Libya no-fly zone, their first-ever combat mission. However, the air-to-air component gradually decreased in favor of the attack component. In early April, two Typhoons returned to the United Kingdom, while the addition of four aircraft boosted the Tornado component to a total of 12. Simultaneously, four of the remaining eight Typhoons had shifted from air defense to ground attack. The resulting 16 ground-attack aircraft allowed the

> RAF to provide a quarter of NATO's ground-attack assets. In the second half of July, the RAF once more boosted its attack and reconnaissance capabilities by deploying another four Tornados, one of them equipped with a reconnaissance pod. Henceforth, the RAF operated 16 Tornados and six Typhoons. . . . [T]he Tornado remained the RAF's preferred aircraft.[20]

There are a number of points to note, beginning with the fact that the Royal Air Force (RAF) did not really initiate ground attacks until after the United States had completed the air-defense suppression campaign; the early air-combat patrols by the Eurofighters were of marginal value. The Panavia Tornado remains the workhorse of British ground-attack efforts, but it was first fielded in 1979, and is slated for retirement under the most recent British defense review.

The Tornado's multimission capability and sheer size allowed it, with the addition of external pods, to conduct a wide variety of missions. Even for the British, the need to sustain even a fleet of just 22 aircraft was difficult. As the campaign progressed, both the British and French began to employ attack helicopters to increase their ground-attack assets.

This was also a response to the duration of the war and the need to maintain continuous ground-attack aircraft over the battlefield to hit mobile and hard-to-find targets. Anrig's assessment captures the essence of the campaign. As early as April 2011, "only 10 percent of the daily sorties represented designated targets; dynamic strikes dealt with the remainder." The term "dynamic strikes" was really a euphemism for "loitering for a couple of hours in search of targets."[21]

In other words, pilots did it the old-fashioned way: they had to find, identify, and confirm targets themselves, and work very closely with a small contingent of special operations forces as the latter contacted and then maneuvered to support the Libyan rebels. The British experience bears this out:

> The RAF [flew] approximately 90 percent of its combat missions against dynamic targets, which are more demanding than pre-planned static objectives. As of August 24, 2011, U.K. forces had destroyed 890 former regime targets, including several hundred tanks, artillery pieces and armed vehicles. When street fighting started in Tripoli, RAF aircraft maintained a presence over the city . . . British aircraft staged a mini-Scud hunt on August 24, destroying three Scud-support vehicles near Sirte, a site from which former regime forces launched Scud ballistic missiles against the [rebel stronghold] of Misrata.[22]

It is hard to avoid the conclusion that the initial US strikes were a relatively lesser contribution to the victory in Libya—a necessary enabler but far from decisive. Even in those opening salvos, Anrig suggests that the eight Harrier jump jets based on the Marine amphibious ship *USS Kearsarge* were more valuable than the hundreds of Tomahawk cruise missiles that were launched. "Given their proximity to the Libya coast, the *Kearsarge*'s six AV-8Bs could fly two sorties per night, demonstrating the advantages of seaborne air power in the opening of the campaign."[23]

In sum, in Libya, persistent air power proved perhaps more important than precision air power. While a closer analysis of the campaign is beyond the scope of this study, the Libya experience is suggestive of the qualities of the coalition capacities needed for this sort of campaign—the kind that any decision to intervene in Syria, for example, would demand.

As Daalder and Stavridis make plain, success in contingency operations rests in large measure on whatever preparations have been made in advance. This applies to the matériel side of the equation—common platforms, sensors, weapons, and parts. It likewise applies to the human dimension of operations, including command and control arrangements, concepts of operation, and tactical synchronization, all of which must be developed in advance.

And similar to the notional China and Iran coalitions described previously, the F-35 can play an important role in building contingency coalitions for the future. Among NATO nations, the program

includes Italy, Norway, Denmark, Holland, and Canada. The United Arab Emirates, another likely F-35 partner, played a critical role in the Libya coalition. Bridging the gap from Europe to the Middle East and the Persian Gulf states would improve both the rapid-response capabilities of such a coalition and, even more critically, their ability to sustain the effort.

The character of the Libya campaign offers lessons for the United States as well. The need for on-scene piloted aircraft is plain, as are the limits of pre-planned strikes against an adversary who presents a relatively small number of targets. Another notable feature of the war is that it was conducted without a large-deck Navy aircraft carrier. The French, British, and Italians all employed their small-deck carriers, and of course the Marine *Kearsarge* and its jump jets made a major contribution.

There is a premium on finding ways to win such wars—even when the United States chooses to continue to lead them from behind, and when the conflict lasts longer than anticipated—while preserving other assets for other purposes. And it is natural to wonder what two or three Marine amphibians with F-35Bs—or the British and Italian small-deck carriers with the F-35Bs that both nations plan to purchase—might have done to accelerate the removal of Gaddafi (to learn about the F-35 variants, see table 1).

Taken altogether, these three "coalition scenarios" intertwine a number of powerful arguments for regarding the F-35 program as a unique asset for building the partner capacities needed for the future. Beyond the performance virtues of the jet itself—for example, its stealth and the common logistics and ease of common operational and tactical integration—the whole (including what would be a global industrial base) is more than the sum of the parts.

To repeat: these are virtues of the F-35 *fleet*, virtues that no other fleet of aircraft can match. As the DOD and the US Congress consider the future of the program, these factors should be weighed in the balance, and perhaps weighed more heavily than the minutiae of cost growth, flight testing, and scheduling. The F-35 provides immense partner-enabling opportunities, but they will not be realized if these many potential partners conclude that the American commitment is uncertain.

2

Addressing Anti-Access

The unforeseen collapse of the Soviet Union, soon followed by the surprising success of Operation Desert Storm, lulled many to believe that US armed forces enjoyed advantages in military technology, tactical competence, and operational effectiveness so great that potential antagonists might be entirely dissuaded from competing at all in the realm of conventional military power.

The 9/11 attacks and the fear of irregular forces with weapons of mass destruction suggested that war in the 21st century would be a highly "asymmetric" affair, a contest between the American Leviathan and shape-shifting "networks" of terror groups, criminal gangs, and rogue states whose only means of achieving their goal was to undermine the international system from within.

The best that adversary states might hope for is to learn the comparative lessons of Iraq and North Korea: Saddam Hussein failed to acquire nuclear weapons before provoking the United States, while the Kim Jong-il dictatorship, with a handful of warheads and a primitive ballistic missile program, has managed to survive despite famine and international sanctions.

China's growing prosperity and accelerating military modernization have fundamentally shifted the view from the Pentagon. The role of high-technology conventional military power has returned—after more than a decade of sustained irregular warfare in Afghanistan and Iraq and continued emphasis on counterterrorism operations—as the principal focus of US defense planning.

More precisely, it has remained the core concern. Beyond the marginal increases in active-duty land-force strength initiated in 2007, a willingness to mobilize reservists and National Guard units with unprecedented frequency, and ad hoc acquisitions like the family of Mine-Resistant Ambush-Protected trucks, the sole measure of irregular warfare missions on US force structure has been the expansion of special operations forces.

While DOD (and the US government as a whole) was slow to appreciate developments in the People's Liberation Army (PLA), and even now struggles to connect the nature of Chinese military modernization to Beijing's strategic design, DOD is obsessed with what it regards as the growing problem of anti-access and area-denial. As the *2010 Quadrennial Defense Review Repor*t conveys:

> U.S. forces must be able to deter, defend against, and defeat aggression by potentially hostile nation-states. This capability is fundamental to the nation's ability to protect its interests and to provide security in key regions. Anti-access strategies seek to deny outside countries the ability to project power into a region, thereby allowing aggression or other destabilizing actions to be conducted by the anti-access power. Without dominant U.S. capabilities to project power, the integrity of U.S. alliances and security partnerships could be called into question, reducing U.S. security and influence and increasing the possibility of conflict.
>
> In the future, U.S. forces conducting power projection operations abroad will face myriad challenges. States with the means to do so are acquiring a wide range of sophisticated weapons and supporting capabilities that, in combination, can support anti-access strategies aimed at impeding the deployment of U.S. forces to the theater and blunting the operations of those forces that do deploy forward.[24]

In a nutshell, the Pentagon has concluded that the operational challenge posed by China's rapid development of advanced military technologies poses

a strategic challenge to the United States and, indeed, to the international system.[25] It is also apparent that other potential adversaries such as Iran are studying Chinese developments.[26]

The trend has been particularly worrisome to planners in the US Navy and Air Force, whose traditional modes of operation are viewed as at risk. In recent years, the two services have begun to develop the aforementioned response known as AirSea Battle, modeled on the Army-Air Force AirLand Battle doctrine of the 1980s, a successful response to Soviet developments of that time. Indeed, AirSea Battle is now a fully joint undertaking.

While AirSea Battle is something of a moving target—a process rather than a developed doctrine—it has raised questions about the "American way of power projection," the value of tactical aircraft generally, and the large investment of the F-35 program in particular.[27] This section will review the debate over the anti-access and area-denial challenges, shorthanded as the "A2/AD problem;" we will argue that placing the operational cart before the strategic horse would have even more fatal consequences for the American-led international system.

In sum, AirSea Battle must be more comprehensively conceived. Indeed, even the best literature on the subject takes little account of either China's or America's strategy. Properly understood, these issues constitute a strong argument for the F-35, rather than a reason to reconsider the program.

New Challenges, Same Strategy. The Center for Strategic and Budgetary Assessments (CSBA) has produced the most comprehensive range of public domain studies on the A2/AD challenges and the requirements for an AirSea Battle operational concept. Through its involvement with the Pentagon's Office of Net Assessment (ONA), CSBA can fairly be said to have had an immense influence in framing the way these issues are now understood. The seminal 2010 study *AirSea Battle: A Point-of-Departure Operational Concept* is as neat a summary of both the problems faced by US forces and the state of American thinking about a solution as can be found.[28]

The study begins with a concise and correct appreciation of the role US military power plays in the current international order. "For well over half a century," the report observes, "the United States has been a global power with global interests."[29] These interests include not just a favorable geopolitical balance of power, but "extending and defending" democratic governance; that is, preserving the quality of global politics, economic interests including "maintaining access to key trading partners and resources," and maintaining a system of "allies and partners who cooperate with the United States in defending those common interests."[30]

The ability of US armed forces "to project and sustain military power on a large scale has been, and remains, essential to this endeavor."[31]The critical element, it must be emphasized, is America's ability to sustain its military power—that is, to win the war, not just a particular battle.

The study also correctly understands that, in contrast to recent experience, there is a nascent operational challenge to this ability to project and sustain military power, particularly in the Western Pacific. "The Chinese People's Liberation Army's ongoing efforts to field robust anti-access/area-denial capabilities are threatening to make U.S. power projection increasingly risky and, in some cases and contexts, prohibitively costly."[32] Building on a flood of other reports and studies, the CSBA *AirSea Battle* paper also provides an excellent summary of the range of recent Chinese military improvements, which include not just equipment purchases, but doctrinal developments.

Where the CSBA study is wanting is in its consideration of the political and strategic framework in which these Chinese operational challenges are taking place. The effect is to reduce the ongoing competition in East Asia (and, in fact, in neighboring regions like the Indian Ocean and, arguably, in other areas as well) to its narrowest technological, tactical, and operational measures. To the degree that US defense policy and planning mirrors this wrong-end-of-the-telescope view, it too would mistake the necessary for the sufficient, a "point of departure" for the destination.

Perhaps the best point of departure for thinking about China's international and strategic behavior is to look at its domestic politics and its own history.[33] Communist Party ideology no longer provides sufficient social cohesion to a large and diverse state. Thus, the Beijing regime struggles to legitimize its rule, relying on constant economic progress—with an occasional Confucian veneer—to justify what might otherwise appear as a form of Han blood-and-soil nationalism. Profoundly uncertain about its modern identity, the regime is likewise uncertain about its role in the world. China wants to play a more forceful role, but it cannot define for itself or others exactly what that means.

It does, however, mean that China wants to create a sphere of influence in its "near abroad;" in conversations with Americans, Chinese strategists make constant reference to the Monroe Doctrine. And, like the Monroe Doctrine, Chinese strategy seeks both to exclude outside powers but also to exert its own power. The military modernization efforts that have created the A2/AD problem reflect the "keep out" sign in Chinese strategy, but Beijing's ambitions do not end there. Just as the United States had designs on Latin America—including territorial expansion—after the region's revolutions from Spain, China looks to extend even its sovereign claims in East Asia and to be the dominant force in the region, building a balance of power favorable to Beijing and securing sea, air, and other critical lines of communication.

Both geography and current international politics complicate China's task. Continental disputes have traditionally been Beijing's first strategic priority; its newfound maritime strategic focus can only be understood as the result of having achieved sufficient continental security. This is a huge area: China's "near seas" are exponentially vaster than the Caribbean. While the European great powers of the early 19th century had already lost most of their hold in North and Central America when the Monroe Doctrine was promulgated, China faces a region chock-a-block with American treaty allies and longtime strategic partners. China must set security priorities.

At the top of the list is Taiwan. Beijing has staked immense capital on both cajoling and coercing Taipei into unification. It is a hot-button issue in Chinese domestic debate, and is a "canonical scenario" for military planning. Seizing Taiwan would break what China sees as the chain of American containment along the "first island chain" in the Western Pacific.

The second priority is expanding China's reach and power in Southeast Asia—in particular, in the South China Sea. Beijing sees the Southeast Asian states as relatively weak—especially in military terms—and views the US presence in the region as less of a concern than it does the US presence in Northeast Asia. Thanks largely to the American withdrawal from the region after the end of the Cold War, China sees much greater room to maneuver. If US forces have an "access" problem in Southeast Asia, its first cause is the absence of forces to patrol the region, not the lethality of the PLA. Indeed, the absence of US forces in Southeast Asia makes it more appealing for China to fold the region into its orbit. The door is already open.

A third Chinese security priority is preserving a balance of power in Northeast Asia that prevents the United States, Japan, and South Korea from shifting their focus elsewhere; this is essentially an economy-of-force mission for Beijing. Seen in this light, the continuing melodrama of the Kim regime in North Korea plays to China's advantage—and at relatively modest risk to Beijing. While the region represents an American anchor that would be extremely difficult to dislodge, the global value of the US-Japan and US-South Korea alliances would be dramatically diminished if isolated through Chinese unification with Taiwan or the extension of China's sphere of influence to Southeast Asia.

Finally, the Chinese are already looking farther afield, particularly toward the Indian Ocean—and the shipping lanes that are the superhighway of 21st-century trade between Asia and the greater Middle East—for energy and other natural resources essential for a rapidly industrializing Chinese economy. More broadly, Beijing obviously understands that its rise to power is occurring in the context of a globalized,

Americanized international system, and that developments across the world will shape their circumstances.

In fairness to the CSBA report, the authors admit that "AirSea Battle, as a doctrine for the operational level of war, cannot and should not be seen as a 'war-winning' concept in itself. . . . Instead it should be viewed as helping to set the conditions . . . to sustain a stable, favorable conventional military balance throughout the Western Pacific region."[34] However, by emphasizing the condition-setting, and in recommending a thoroughgoing shift in nearly every aspect of US defense posture and investment, the study fails to adequately consider what "winning the war" would look like.

CSBA's ties to the ONA are evident in CSBA's settling for a "cost-imposing" measure of US strategy. This rhetoric was also prevalent during the late Cold War, and surrounded much of the discussion about AirLand Battle. While imposing costs on an adversary is a great idea in the abstract, it is a means, not an end. A better method is to define a coherent military strategy and operational concepts that will support the strategy.

Understanding the China "War." As the first section of this paper conveys, the de facto strategy of the United States is to prevent China from intimidating US allies and partners. Specifically, the United States looks to deter China from employing the capable, lethal, and mobile forces it has developed in either the outright seizure of disputed territory or in the extraction of territorial or geopolitical concessions through coercion.

Broadly speaking, the PLA's expanding inventory of strike systems is creating the potential for a kind of East Asian "blitzkrieg"—a lightning campaign that would present the region and the United States with a fait accompli that might well be limited in scope and scale, but that would be costly and difficult to prevent. The strategic competition is not unlike that of the Cold War: though the probability of a war is low and overshadowed by the danger of nuclear weapons, the correlation of conventional forces is critical.

One of the challenges for the Chinese is that the United States counts most of the important and powerful East Asian states as its allies or partners. And, consequently, the US military maintains a network of bases and access arrangements throughout the region. Beijing faces the problem of "horizontal escalation"—a PLA attack on Taiwan, for example, would be hazardous for US forces at sea or operating from Japan or South Korea. And Chinese actions in Southeast Asia—and around the South China Sea in particular—are leading states around the region to seek closer military ties with the United States.

For example, US forces have begun to operate from bases in the Philippines again; the arrangements fall well short of the huge presence of the Cold War, but are increasingly frequent and substantial. While Beijing clearly wishes to divide the loose but long-lived American coalition in the region, China's ability to limit a conflict is very doubtful. The prospects of a wider war—particularly one involving its historical enemies like the Japanese—should be a very strong deterrent to Beijing.

These geopolitical factors also drive American military requirements and constrain US choices. In short, the United States currently enjoys unrivaled access to the skies, seas, and near-earth space of the Eastern Pacific region, together comprising a secure environment for its interests, the interests of its allies, and for commerce and other peaceful pursuits. Its strategic task is to preserve and even enhance this secure environment, one built painstakingly and at tremendous cost over the course of centuries.

Ironically, China's "rise" is one of the great human accomplishments that this environment has produced, but as the CSBA study and the growing corpus of anti-access literature make plain, much of the PLA's modernization program constitutes a serious threat. The capabilities China is developing do not bolster the current order; they challenge it.

The sine qua non for America's strategic success must be to retain cohesion and solidarity across its de facto deterrence coalition; America and its allies must hang together or hang separately. In military terms, this demands a high degree of combined operational capability, with US forces providing the backbone and central nervous system and other partners providing

complementary military capabilities; the essential strategic contribution will be the central battlefield. In this way, the competition with China is very much like America's Cold War confrontation with the Soviet Union.

The "front line" is a long way from American shores, but the US-led coalition has little strategic depth; to expose front-line states to too much danger—or a potentially unanswered attack—would be to fracture the coalition. Nor, as the long debate over NATO strategy makes plain, is there a realistic option of trading space for time and relying exclusively on a counterattack or a stalemate to force a return to the way things were before.

The first operational principle for deterring China is a credible forward conventional defense that brings critical allies into play from the start. Even without a formal chartering document, a China deterrence coalition must aspire to something functionally equivalent to the Washington Treaty's "Article V."

A brief review of the immediate post–World War II strategic situation shows the strategic necessity for coalition forward defense. The United States and its European allies faced a set of operational problems that dwarf today's anti-access challenge from China.

Ensuring the territorial integrity of all NATO members led to the operational imperative of forward defense. Soviet forces threatened the Central Front, the flank zones of Norway and Turkey, and sea lines of communication between the United States and Europe. NATO eventually settled on a "mobile defense" concept that would "ensure that the Russians would meet some organized resistance from the moment they crossed the border," but the decisive engagement was deeper in West Germany—someplace "east" between the intra-German border and the Rhine.[35]

The real test of the operational concept was whether it convinced the West German Social Democratic Party (SDP) that the return on investment was worth the cost of rearmament. In late 1950, SDP leader Kurt Schumacher allowed that he was "ready to bear arms again if, with us, the Western Allies take over the same risk and same chance of warding off a Soviet attack, establishing themselves in the greatest possible strength on the Elbe."[36]

The tension between the strategic need to defend forward and the operational desire to extend the depth of the battle space was never perfectly resolved throughout the entire Cold War, even in the 1980's heyday of US AirLand Battle doctrine. NATO airfields, ports, headquarters, and other critical positions were under the gun—and, in attempting to meet the 10-divisions-in-10-days metric for conventional reinforcement from the continental United States, the American military faced a potentially crippling anti-access challenge.

The sine qua non for America's strategic success must be to retain cohesion and solidarity across its de facto deterrence coalition; America and its allies must hang together or hang separately.

But the critical point was—and is, in today's context—that alliance politics and coalition military strategy trumped very serious operational concerns, including the potential loss of tactical or operational initiative; to fight the battles the general staff preferred would have meant risking losing the war. Thus, for the duration of the Cold War, NATO armies exposed substantial "covering" forces across the width of the alliance front, and held sufficient operational reserves to limit the prospects for a rapid, decisive Soviet victory while also having begun to wrestle with the problems of strategic reinforcement.

Convincing conventional deterrence—meaning raising the threshold at which the situation would demand a nuclear response or even an escalated nuclear threat—was a central problem for US and NATO defense planning for decades, but the rough dictates of a forward defense strategy were constant. The point was to solve the "access problem" by forestalling it.

There is a growing body of US and other research on evolving strategic and operational concepts as well as DOD and independent assessments of the scope of technological and tactical development within the PLA. The authors of the CSBA *AirSea Battle* study are conversant with this literature, and their assessment of "an illustrative PLA attack" represents something like the conventional wisdom on the subject. The study describes four characteristics of this notional Chinese campaign:

- "In the opening minutes of a conflict, China would seek to: Render U.S. and allied forces 'deaf, dumb and blind' by 'destroying or degrading' surveillance and communications capabilities, through anti-satellite and cyber attacks, jamming and other means."[37]

- "Conduct ballistic missile salvo attacks, complemented by [land-attack cruise missiles] launched from various platform types, against U.S. and Japanese air and naval bases," with the purpose of limiting US air power.[38]

- "Conduct major strikes using land-based anti-ship ballistic missiles and anti-ship cruise missiles launched from various platforms . . . against all major U.S. Navy and allied warships within 1,500 [nautical miles] of the Chinese coast."[39]

- "Interdict U.S. and allied sea lines of communication throughout Southeast Asia and the Western Pacific."[40]

In sum, this is a phenomenally ambitious campaign, a preemptive strike that rivals—or even exceeds—the Japanese attack on Pearl Harbor in 1945. Indeed, it is so ambitious and so large in scope that there is some reason to doubt that the PLA is capable of fielding a force that can accomplish these goals in short order; striking all US and allied warships within a 1,500-mile range of China is a formidable task. As we will argue, the prospect of PLA "overreach" is one of the faults in China's operational concept. Nonetheless, the CSBA study does a useful service by clarifying China's military goals. Indeed, by illuminating the nature of PLA operational concepts, it is a good first step toward understanding and exploiting the weaknesses in Chinese strategy.

F-35 and Conventional Deterrence in East Asia. The lessons for any China deterrence coalition could not be plainer: international politics and coalition strategy demand a forward defense and a forward operational posture, backed by both theater reserves and strategic reserves capable of denying the PLA the ability to secure its anti-access goals. This posture is required both to deter China from ever launching such an attack, and to deny Beijing geopolitical leverage from coercive threats. Broadly speaking, this strategy demands that the United States and its allies toughen their defenses, and, especially, disperse their forces.

The F-35 fleet is critical to ensuring that US forces and coalition forces are sufficiently capable at all echelons. It is crucial to understand the F-35 not simply as a uniquely capable platform, but as one of the few, if not the only, sources of operational mass in the Western Pacific theater. Without the mass and flexibility it provides, any first strike by China will fall on an inherently brittle defense.

The first order of business is ensuring that the covering force has the capability and capacity not just for reconnaissance and surveillance—nor simply to die in place—but to "develop the situation" in ways that convince the Chinese high command that it lacks the ability for a blitzkrieg-like campaign. Like the fighter wings and armored cavalry regiments that formed NATO's front-line defenses, US and coalition forces along the long arc of the Western Pacific must possess organic mobility, firepower, and, above all, flexibility. They must be able to perform many roles to deny Beijing confidence in the PLA's ability to quickly achieve a decisive result.

Creating an adequate "covering force" for the Western Pacific is a subject that deserves research well

beyond the scope of this paper or the analytical capabilities of any single author. As the CSBA's *AirSea Battle* and other studies have pointed out, there is a de facto "forward echelon" in the virtual and physical domains (including near-earth space and the electromagnetic spectrum).[41]

The requirement for a sizeable fleet of multirole, stealthy aircraft to secure these domains is plain. It is true that these aircraft will be vulnerable when parked at theater airfields within range of PLA missiles—but ensuring that Chinese aggression draws blood from many nations is a critical element in raising the bar of deterrence. This is a situation in which the political and strategic imperative for forward presence and quick response competes with—and must overbalance—the operational desire for depth.

The threat to forward air bases is hardly novel. Such was also the case for NATO during the late Cold War. Indeed, throughout the Cold War period, the alliance and US forces developed a number of "passive air defense" measures built around the principles of hardening airfields and dispersing forces. Both took place within the scope of existing airfields, but, critically, by preparing to employ many makeshift airfields—even roads and highways—to preserve forward-deployed aircraft and accommodate follow-on forces.

This concern was brought into sharp focus after the Arab-Israeli War of 1967. In the opening phases of that conflict, the Israeli Air Force (IAF) "executed a devastating pre-emptive strike against the Egyptian air force and delivered serious blows to the air arms of other Arab nations." In all, the IAF destroyed about 400 Syrian, Jordanian, and Egyptian aircraft in the first day.[42]

Analysis of that conflict and the 1973 Arab-Israeli war prompted NATO air planners to take a number of steps to maintain their access to and ability to use forward airfields, which were absolutely critical to responding to any preemptive Soviet attack. One initiative was the Collocated Operating Base program, which more than quadrupled the number of potential European air bases from 20 to 60, including 30 new fields in NATO's Central Region. This "reduce[d] force concentration and decrease[d] vulnerability."[43] The alliance also increased the density and quality of its air defenses and hardened facilities. Beyond that, NATO also developed deep strike systems that could hold Soviet bases at risk, thus helping to constrain the Warsaw Pact's ability to launch attacks at NATO fields.

Nevertheless, a US Air Force exercise of the mid–1980s, dubbed "Salty Demo," which simulated an attack of "moderate severity" on Spangdahlem Air Base in Germany, revealed two truths: that much more needed to be done to make an airfield ready to sustain such attacks, but also that the ability to disperse had been undervalued. As former US Air Force strategist Christopher Bowie has written, "Some . . . argued that NATO should move to an even more dispersed posture by operating small flights of aircraft from roads or other dispersed airfields," and the Swedish Air Force did so—and indeed has institutionalized this approach.[44]

It is crucial to understand the F-35 not simply as a uniquely capable platform, but as one of the few, if not the only, sources of operational mass in the Western Pacific theater. Without the mass and flexibility it provides, any first strike by China will fall on an inherently brittle defense.

The Cold War came to an end before either the "hardening" or "dispersal" approaches were fully understood or solutions implemented, but both need to be thoroughly reconsidered in light of present-day Chinese capabilities, and in the context of the larger challenge of anti-access systems and area-denial tactics.

Much of the current debate has emphasized airbase hardening, and the five-week Salty Demo exercise is still relevant to that discussion. The exercise simulated a Soviet attack that hit Spangdahlem two

or three times a day with raids employing 30 to 40 munitions per attack. That is an extremely heavy pummeling, conducted over an extended period. It was reasonable to assume the Soviets could sustain such a campaign because of the immense size of Warsaw Pact forces, but also because of the proximity of their bases.

Despite China's growing fleet of ballistic and cruise missiles, the PLA has much less ability to sustain airfield attacks without resorting to fixed-wing aircraft—the PLA Air Force and PLA Navy fleets almost certainly lack the size or sophistication to conduct such sustained strikes throughout a much larger theater of operations. They would be extremely vulnerable to surviving US and allied aircraft, particularly fifth-generation aircraft such as the F-22 and F-35.

The US Marine Corps was mong the closest students of the Cold War questions of air-base vulnerability. As they acquired and learned to exploit the capabilities of the AV-8B Harrier jump jet, the Marines became enthusiasts for dispersed operations. One 1989 Marine study outlined what was to become an important element of service expeditionary doctrine for defensive measures before attack and recovery.[45] It identified four elements of dispersed operations:

- **Rearward Dispersal**: "keeping as many critical assets as possible out of range of the main systems that can do them harm;"[46]

- **Horizontal Dispersal**: "shifting within the same theatre from main operating bases to one or more collocated operating bases or forward operating bases;"[47]

- **On-Base Dispersal**: "instead of putting all the aircraft in one place, all the munitions in the other place and all the fuel in a third place, aircraft shelters could be spread throughout the base, with sufficient munitions for a sortie to two stored with or near the aircraft;"[48] and

- **Mixed-force dispersal**: the creation of ad-hoc, theater-mobile task forces with several kinds of aircraft and capabilities.[49]

While recognizing that dispersed operations were a command and control challenge and a logistical nightmare, the Marine Corps also recognized that—particularly in light of its expeditionary mission, the need for airborne firepower, and the flexibility inherent in the Harrier II—dispersing was the best solution to the air-base threat. Thus, they developed tactics, techniques, and procedures to allow their jump jets to operate much in the manner of Army attack aviation, with highly mobile forward-arming and refueling points. They planned to employ this method during the ground campaign of Operation Desert Storm, but the attack on Kuwait was too rapid a success.

Developing the ability to operate in a similarly dispersed fashion should be an essential element of any AirSea concept meant to frustrate the PLA's anti-access and area-denial capabilities. Indeed, it is the one tactic that solves both the operational puzzle created by China's missiles, and the political and strategic conundrum that demands forward presence.

Dispersed operations will demand, first of all, the negotiation of access and temporary basing arrangements around the region, including logistics arrangements for fuel and prepositioned munitions—a political challenge in itself—but also a substantial force designed to operate in this environment. Such a force must be tactically flexible, and must include a robust sustainment capability.

This is not a force that needs large aircraft or other platforms. It is essentially a light raiding, or—perhaps more important—a scouting hit-and-run "cavalry" force that can both fight for information and begin to shape the battlefield for larger and more powerful forces to exploit. It must also be highly survivable and logistically sustainable; that is, maintainable in a bare-bones environment. It also needs to be a very sophisticated, multimission aircraft capable of doing many things very well.

Only the F-35—and, perhaps above all, the F-35B—will be able to do all of this, at least in the foreseeable

future. Longer-range systems cannot be fielded in the proper numbers or employed with such flexibility, and to operate them forward in this way would mean squandering their value. Similar constraints limit unmanned systems—including Navy unmanned systems that would still be limited by carrier basing; indeed, it might be more fruitful to regard carriers as stand-off supply bases and maintenance facilities through which reconnaissance and strike aircraft cycle forward and back, giving the "rearward" and perhaps "horizontal" dispersal described by the Marines.

Operationally dispersing—around maritime Asia, or even into Central Asia—in response to China's modernization would considerably raise the cost of the competition for Beijing, and multiply its political and strategic calculations many times over. Furthermore, it would be far easier to hold "inland" targets at risk and penetrate Chinese airspace, while reviving Beijing's traditional uncertainties about its vulnerability on the continent. Such a response would also maximize the advantages of the potential F-35 industrial coalition, and in no case more than that of India.

Finally, the F-35 must necessarily play an important role in the theater and strategic reserves that are the second element in frustrating any anti-access or area-denial strategy—and not just of China's efforts. To repeat: the central premise of this strategy is to threaten a preemptive attack that would overawe frontline states and raise the cost of a US intervention. Overcoming that strategy requires both that the initial blitz fail and that the deterring coalition retain sufficient military strength to exact unacceptable punishment in retaliation—and, if conventional deterrence is to work, to do so without recourse to nuclear weapons.

While our brief analysis has described an approach to forward presence and defense that reassures American allies while also having addressed the initial operational problems, more analysis must be done to understand the requirements for the theater and strategic reserve needed for credible deterrence. While such analysis is beyond the scope of this paper, it is clear that such a deterrent force must be large enough to threaten heavy retaliation; numbers will matter. While long-range systems will be valuable, too, under such a circumstance, they cannot be sufficient.

If the previous section emphasized the geopolitical and strategic value of the F-35 program in solidifying a China-deterring coalition (and providing a model for a coalition to deter Iran), this section has advocated the operational need for the F-35 as a "forward-deterring" system; the technological and tactical link between the very real strategic need for front-line, forward-based air operations; and the realities of the emerging battlefield.

3

The F-35 and the US Marine Corps

The post–9/11 years have been unkind to the US Marine Corps. It has been fully embroiled in the extended campaigns in Iraq and Afghanistan. These inherently taxing efforts have been made even more so by the very structure of the Corps. A service designed for sea-basing and relatively short-term expeditionary operations (with a force-generation model geared to produce units that deploy for just six or seven months) has struggled to meet the demands of long-lasting missions well ashore.

As with the US Army, the unremitting requirements of irregular warfare have hamstrung the Corps' modernization efforts. To be sure, recent years have seen the successful fielding and employment of the V-22 Osprey tilt-rotor aircraft, particularly in Afghanistan. And the procurement of new amphibious assault vehicles is proceeding at a pace no worse than the rest of the Navy's shipbuilding program. But the termination of the Expeditionary Fighting Vehicle (EFV) has left the Marines both without a viable solution for rapidly moving sizeable units from ship to shore and without much in the way of mobile, protected firepower on land.

In this context, the tumultuous and long-delayed development of the "B" version of the F-35—the project was placed on "probation" by former secretary of defense Robert Gates and is still vulnerable to future defense budget cuts—casts a pall not only over the past decade, but over the Corps' entire future. Without the capabilities of the F-35B, the Marine Corps would have to reengineer its entire concept of operations, and its role as an independent service would be called into question.

This section will examine the Corps' conundrum in detail, arguing the case for preserving the fundamental character of the Corps—even if it means that the size of the service is reduced. It will explain how the F-35B is the critical piece of this puzzle, and conclude with an analysis of the increasing value of a short-takeoff, vertical-landing aircraft such as the F-35B.

What the Marines Do. Since World War II, one constant has defined the operational approach and thus the structure of the Marine Corps. The operational approach reflects the amphibious essence of the service: its ability to project military power from the sea to land—"transitioning national combat power and influence across the critical maritime, land and air domain interface," as Marine doctrine accurately puts it.[50] Several corollaries follow from this starting point: marines must maintain a regular forward posture, are often called upon in crises, and must be prepared to respond to a range of conflicts that may include intense combat with only the assets they themselves have on hand.

In sum, if marines live at sea, they must be able to get substantial force across the sea-land "interface"—a period of particular vulnerability—as fast as possible, and they must be able to operate, maneuver, and fight once ashore. In theory, these are short-term operations that result in Marine redeployment to sea, and which may include replacement by follow-on forces to sustain operations into the future.

Thus, the critical Marine formation, which the Corps is built to generate, is the Marine Air-Ground Task Force (MAGTF). While MAGTFs may be organized into brigade-sized or division-sized units, the basic building block is the battalion-sized Marine Expeditionary Unit, with supporting aircraft and logistics, deployed aboard the ships of an Amphibious Ready Group (ARG). The core components of an ARG are an amphibious assault ship, resembling a small aircraft carrier; an amphibious transport dock ship, which primarily houses the means needed to get forces ashore; and a dock-landing ship, which actually supports the landing itself.

Together, these self-contained and at least temporarily self-sustaining MAGTFs are the *raison d'etre* of the Marine Corps. The MAGTF is a synergistic whole whose operational effects are greater than the sum of itse parts. Conversely, the loss of a major part can be crippling to the whole.

For the better part of two decades, the Marine Corps has been committed to modernizing and improving the capabilities of the MAGTF both to exploit new technologies and to respond to operational and tactical challenges. Almost every element in the Marine inventory has been subjected to this effort, although Marine infantry remain the basis of all Marine forces.

New classes of amphibious ships have been built, the V-22 Osprey developed and acquired to replace traditional CH-46 lift helicopters, the EFV developed but not acquired for ship-to-shore assaults and land maneuver, and the Marines have invested heavily in the F-35B. Along with the US Navy, the Marine Corps was convinced that the post–Cold War era heralded, in Thomas Barnett's words, a shift in the purpose of maritime forces from *achieving* command of the sea to *using* or *exploiting* command of the sea to influence events ashore.[51] But the basic Marine mechanism remained the MAGTF.

Current Conundrum. Developments of recent years have complicated the picture for the Marines. To begin with, the size and duration of the Iraq and Afghanistan campaigns demanded constant Marine participation. Moreover, the commitment to Afghanistan continues today. While Marine units have performed superbly, the essential sea-based capabilities of the Marines are irrelevant to counterinsurgency and extended irregular operations deep inland.

Second, reduced investment budgets and engineering difficulties have delayed the pace of Marine Corps modernization; every major program has been significantly slowed, resulting in the termination of the EFV effort and putting the F-35B in constant danger. Finally, the concerns with anti-access and area-denial have called into question the US ability to exploit sea-based forces; command of the seas is perceived to be at risk. Shortly before retiring as defense secretary, Robert Gates posed the question:

> We have to take a hard look at where it would be necessary or sensible to launch another major amphibious landing again—especially as advances in anti-ship systems keep pushing the potential launch point [farther] from shore. On a more basic level, in the 21st century, what kind of amphibious capability do we really need to deal with the most likely scenarios, and then how much?[52]

The challenge is one the current Marine leadership takes seriously—especially since Gates terminated the EFV program, the Corps' effort to develop a more rapid ship-to-shore platform. Even at the peak of the Marine deployment to Afghanistan, former commandant general James Conway began a campaign to refocus the Corps on its amphibious mission; current Commandant General James Amos has sustained and expanded the effort, emphasizing the service's role in the Asia-Pacific region and exploiting the AirSea Battle initiative as a means to urge the relevancy of Marine capabilities and need for modernization. "Marines are first and foremost a naval force, even though some would like to see us branded as ground forces," has been Amos's mantra.[53]

The Future of the Marines. To better flesh out the Corps' own understanding of its role in a shifting strategic and operational landscape, General Amos established the Amphibious Capabilities Working Group, better known as the "Ellis Group," in honor of Lieutenant Colonel Earl "Pete" Ellis, one of the great Marine innovators and father of amphibious warfare doctrine in the period preceding World War II. In April 2012, this group released a report that encapsulates the service's thinking on the subject, which gives a good indication of evolving Marine aviation doctrine and the value of the F-35B. *Naval Amphibious Capability in the 21st Century* is a close read.[54]

The report begins by appealing to American tradition: "The Marine Corps' and the Navy's amphibious

capabilities have long played a central role in securing the global interests of a maritime nation."[55] Amid the shifting security demands of the present era, the report argues:

> [n]ow, more than ever, the rapid-responsiveness, readiness, flexibility, precision and strategic mobility of maritime forces are essential to ensuring continued access and security in the global commons and the littoral regions that border them.[56]

But emerging conditions—such as the proliferation of anti-access and area-denial capabilities described in this paper—are not simply new challenges, but opportunities. Indeed, claims the Marine report, "[T]he U.S. naval force of the 21st century stands at the threshold of a uniquely 'maritime moment' of opportunity."[57] In particular, the Marines "offer a portfolio of innovative, low-cost, small-footprint means for crisis response, forward engagement, direct and indirect approaches."[58]

Beyond the timeless tenets of the Marine ethos—Marines can do everything, do it well, do it cheaply, and do it on time—the working group has made a serious effort to wrestle with emerging strategic and operational realities. What the report describes may not be a sufficient solution to new threats, but is in fact a necessary response. The value of Marine capabilities will indeed increase, reflecting both the unique blend of integrated air, land, and sea forces that the service fields. The value of the Corps will also increase because the Navy alone, and especially its big-deck carrier fleet, will not be large or capable enough to answer the foreseeable need.

While it may be overly optimistic to describe the current strategic and emerging operational environment as a "moment of opportunity," the Marines are correct to focus on the littoral regions as geopolitically pivotal points and centers both of renewed military contest and technological competition. Littoral regions are already home to four-fifths of the world's population, but continually flooded—most notably in China, but throughout Asia and in Africa—with migrants from the countryside.

The regions are where modern technological, economic, demographic, and political trends intersect with the proliferation of advanced weaponry. The study is correct to observe that "[t]he protection of U.S. citizens, allies and interests requires response forces that can smoothly cross the seams in the littoral environment without the need for infrastructure or large force buildups ashore."[59]

This kind of capability will be increasingly valuable in the greater Middle East and greater East Asia. Across the Middle East, the combination of internal upheaval and American withdrawal from on-shore positions in Iraq and Afghanistan increases the likelihood of violent crisis while diminishing options for US military response. Events in Libya reveal this truth. Not only would on-station Marine forces have allowed for a better initial response, but, if fully employed, a more rapid conclusion to the Gaddafi regime. Such forces might well have made for a different outcome to the crisis of September 11, 2012, which cost the lives of Ambassador Christopher Stevens and three other Americans.

Not only would substantial ground forces and firepower have been more rapidly available, but a show of force—simply "buzzing the compound"—might have been made almost immediately, with a potential deterrent effect on the groups assaulting both the consulate and the Central Intelligence Agency facility. Equally, the shrinking footprint in the Persian Gulf region, at a time of continuous tension with Iran, is compelling US forces to fall back to an "offshore balancing" posture; hence, the constant presence of multiple big-deck US Navy carriers in the Gulf and the more open waters of the Red Sea.

The Marine Ellis Group report also represents an important advance in thinking about the development of Chinese anti-access and area-denial systems, translating the strategic requirement to sustain forward presence and reassure front-line allies into operational and tactical terms. "The assurance of sustained littoral access presents a cost-imposing deterrent to would-be opponents," the report observes. "Where the objectives . . . of a military campaign require forces ashore, the [United States] requires . . .

forcible entry capabilities that can . . . exploit seams in an enemy's defenses."[60] By simply multiplying the potential points of approach, US forces can multiply the PLA's challenges in implementing its anti-access and area-denial strategy many times over.

Most importantly, the Marine study reflects the service's understanding—too often lacking in the Navy, Air Force, or indeed in the current public debate—that defeating the anti-access and area-denial challenges are simply condition-setting operations.

While touting the ability of Marine forces built around large-deck amphibious ships, and the V-22 and the F-35B's ability to initially operate hundreds of miles from shore, the study concludes that "innovation in power projection creates new opportunities for . . . setting localized superiority to allow for closer approaches," and thus more decisive results.[61] One passage in particular is worth quoting at length:

> While the model of a technological "pacing threat" is useful, solutions to access challenges must consider the [overall capability] advantage of the U.S. joint force. The joint force will general conduct counter[anti access and area denial operations] to enable the objectives of a campaign, not as an end-state in itself. . . . Littoral maneuver, as a methodology to bypasss fixed defenses and exploit enemy seams, must overcome the potentially widening gap between ship and shore. The naval force must outmaneuver the enemy…not present an overmatch in firepower alone.[62]

One final observation about this study: it places renewed emphasis on raiding forms of warfare. Again, the need for such capabilities is to some degree the lamentable result of a contracting defense posture. The Marines have the unique capacity to stage larger-scale raids or to provide the outer perimeter of security and additional firepower to the kinds of special-operations-forces raids that have become increasingly attractive expressions of US military power. "Amphibious raids, small or large in scale, to deny terrorist sanctuary, secure potential [weapons of mass destruction] sites, conduct raids of ships, eliminate pirate safe havens or destroy threat[s] . . . in port are essential national capabilities."[63] Moreover, the capacity to conduct larger-scale raids in the context of a longer-lasting conventional conflict or competition—like the Doolittle Raid on Tokyo in 1942—would be similarly valuable, if less likely to take place.

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In sum, the study reflects the Marine Corps groping its way toward a vision of its future, what it describes as a "single naval battle," a refinement and improvement of much of what is subsumed in the fog of AirSea Battle. This approach is to "view the maritime domain as an indivisible whole," and attempts to "bridge the seams between air, land and sea."[64]

It rightly defines the seemingly discrete anti-access and area-denial challenges as a broader contest for superiority across an expanded littoral battlefield—a battlefield where the measure of success results from the ability to project power and influence events ashore. While it is also possible to read the study as a reflection of the kind of war the Marine Corps would prefer to fight, or the one that preserves the Marines as a separate service, it compares favorably to similar efforts in other services.

The Role of the F-35 in Future Marine Operations. What is notably missing from the Ellis Group's report is a well-enunciated argument for the F-35. This is surprising for several reasons. First, making the

public case for the unique value of the short-takeoff and vertical-landing-aircraft (STOVL) version of the F-35 is a key component of the larger argument for the unique value of the Marine Corps. Second, and more critically, the aircraft is the keystone to the Marine operational concept.

The service has not updated its basic aviation doctrine since 2000. This is shocking, considering not only the cost of the F-35B program, but the fact that the Marines have also invested billions to develop and now deploy a new-design, large-deck amphibious ship—the *America* class—that lacks the floodable lower well deck that allows the launching of landing craft, "swimming" vehicles, and other small boats such as riverine vessels. *America* and her sister *Tripoli* have been built with extra aviation facilities, including a larger hangar deck and storage for additional fuel and munitions. These amphibious vehicles are designed to accommodate both the F-35 and V-22, which are larger aircraft than those that they are replacing. They truly are small aircraft carriers rather than traditional amphibious ships.

This reflects the fact that the "air combat element," as the Marines call it, is naturally assuming a larger role in Marine thinking. The need for greater operational range has been discussed above, but Marine forces are also chronically lacking in firepower. Marine land forces do not have much in the way of armor or artillery, still operate an upgraded version of the Vietnam-era Cobra attack helicopter (much smaller and less sophisticated than the Army's AH-64D Apache), and thus rely on fixed-wing aviation for close air support.

The Corps' current jump jet, the small and aging AV-8B Harrier II, lacks the range and payload to conduct much in the way of deeper interdiction missions, and the systems or capacity for suppressing air defenses. The Corps' small fleet of F/A-18 Hornets is tied either to Navy carriers—the Marines help make up for the fact that the Navy has more carrier decks than air wings—or large land bases. In combat, the Marines are now often consumers of other people's firepower rather than the self-contained, self-sustaining force of Marine myth.

Despite the service's heavy investment in new aircraft and new ships to maximize the value of these aircraft, formal Marine doctrine has yet to reflect or even imagine the new capabilities on the near horizon (in the case of the F-35B) or already in service (in the case of the *America* and the V-22).

The capstone aviation manual is derived from the overall Marine operational concept of the mid–1990s' *Operational Maneuver from the Sea.* At that time, it seemed that US control of the "global commons" was absolute, and that sea-basing provided an invulnerable sanctuary for headquarters, logistics, and most fire-support functions. "Seabased forces enable commanders to provide [support] assets to fighting units without being distracted by the rear area security concerns inherent in in-shore-based logistic operations . . . to put the 'teeth' ashore while leaving the support 'tail' afloat." For its part, in staging areas over the horizon, Marine aviation would "provide responsive and sustained fires and logistic support directly into objective areas ashore."[65]

Indeed, the amphibious working group study admits that "the modern aviation combat element provides significant gains that have not been fully incorporated into operating concepts." The group understands that the "coming F-35B [will] provide significant [Marine] enhancements over legacy platforms. These provide unprecedented capability for littoral maneuver and fire support through the depth of the operating area."[66]

The study does not flesh out or clarify these opaque suggestions, but does elaborate a tactical "vignette" wherein a Marine task force is given a mission to help a threatened ally—a littoral nation dubbed "Cyan"—against an attack by its "Tan" neighbor. Tan's anti-access capabilities more resembled Iran's than China's: "They had sufficient [intelligence, surveillance, and reconnaissance capabilities] to cover out to about 200 miles [from shore] and had patrol craft, small boats and antiship cruise missiles capable of hitting us at that range." And the quality of the problem is an increasingly common one: these kinds of threats "erased the distinction . . . between threats

ashore and threats afloat." The Marines clearly acknowledge that the days of unfettered access to littoral regions have passed. In the vignette, the "seabased" forces initially operate from 300 miles at sea.[67]

Another bit of forward-looking realism is the recognition of the painstaking air defense suppression campaigns that have been *de rigeur* since Operation Desert Storm through Libya. The vignette said that "we take significant risk to support beleaguered Cyan forces before we had fully taken down the [adversary] integrated air defense system."[68] This is surely an emerging, real-world pressure. Think about operations to thwart a Chinese attack on Taiwan or even a raid on Iran's nuclear facilities: US forces have, in recent years, had the luxury of time to unlock what, by comparison, were simple and much less capable air defenses.

The study puts the new reality in dry, acronym-laden terms: "Until the JFACC took down the identified IADS, the TLAMs and F-35s bore the brunt of close air support and direct support fires to Cyan."[69] In plain English, this means that until the overall air commander gave the all-clear, only cruise missiles—of which there will always be a limited supply—and the F-35 were capable of flying strike missions. In such circumstances, an *America*-class amphibious ship with its F-35Bs will be almost as valuable as a large-deck Navy carrier—which would have to clear off its F/A-18s and load up with F-35Cs.

Later scenes in the vignette also underscore the versatility of the STOVL capabilities of the F-35B. As US forces come ashore to assist their Cyan allies, the Marines establish a "forward arming and refueling point" within their lodgment. In other words, they adapted common helicopter tactics to their strike fighters; a so-called "Forward Area Refueling Point" is a temporary gas-and-ammo station close to the front lines. As the vignette argues, this "really allows for significant flexibility in air assault operations and increased our Joint Strike Fighter (JSF) sortie rate by about one-third."[70] And indeed, this is a trick that has long been in the Marine playbook. A similar operation was conducted to support the Marine thrust into Kuwait in 1991, and would have been a critical factor had Iraqi resistance not crumbled so rapidly. These tactics will be central to defeating any substantial anti-access or area-denial challenge in the future.

In sum, introducing the F-35 into the Marine Corps will truly transform the value and utility of the service, not simply extending its value in small wars and permitting it to support larger conventional campaigns, but perhaps by making it a centerpiece in operations of all kinds. General Amos is correct to observe that he and his predecessors have not done enough to articulate these contributions; they have been insistent on the need for the stealthy jump jet, but mum on the rationale. Conversely, unless the Marines fully field the F-35B, the utility of the Corps will decline precipitously. The Marines will either be at the center of everything, or on the periphery.

4

The F-35 and Military Modernization

Given that the United States spends more on its military than the next-13-highest-spending countries combined, and that the technological capabilities of US forces are the envy of the world, the need for military modernization may not be obvious at first blush.[71] Indeed, it is fair to say that one of the reasons for DOD's stalled modernization efforts over the past two decades is the broad feeling that the qualitative advantages enjoyed by US armed forces are beyond challenge.

The few cases for concern—such as the need to respond to the "improvised explosive devices" that revealed the vulnerabilities of US Army and Marine wheeled vehicles—resulted from the unique circumstances of the post–9/11 conflicts. The larger lesson for the American political class appears to have been to avoid such long-running irregular conflicts rather than accelerate force modernization.

But it is undeniably true that, compared to previous plans, post–Cold War modernization efforts across the services are moving along at a snail's pace. While the utility and value of American air power—and the need for it among the services—has never enjoyed as much appreciation as it ought to, investments to maintain the US air-power advantage have slowed dramatically. The first crop of "stealth" aircraft, the small F-117 Nighthawk fleet, has been retired altogether.

Only 21 B-2 bombers of a planned 132 were purchased. Similarly, the F-22 program, originally intended to produce 750 jets, was terminated in 2009 with the procurement of only 187 planes. Therefore, the vast majority of the manned aircraft in the US Air Force's inventory were designed in the late 1960s or early 1970s.[72] Because of its versatility, more robust stealth technology, and the sheer size of the program, the F-35—and only the F-35—can move the military's modernization process beyond these decades of incrementalism. It is the sole practical solution for ensuring the superiority of American air power for decades to come.

The F-35 was always intended as the largest project of its era, the "fifth generation" of aircraft and other systems envisioned near the end of the Cold War and immediately after, and is now one of the few remaining opportunities to bring those technologies into use. If the F-35 program is further truncated—indeed, if it is not accelerated and sustained—the United States will essentially have "skipped a generation" of military modernization. This section will show how the F-35 program fits into a larger strategy of military modernization necessary to defeat potential future enemies, how it is uniquely positioned to ensure the continued superiority of American air power, and discuss the importance of maintaining the critical sections of America's defense industrial base—including the parts of the base associated with the F-35, which would allow America to counter future threats.

There are two important ways in which the F-35 program is critical for the future security of the United States. First, the Lightning II's capabilities would become the core of emerging US military operational concepts. Beyond the essential functionality that the JSF would provide the US Marine Corps, Air Force and Navy concepts of operation will similarly depend on fielding the F-35 in numbers. Secondly, the many elements of the F-35 project, not just the completed aircraft, but also the many subsystems and the tremendous amount of software required, represent an outsized proportion of the US defense industrial base.

Why Modernize? Since the late Cold War, US force planning has depended upon, as Pentagon Director of Net Assessment Andrew Marshall put it, "maintaining

significant margins of advantage" in key areas deemed critical to the US military's position.[73] In other words, while the United States often fails to articulate a defense strategy that permits definitive modernization choices, it consistently gives a very high priority to certain capabilities. At the top of that list is tactical air power. The sustainment of global power balances directly hinges on America's ability to project power efficiently and effectively, at a moment's notice, anywhere on earth.[74] US military reliance on very sophisticated aircraft and munitions to achieve both flexibility and mass undergird these capabilities; a mass of platforms results in a mass in effect.

Thus, US force planning is driven by one enduring certainty: that the United States will remain the global guarantor of security. Yet it is also driven by one constant uncertainty: that it is difficult to know where the next crisis or conflict will occur. Therefore, modernization efforts across the services have centered on the need for systems that can operate under varied contingencies and that avoid the overall costs of having to build more numerous and more specialized systems.

On the naval front, for example, the Virginia-class attack submarine program was conceived as a lower-cost version of the Seawolf-class submarine that would also feature "improved, multi-mission operational flexibility."[75] Unlike the system that it replaced, Virginia-class vessels were designed to operate well in deep-water and littoral environments, which could prove useful should a conflict arise, for example, in either the Persian Gulf or in East Asia.

The principle of operational versatility applies in spades when it comes to the F-35. The F-35 is wrongly thought of as a strike-fighter replacement for the F-16, F/A-18, and AV-8B Harrier II. It is that, but also much more—its advanced sensors, when networked together, will eventually substitute for the Navy and Air Force fleets of very expensive (and very in-demand) surveillance and reconnaissance and command and control aircraft. When used in combination with munitions-carrying drones, small formations of F-35s will be able to conduct large-scale strikes that remain the purview of large, manned bombers.

But compared on a fighter-to-fighter basis, the costs of the F-35 seem staggering. Senator John McCain, while often a supporter of the program, has decried "the cost overruns and problems" associated with the JSF. Program delays resulting from the engineering challenges of the aircraft itself, the initial desire to rapidly field and thus concurrently design and build the F-35, and constant changes in program budgets have driven the price of the plane upward. A Government Accountability Office report on the program calculated that cost overruns would add $11 million to the per-unit cost of each of the 63 aircraft currently under contract.[76]

If the F-35 program is further truncated—indeed, if it is not accelerated and sustained—the United States will essentially have "skipped a generation" of military modernization.

Critics in Congress and the press regularly overlook the role the government plays in these price rises. For example, mid-contract changes to the aircraft specifications naturally increase costs because they require the contracting agent to modify procedures or equipment mid-stream to accommodate the government's requests. Also, many original Pentagon cost estimates regarding the JSF were made under generous assumptions about the long-term rate of inflation, and government cost estimates frequently fail to take into account the per-unit savings that could be realized by increased economies of scale.[77]

In the context of historical aircraft development programs, delays and cost overruns are hardly unique to the F-35: the development programs of the C-17 Globemaster III and the F-22, for example, both experienced similar problems. Cost overruns are a problem, but cannot be overcome simply by slapping the hands of contracting agents. The Pentagon and

Congress must also examine their behavior with regards to such long-term contracts to ensure that mid-stream requirements changes do not result in higher costs to the taxpayer.

Fleet-to-Fleet Comparison? Cost criticisms and studies also fail to account for many kinds of opportunity costs associated with preserving the current generation of aircraft for an extended period of time. Those opportunity costs are already being paid. As of 2002, the average fighter aircraft in the US Air Force was 20 years old, and support aircraft were older still.[78] The average age of aircraft has only gone up since that time, and the conflicts in Iraq and Afghanistan will likely necessitate many costly repairs to the fleet in order to maintain its functionality into the future.

Sustaining airborne power projection capabilities also requires maintaining a host of frequently overlooked support equipment and functions. Current tactical aircraft systems, for example, rely on a host of auxiliary platforms—such as the joint surveillance and target attack system (JSTARS)—for critical electronic warfare and command-and-control support. Long-term reliance on the JSTARS platform would require expensive computer system upgrades that might be of questionable utility given the accelerating development of systems designed to thwart it.[79] Aside from the added expense, the coordination of additional platforms upon which fourth-generation tactical fighters rely decreases efficiency and increases the chances of operational complications or failure.

The fact that the F-35 will render many of these systems redundant creates opportunities for decreased costs and increased operational efficiency in the future.[80] Thus, a true capability-to-capability comparison would also make the F-35 look like a better bargain. In addition to streamlining future operations, technology onboard the F-35 will also increase the operational choices available to military decision makers. Digital radio frequency memory countermeasures, for example, will allow the F-35 to better defeat air-to-air and surface-to-air missile systems, and the aircraft's advances in stealth technology will not only allow it to operate during the day, but will also provide an edge against the increasingly sophisticated counter-stealth efforts of other countries.[81]

Furthermore, because of the versatility and open design of the aircraft, the F-35 will replace not only aircraft used by the US Air Force, but also fit well into the missions of Naval and Marine Corps aviation. And, even with the concomitant life-extension programs that would be required for the large surveillance, reconnaissance, and other support aircraft needed to make fourth-generation strike aircraft useful against modern air defenses, it is far from clear that the current generation will continue to be so effective in combat.

Air Supremacy and American Power. Air power is the signature form of American military power. It is not just that air power is effective on its own; advantages in air power are moreover critical to success in naval and land operations. Air-power theorists have long distinguished between "superiority" (the ability to grab a temporary and local advantage) and "supremacy" (larger-scale and longer-lasting advantages that often correlate to a more decisive outcome). The history of air power in the 20th century provides several lessons regarding the central importance of air supremacy in modern warfare:[82]

- *World War I:* the first conflict where air power was a decisive factor showed that the effectiveness of ground forces was enhanced by air support, but that this was not possible without first achieving air superiority;

- *Sino-Japanese War:* demonstrated how easily air supremacy could be lost and the importance of forward bases to extending power projection capabilities;

- *World War II:* El Alamein demonstrated that air superiority over battle zones was not only helpful, but central to winning battles; Operation Overlord (code name for the Battle of Normandy) brought to light an additional benefit of air superiority—denying

the enemy reconnaissance opportunities—and the Battle for the Atlantic showed that air power could render many aspects of sea power moot;

- *Korean War:* showed that fully leveraging air power requires nuance when facing an enemy that is not highly reliant on infrastructure and industrial supply lines;

- *Vietnam War:* revealed the importance of countering the threats posed by surface-to-air missiles to maintain and fully leverage air supremacy;

- *Persian Gulf War:* showcased the technological superiority of American air power, and demonstrated that air power could also serve as a primary means to "paralyze" the leadership of a hostile nation, even amidst a casualty-averse environment.[83]

Operations through the many phases of the Iraq war showcased the many "enabled and enabling" aspects of US air power, from satellite networks to the increasing importance of tactical unmanned aerial vehicles. Yet none of these advantages can be fully leveraged in a combat zone without air superiority, and America's ability to achieve it is essentially a job for the US fighter fleet. Although current capabilities may be sufficient to thwart the air forces of many countries, the technological gap between much of the US tactical aircraft fleet and the next-most-capable militaries is only about five years.[84] The gap between American stealth technology and those of other countries is wider, but that gap may be narrowing as well, as some are moving forward with fifth-generation aircraft.

Two versions of China's J-20 fifth-generation stealth fighter have had successful test flights as of November 2012, for example, and Russia's T-50 fifth-generation stealth fighter, which took its maiden flight in 2010, has recently tested an additional variant with upgraded on-board radar capabilities.[85] The United States must command the skies to take full advantage of its space-based and theater-level assets; and to attain command of the skies, the United States must ensure that its fighter force is second-to-none on the planet.

The F-35 promises to deliver on both of these requirements because of its superior combat radius, versatility, and the highly upgradable nature of its design. First, its radius of operation is superior to that of the F-16, F-22, and A-10 Thunderbolt II, which will increase America's ability to project air power into enemy territory.[86] With a combat radius of 600 nautical miles, the F-35C could easily reach Tehran from the Persian Gulf (or fly from Washington, DC, to Jacksonville, FL, and back), a task beyond the range of the F-22, the next-best fighter in the US fleet in that regard, and also well beyond the range of fourth-generation aircraft.

When used in combination with munitions-carrying drones, small formations of F-35s will be able to conduct large-scale strikes that remain the purview of large, manned bombers.

Second, the versatility of the F-35 will allow military decision makers to project this power under a wide range of circumstances. The STOVL capability of the F-35B, as argued extensively above, will allow the launching of fighter missions from preexisting ship decks and austere bases, and a potential pilotless version of the F-35 will increase the ability of the US military to operate in high-risk environments with an even greater range.[87] Third, the F-35 has been designed to maximize "commonality," which translates to a reduction in unique parts between variants, better interoperability with allied forces, and an ability to integrate new technologies into the aircraft.[88]

Thus, as new radar countermeasures are designed or as communications technology evolves, so will the

F-35, and interoperability between variants will keep the cost of upgrading the entire fleet low. Put simply, the F-35 will expand America's strategic options throughout the globe and enhance its ability to attain air superiority under a variety of circumstances. In the words of Ashton B. Carter, the man at the center of the Obama administration's procurement and force-planning efforts, the JSF "will be the backbone of US combat air superiority for the next generation."[89]

The F-35 and American Defense Industrial Supremacy. It is largely undeniable that maintaining America's ability to attain air superiority is an important goal, but the current fiscal climate has left some wondering if now is the right time to make costly investments in US military equipment. Some argue that, as evidenced by the US military's performance in Iraq and Afghanistan, now is precisely not the time when America has to worry about maintaining the technological edge enjoyed by its armed forces.

After the success of US forces in the Gulf War, proponents of the idea of a post-war "peace dividend" made a similar argument.[90] These positions are shortsighted. Not only is the timing for increased investment right because of the technological progress of America's enemies and the aging state of the country's aircraft fleet; the timely investment is critical to the continued health of the defense industrial base.

The sector is highly sensitive to decreases in government orders of the goods it produces, its contribution to the economy is not inconsequential, and its pool of talent and skilled workers is shrinking. Though maintaining or increasing funding for the JSF will not solve all of these problems, its status as the Pentagon's largest current acquisition program would send a clear message to the industry that its contribution to the economy and US defense will be sustained well into the future.

The relationship between government and industry is complicated by the nature of the market for defense-related goods, which is essentially a monopsony with one customer and many suppliers.[91]This situation creates several market distortions that ultimately increase costs. First, if the government reduces or eliminates orders, many contracting elements cannot simply switch to a new customer base to fill unmet demand.[92] Instead, contracting agents seek to mitigate their losses by eliminating industrial capacity, impacting both employment and the nation's ability to fill its defense equipment needs in times of crisis. Second, the monopsonistic nature of the defense sector creates the perception of ballooning costs that have been referenced by numerous congressional hearings and news reports. Yet, because the US government holds the power to set the price, contracting agents often compete via the so-called "low-bid" system that cannot account for the unforeseen circumstances—such as mid-stream program changes—that necessarily increase post-inception contracting costs.[93]

These cost increases often lead to decreased equipment orders, which either result in additional per-unit costs because of reduced economies of scale, or a diminishment of the industrial base necessary to produce such equipment. We do not argue that defense production should be conducted by the government itself—this would naturally create an excess capacity problem—but without careful attention to the defense industrial base's responses to the market in which it operates, the United States risks losing aspects of its industrial base that may prove critical to the future defense of the nation. Pentagon officials recognize as much: in their *Annual Industrial Capabilities Report to Congress* in August 2012, they recognized that a "strong, technologically vibrant, and financially successful defense industry is in the national interest."[94]

Despite the inefficiencies inherent in the interactions between the defense industry and the government, the sector produces large economic and employment benefits. At a time of escalating trade deficits, for example, exports from the defense sector are a net positive to America's trade balance with foreign countries, amounting to $42.1 billion in 2010 even in light of restrictive export control policies.[95] The defense industry contributed 2.3 percent of overall US gross domestic product in 2009—more than the automobile industry—and contributed even

more to the local economies of certain states such as Virginia, California, Texas, and Florida.[96] The defense industry also employed over 1 million people in 2010, with an average sector salary second only to information technology.

Looking beyond the numbers, many of the employees in these positions possess "skills that are critical to [addressing] future national security threats," an asset that would not be easily reproduced if their positions were to vanish because of indiscriminate funding cuts.[97] Less quantifiable but no less important are the spillover effects of innovation in the defense sector to the rest of the economy; many technologies upon which the United States now relies were first developed for national defense reasons. The defense industrial base not only contributes vitally to US national security, but also to America's overall economic vitality.

The F-35 program, in addition to providing the next generation of stealth aircraft, also reflects the positive economic contributions of the defense industrial base. Many of the personnel working on the program are trained in aerodynamics, thrust vectoring, carrier operations, and low observable technology, skill sets that "face current atrophy or erosion," said to a 2012 Pentagon report.[98] According to the principle contractor, Lockheed Martin, the F-35 program employs over 133,000, had a $17.7 billion impact on the US economy, and could contribute up to $200 billion in export receipts over the next several decades.[99]

Lockheed Martin has much at stake with the F-35: its revenue levels over the next 20 years will hinge largely upon the successful completion of the program.[100] Yet the more disconcerting impact of a decreased F-35 buy might be felt by subcontractors, some of whom might be "forced out of the business" because of lack of alternative sources of revenue.[101] The manner in which the government handles the F-35 program will indicate the seriousness with which it intends to maintain the industrial capabilities that undergird America's defense.

Contracting agencies are not alone in having much at stake with the program: given that by 2010, the government had already spent $56 billion of taxpayer money on the F-35, and that total costs are estimated in the $260 billion range, a great deal of taxpayer money rides on the success of the JSF.[102] At stake is not only the actual final cost of the program, which will be highly dependent on variables such as inflation and the actual number of aircraft ordered, but also unique components developed for the F-35 that supersede the capabilities yielded by technology used in older aircraft.[103]

As new radar countermeasures are designed or as communications technology evolves, so will the F-35, and interoperability between variants will keep the cost of upgrading the entire fleet low.

For example, the variant of the active, electronically scanned array radar designed specifically for the F-35 (the AN/APG-81) surpassed the abilities of the radars on the F-16 and the F-18.[104] Without F-35 production, the demand for this specially built radar would disappear, as would the taxpayer funds that went into its development. The jobs and facilities related to its design and production would also become unnecessary. If a crisis arose in which this or other capabilities unique to the JSF were deemed important, the infrastructure, jobs, and network of subcontractors needed to produce it could not be reassembled overnight.

Faced with constant annual deficits and a ballooning overall federal debt, American politicians have begun to confront difficult choices. But the choices made regarding defense have consequences far beyond the fiscal realm: they will signal to the American people, America's allies, and its enemies the extent to which the country is willing to prioritize its future security. The choices made by policymakers will also send a message to the defense industrial base about whether it should retain many of its highly

skilled workers, whether it should maintain manufacturing capabilities that are unique to defense, and whether the government is a customer that, despite its considerable market power, is willing to follow through with its commitments.

This last signal is important: the F-22 fighter jet was terminated after only 187 of the 700-plus expected aircraft were procured, but the JSF takes up a much larger proportion of the Pentagon's procurement budget than the F-22 ever did. This means that the health of the F-35 program is many times more important to the overall health of the industry. If the government continues to delay, reduce, or terminate the F-35 project, it will have dealt a body blow to the defense industrial base. Conversely, by sustaining or increasing the procurement rate, it will ensure the continued existence of the kind of deep, multitiered supplier base needed not only today, but for a very uncertain future. And, of course, the government would enjoy increased economies of scale and a lower per-unit cost of the JSF.

Conclusion

Not by rambling operations, or duels, are wars decided,
but by force massed and handled in skillful combinations.

—Alfred Thayer Mahan[105]

For more than a generation, the US defense establishment has been mesmerized by the advantages of advanced technology on modern battlefields. As President Obama famously told Republican challenger Mitt Romney in the 2012 candidates' debates, modern warships are far more capable than those of bygone eras. And the advantages of technology are most obviously apparent in this "age of airpower." Though embroiled in high-tempo operations since the 1991 Gulf War, the US military routinely loses more aircraft in training accidents than in combat every year.

Nonetheless, this study boils down to one simple but eternal truth: in war, numbers matter. Numbers matter in weapons programs as well. Scale in production brings not only economy, but improved performance; the 1,000th F-35 will be a better plane than the 100th. Scale brings efficiencies and produces greater effectiveness in industry as well; program stability, even in a government-regulated business—where even the profits are regulated—makes for improved finance, a reliable network of subcontractors and suppliers, and a better workforce.

The F-35 is a much better strike fighter than the fourth-generation aircraft that have served US forces for so long. As a "network," F-35 formations will be able to do many of the reconnaissance, surveillance, and support missions of the current fleet. But most of all, the F-35 fleet will possess one quality—mass—that America will otherwise lack. And an America reduced to duel-fighting, or indecisive "rambling operations," will no longer enjoy anything like the supremacy of the recent past.

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