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# The Opportunity Costs of Large-Deck Carriers: Naval Strategy for the 1990s and Beyond

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Mark A. Randol and Wallace J. Thies

**A**s a nation of travelers and traders, naval power has long played a central role in the defense of American interests abroad. The oceans bordering North America have been both a barrier and a highway, separating the United States from potential enemies, connecting it to allies, and providing a venue for commerce and trade. Geography dictated the prominent role of naval forces in American foreign policy during the eighteenth and nineteenth centuries, and with the emergence of the United States as a military and economic superpower, Americans have come to depend even more heavily on naval forces as foreign policy instruments.

We currently expect the navy to perform four missions that are vital to maintaining the kind of world order within which American values and institutions can survive and flourish: Those missions are to deter nuclear war, keep open the sea lanes, project power ashore, and maintain a military presence in troubled areas abroad. To perform these missions well, naval forces “must be able to project power under the sea, on the surface, in the air above, and over land.<sup>1</sup> Supporting such a navy would be difficult enough during a period of budgetary feast, but clearly the navy is now facing a period of static or even declining budgets, which are likely to extend well through the 1990s.<sup>2</sup> This shrinking of budgetary resources is taking place at a particularly inopportune time.

By the late 1970s, a decade of lean budgets had not only left ship numbers at a post-World War II low, but most of the ships still in service had grown old. The Reagan administration, which made a larger navy the cornerstone of its plans to rebuild American military strength, sought to expand and modernize the fleet by procuring new classes of ships capable of meeting the

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challenges posed both by Soviet naval power and by the diffusion of modern military technology to such countries as Iraq, Iran and Libya. In order to recruit and retain the kind of personnel needed to operate its new and complex vessels, the navy also attempted during the 1980s to reduce ships' time away from home ports. The attempt to simultaneously expand, modernize, and reduce operating tempo led the navy to undertake its most ambitious shipbuilding program since the Second World War.

These initiatives were set in motion early in the 1980s when defense budgets were expanding rapidly. Now the bills have come due, and the navy finds itself with insufficient funds to complete all of the modernization and expansion programs that were begun at the start of the decade. As a result, in the years ahead the navy will face a series of dilemmas that will prove increasingly difficult to resolve.

Our purpose is to investigate whether some of these dilemmas can be alleviated by creating a new class of aircraft carrier, thereby allowing a restructuring of the fleet that will enable it to better perform the sea control, power projection, and presence missions. This new ship would be about half the size of the *Nimitz*-class and would capitalize on the maturing technology in vertical or short takeoff and landing (VSTOL) aircraft for combat roles at sea.

We will not rehash the old "large versus small" carrier debate. If the navy could count on unlimited shipbuilding growth, large-deck carriers would be preferable, perhaps even more than the 15-ship force that has long been its goal. But shipbuilding budgets are limited, and in the near term there will be no growth in defense spending. Therefore, exclusive reliance on large-deck carriers may not be the best use of available resources in the coming decade. It is thus incumbent on defense planners to consider the opportunity costs of continuing to build ships that, although very capable, are very costly.

### Rebuilding the Fleet in the Post-Vietnam Era

The post-World War II navy reached its peak strength of 976 ships, including 15 attack and eight antisubmarine carriers, in 1968 at the height of the Vietnam War. During the 1950s, four new carriers had entered the fleet as replacements for older vessels, followed by five more replacement carriers during the 1960s (see table 1).

Between 1970 and 1980, defense spending in the United States declined at an average annual rate of 1.5 percent, measured in constant prices,<sup>3</sup> resulting in a slowdown in naval construction and, consequently, aging of the carrier fleet.

During the 1970s only two new carriers joined the fleet, with two more under construction at the end of the decade.<sup>4</sup> To compensate for this slowdown in construction, two World War II-vintage carriers, the *Midway* and the *Coral*

Sea, were kept in service even though they had reached the end of their expected 30-year service by 1975 and 1977 respectively.

### Current and Projected Aircraft Carriers

Ship Class/Name	Number	Enter Fleet	Enter SLEP*	Complete SLEP*	Expected Retirement
<u>NIMITZ</u>					
<i>United States</i>	CVN-75	1997			
<i>Stennis</i>	CVN-74	1996			
<i>Washington</i>	CVN-73	1992			
<i>Lincoln</i>	CVN-72	1990			
<i>T. Roosevelt</i>	CVN-71	1986	2016?		
<i>Vinson</i>	CVN-70	1982	2012?		
<i>Eisenhower</i>	CVN-69	1977	2007?		
<i>Nimitz</i>	CVN-68	1975	2005?		
<u>KITTY HAWK/KENNEDY</u>					
<i>Kennedy</i>	CV-67	1968	1999	2002	2017
<i>America</i>	CV-66	1965	1996	1999	2014
<i>Constellation</i>	CV-64	1961	1990	1993	2008
<i>Kitty Hawk</i>	CV-63	1961	1987	1990	2005
<u>ENTERPRISE</u>					
<i>Enterprise</i>	CVN-65	1961	(1)	early	2000s
<u>FORRESTAL</u>					
<i>Independence</i>	CV-62	1959	1985	1988	2003
<i>Ranger</i>	CV-61	1957	(2)		1990s
<i>Saratoga</i>	CV-60	1956	1980	1983	1998
<i>Forrestal</i>	CV-59	1955	1982	1985	2000
<u>MIDWAY</u>					
<i>Coral Sea</i>	CV-43	1947			1990
<i>Midway</i>	CV-41	1945			1992

\*Service Life Extension Program

(1) The *Enterprise* (CVN-65) underwent an extensive refit similar to SLEP between 1979-82. She is scheduled to undergo a similar refit in the 1990s. This will extend her service life into the early 2000s.

(2) The *Ranger* (CV-61) is not scheduled to undergo SLEP. But, when she replaces the *Midway* (CV-41) in Japan, she will be upgraded during normal yard repairs extending her life into the 1990s.

Table 1

Source: Polmar, Norman, *The Ships and Aircraft of the U.S. Fleet*, 14th ed. (Annapolis, Md.: Naval Institute Press), 1988.

By 1977 the fleet had shrunk to only 464 ships, including 12 large-deck multipurpose carriers.<sup>5</sup> The antisubmarine carriers had disappeared. This retrenchment reflected both the erosion of public support for military

spending in the post-Vietnam era and the declining need for naval forces due to the American disengagement from Southeast Asia.

The fewer number of ships available made it more difficult for the navy to support American foreign policy by maintaining the necessary military presence near trouble spots overseas. In November 1979, after the U.S. embassy in Tehran was seized by Iranian radicals, it took the *Midway* and her escorts roughly ten days to steam from the western Pacific to the Arabian Sea. The presence of two carrier battle groups near the Persian Gulf throughout 1980 was sustained for the most part by stripping both the Mediterranean and the western Pacific of one of the two carrier groups normally deployed there. Those redeployments occurred at a time when the Soviets were expanding both their Mediterranean squadron and their Pacific fleet, thereby contributing to unease among American allies in those regions.<sup>6</sup>

In retrospect, a strong case can be made that during the 1970s the navy was caught in a vicious cycle that was at least partly of its own making. As defense spending declined, the navy became increasingly anxious to maintain at least 12 large-deck carriers in operation, and by the mid-1970s about 50 percent of the naval budget was devoted to building and operating the carrier force.<sup>7</sup> The more money that was spent on the carriers, the less there was available to support, much less enlarge, the surface fleet. This helps to explain why ship numbers declined steadily during the 1970s. Escorts for carrier battle groups are a high priority, and the decline in fleet size meant that an increasing proportion of the surface fleet had to be dedicated to protecting the carriers. This, in turn, limited the navy's ability to patrol the sea lanes and maintain a presence near trouble spots.

Proponents of continued reliance on large-deck carriers argued that these deficiencies could be offset in part by the carriers' ability to project naval air power directly against Soviet ports and airfields.<sup>8</sup> But in order to keep the carriers out of range of Soviet land-based aircraft, the planes they carried had to become larger, which meant that the carriers had to become larger too. The larger the carriers, the more expensive they were to build and operate, thereby making it more difficult to buy replacement vessels at a time when defense spending was declining. The fewer the carriers available, the more vital it was that they be the very best that could be built, thereby putting even more pressure on budgetary resources.<sup>9</sup>

By the start of the 1980s, the Reagan administration had inherited a fleet stretched almost to the breaking point as a result of expanded responsibilities and diminished resources. Navy ship strength in 1980 was 479 battle force ships, an increase of only 13 over the post-Vietnam low in 1977. Acceptance of new responsibilities in the Indian Ocean created numerous instances in which carrier battle groups were required to remain on station longer than scheduled in order to support emergency deployment requirements.<sup>10</sup> This

increase in operating tempo came at considerable cost to the navy in terms of morale, recruitment, and retention of skilled personnel.<sup>11</sup>

In order to meet these increased forward-deployment requirements, while reducing operating tempo to a more manageable level, the Reagan administration advanced three lines of policy intended to improve the navy's ability to respond to crisis situations. First, it developed a renewed carrier-building program intended to increase the number of readily available carriers from 13 to 15. Because of anticipated retirements and the initiation of the Service Life Extension program in 1980,<sup>12</sup> a net increase of two in the carrier force required persuading Congress to authorize *four* new *Nimitz*-class carriers (in addition to the two already under construction in 1981), the first of which would not enter the fleet until 1990.<sup>13</sup>

Second, the Reagan administration requested the reactivation of the four *Iowa*-class battleships, each of which was to become the centerpiece of a new surface action group complete with escort vessels. The navy justified the reactivation cost of \$1.74 billion on the grounds that the new surface action groups were integral to its plans to expand to 600 ships and would enhance its ability to project power ashore and maintain a presence in troubled areas overseas. It was also hoped that battleship surface action groups could substitute for carrier battle groups in forward-deployment areas to reduce the amount of time spent at sea by the latter.<sup>14</sup>

Third, the Reagan administration proposed an increase in both the number and the quality of the escort and support vessels (cruisers, destroyers, frigates, and underway replenishment ships) needed for the additional carrier and battleship task forces that it planned to create. Some of these new escort vessels were also to be made available for independent operations, such as sea control missions in the Atlantic or the Pacific, maintaining a military presence in the Caribbean or the Persian Gulf, and port calls to friendly nations. These new ships were designed for effective operation in the high-threat environment posed by Soviet submarines and land-based aircraft.

The goal of these initiatives was a 600-ship navy that would include at least 19 task forces organized around either a carrier or a battleship. A large increase in the size of the fleet was achieved during the 1980s: the number of deployable capital ships increased from 13 to 18, and the fleet as a whole increased from 479 ships in 1980 to 565 in August 1989. The rebuilding of the fleet, however, has taken longer than expected and proven extremely costly, thereby calling into question the navy's ability to achieve the numerical goals set during President Reagan's first term.

The principle of a 15-carrier force was accepted by Congress in 1982, when it agreed to include funds in the fiscal 1983 budget for two additional nuclear-powered carriers,<sup>15</sup> but it will take the better part of two decades just to achieve a net increase of two in the number of deployable carriers. The delays encountered in reaching the 15-carrier level are indicative of the problems

facing the navy now that it has entered the 1990s.<sup>16</sup> Part of the reason for these delays is that it takes about seven years to construct a *Nimitz*-class carrier, and only one shipyard in the country has the facilities to build it (Newport News Shipbuilding).

A second and more troubling problem is the relentless aging of the carrier fleet. In 1980, the number of deployable carriers declined from 13 to 12 with the entry of the *Saratoga* into the Service Life Extension Program. The addition of the *Vinson* in 1982 and the *Theodore Roosevelt* in 1986 brought that number back up to 14, but the delivery of the *Lincoln* and the *Washington* in 1990 and 1992 will simply compensate for the long-delayed retirements of the *Midway* and the *Coral Sea*. Completion of the *Stennis* in 1996 will raise the number of deployable carriers to 15 but only for a few years, since by 1998 the *Saratoga* will be ready for retirement, having completed the 15 years of additional service made possible by the Service Life Extension Program. Completion of the *United States* (CVN-75) will buy a few more years but probably no more than that, since during the first decade of the twenty-first century six older carriers will follow the *Saratoga* into retirement.<sup>17</sup> How these ships will be replaced is a matter that has barely been discussed in public, much less decided.

The navy has also incurred significant costs as a result of its other programs for modernization and expansion. The Aegis-equipped *Ticonderoga*-class cruiser (CG-47) was intended to serve as the principal anti-air-warfare escort vessel for both carrier and battleship task forces. When the last vessel of the program's 27-ship production run is delivered, the average cost per ship will have exceeded \$900 million.<sup>18</sup> The first five of the *Arleigh Burke*-class guided missile destroyers (DDG-51), which are to be equipped with a less costly version of the Aegis system, will cost well over \$800 million each.<sup>19</sup> Thirty-eight of these ships are planned.

The Reagan administration also committed the navy to modernizing and expanding the nuclear attack submarine component of the fleet through the construction of a new class of submarines, led by the *Seawolf*. Advances in Soviet submarine and antisubmarine warfare technology have given this program such a high priority that it is unlikely to be scuttled or even scaled back much. At an estimated cost of \$36 billion for 29 submarines, the *Seawolf* program could consume as much as one-third of the navy's shipbuilding budget over the life of the program.<sup>20</sup> In addition, the navy continues to modernize the sea-based leg of the "strategic" forces triad through construction of *Ohio*-class ballistic missile submarines (SSBN). A single *Ohio*-class SSBN, which in 1978 was estimated to cost approximately \$1.2 billion, now costs in excess of \$2 billion.<sup>21</sup> The importance attached to this most survivable of the nation's strategic weapons systems is likely to make this program, like the *Seawolf*, virtually untouchable.

Because of initiatives such as these, by the mid-1980s the navy had so many costly modernization programs underway that many in Congress and in the public began to question whether the nation could afford to make all of these improvements at once.<sup>22</sup>

**A**s set forth by Admiral James D. Watkins, who became Chief of Naval Operations when the Maritime Strategy was being formulated, the navy must be able to respond effectively to various forms of conflict on a worldwide basis: "Preparation for global war is the critical element in ensuring deterrence, but our peacetime operations and response in time of crisis are also crucial contributions to deterrence and stability. . . . In fact, the volatility of today's international situation suggests that we must expect to employ these elements of our Maritime Strategy in an expanding set of the world's trouble spots."<sup>23</sup>As these comments suggest, the Maritime Strategy is based on the premise that it is better to deter conventional conflicts than to fight them. It also recognizes that this will not be easy to do, because the volatility of the international situation and the wide diffusion of modern military technology suggest an expanding rather than a declining list of potential trouble spots.

The principal challenge posed by the Maritime Strategy is that the requirements of operating at differing levels of conflict in widely separated locales are not identical. The ability to contribute to the goals of nuclear deterrence and warfighting in a global war scenario is a function of both the number and quality of the ships available at the outset of such a war. Certain classes of ships will require the most sophisticated technology available in order to perform effectively during such a war: ballistic missile submarines (to ensure their survivability), nuclear attack submarines (in order to find and destroy Soviet submarines), and certain surface combatants (in order to project power directly against the Soviet Union). For other classes of naval forces, the number of ships and planes available would be as important as the sophistication of their weaponry. Controlling the sea lanes is impossible if only a few ships and planes are available, no matter how sophisticated they may be.

The navy's ability to contribute to the goals of crisis prevention and crisis management in nonnuclear scenarios, on the other hand, is determined principally by the number of independently deployable task forces available and the speed with which they can reach the scene of trouble. The more task groups that can be maintained on a forward-deployed basis during normal peacetime operations, the more visible the fleet's operations will be and thus the greater its ability to deter crises by dissuading hostile states from challenging American interests. By the same token, the greater the number of task groups forward-deployed, the more rapid the navy's response to crises that have broken out anyway, and the more effective it can be in support



of efforts to manage and defuse threats to American interests short of war. Crisis prevention and crisis management call for large numbers of ships operating effectively, far from home, although not all of them need incorporate the very latest and most expensive technology.

Since the navy does not have access to an unlimited budget, a balance must be struck between the requirements of preparing for global war and that of contributing to the management of international crises. The navy has argued that a fleet prudently balanced between these missions would consist of about 600 battle force ships organized around 15 carrier battle groups and four battleship surface action groups.<sup>24</sup> This configuration, in the navy's view, would make available sufficient ships to satisfy forward-deployment requirements while holding operating tempo to a manageable level. The 15 large-deck carriers would provide survivable and heavily armed task groups capable of both forward offensive operations in high-threat environments and the diversity of tasks (reconnaissance, surveillance, air defense, power projection) required for successful crisis management.

The Maritime Strategy was intended to clarify the navy's role in supporting broad foreign policy interests, thereby easing the task of allocating scarce resources among competing programs. For a variety of reasons, however, the choices facing the navy in the 1990s are likely to become more difficult. The increase in the size of the fleet notwithstanding, the navy's ability to respond quickly to crisis situations has not improved much over that of the 1970s. This is due in part to the increased demands upon the fleet, but it is also due to unanticipated shortcomings in the fleet configuration called for by the Maritime Strategy.

Foreign policy decisions made by the Carter and Reagan administrations effectively extended the zone of normal peacetime operations from the Mediterranean and the western Pacific to include the Caribbean and the Indian Ocean. The lag in carrier construction during the 1970s, the onset of the Service Life Extension Program, and the delays encountered in building additional *Nimitz*-class vessels have combined to limit the number of deployable carrier task groups to about four.<sup>25</sup> During the 1980s these four have been spread out over four oceans rather than two.

**T**he decision to reactivate the four World War II-era battleships was justified in part by the hope that some forward-deployment requirements could be satisfied by new surface action groups organized around them. In practice, however, the battleship task forces have operated mostly as adjuncts to the carrier task forces rather than as independently deployable components of the fleet. Since battleship task forces lack indigenous air cover, the navy has been reluctant to deploy them outside the range of carrier—or land-based air. During recent reflagging/escort operations in the Persian Gulf, the *Missouri* and the *Iowa* were deployed to

the Indian Ocean and even placed temporarily under the command of the navy's Mid-East Force. But the ships themselves were restricted to the Arabian Sea, where they could operate under the protective cover of carrier-based aircraft.<sup>26</sup>

The formation of the battleship task forces has thus contributed little to the goal of enhancing the navy's ability to control the sea lanes or maintain a military presence near potential trouble spots. These task forces have, however, absorbed escort vessels (about four destroyers and frigates per battleship) that might otherwise have been available for sea control or presence missions. The battleships also have annual operating costs of approximately \$35 million, more than twice that of a cruiser and three times that of a destroyer.<sup>27</sup>

In addition, the navy has encountered difficulties in lowering operating tempo for the fleet as a whole, one of the central objectives behind the decision to build up to 600 ships. By 1985 approximately 60 ships had been added to the fleet, but according to John Lehman, "we have not gotten a single day of relief." Instead of the same workload being distributed over a larger fleet, the theater commanders "have scarfed up every new ship" and given them additional duties.<sup>28</sup> In 1987, over one-quarter of the ships assigned to the Atlantic and Pacific fleets failed to meet the goals set by the Chief of Naval Operations: no deployments longer than six months and no more than 50 percent of their time spent away from their homeports.<sup>29</sup> Notable among these exceptions were the crews of aircraft carriers and crews deployed to the Persian Gulf/Indian Ocean region.

In sum, with about 475 ships and 12 large-deck carriers during the 1970s, the navy could keep four carriers forward-deployed in the Mediterranean and the western Pacific. Since 1977 almost 100 additional ships have been acquired, including two new carriers, but the navy has also acquired new responsibilities in the Indian Ocean and the Caribbean. These new duties have been met largely by stripping ships from the Mediterranean and the western Pacific. In effect, the navy has had to run hard just to stay in place, and there are reasons for believing that the task of reconciling resources and responsibilities will become even more difficult in the years to come.

The recommissioning of the battleship *Wisconsin* in October 1988 brought the total number of battle force ships to 566, just 34 short of the 600-ship goal. Testimony before the House Armed Services Committee during 1987 indicated that, just to sustain a 600-ship navy, annual budget growth of 2-3 percent in real terms and an average of 20 ships per year in new construction would be required.<sup>30</sup> President Bush has ruled out such growth in defense spending for the foreseeable future, and Secretary of Defense Richard Cheney has decreed early retirement of the *Midway*, *Iowa*, and *New Jersey* to ease the strain on the navy's budget.<sup>31</sup>

The Maritime Strategy in effect reaffirmed the navy's commitment to an ambitious program for modernization and expansion just as the resources available for the completion of that program were beginning to contract. Faced with choosing between a small number of high-cost vessels and a larger number of lower cost, but also less-capable, vessels, the navy opted for a fleet organized around 19 very expensive capital ships (15 carriers and four battleships) in the hope that 19 task forces would be enough to cover the sea control, power projection, and presence missions while reducing operating tempo to a more comfortable level. The battleship task forces, however, have not demonstrated an ability to operate independently, and even before the recent defense cutbacks the seven-year construction time for *Nimitz*-class carriers would have prevented the navy from reaching its goal of 15 deployable carriers until 1996, at the earliest. Moreover, at a cost of \$7 billion for each of these vessels, including its embarked air wing, the construction of additional *Nimitz*-class carriers will very likely be at the expense of other shipbuilding programs. In view of the projected retirement of seven older carriers between 1998 and 2008 and the long lead times required to build and outfit new ships, crucial decisions on the composition of the fleet in the next century must be made soon. And these decisions will have to be made in a climate of declining, rather than expanding, resources for defense.

The navy therefore faces several strategic dilemmas in the decade ahead. If it continues to pursue the goal of as many capital ships as possible, but without cutting back on other high-priority programs (*Seawolf*, *Ohio*-class SSBNS), it will very likely have to slow modernization of the rest of the fleet and thus may not be able to build enough smaller ships to meet the demands for them. If the navy slows the carrier-building portion of its modernization program, it will have to accept a reduction in the number of task groups capable of operating independently in high-threat environments. If it tries to compensate for a reduction in the number of deployable carrier task forces by stepping up operating tempo, it runs the risk of losing skilled personnel who are unwilling to accept long separations from their families. If it attempts to reduce operating tempo, it runs the risk of not having enough forward-deployed task forces to permit a quick response to crises.

The combination of increased responsibilities and declining budgets suggests that it may be useful to explore alternatives to continued pursuit of a force centered solely on as many large-deck carriers as funds will allow. This is not to suggest that the navy should phase out its existing large-deck carriers or even stop building new ones. It is only to recognize that the impressive capabilities of *Nimitz*-class carriers come at a significant cost in terms of opportunities foregone. It may be possible (and preferable) to operate more carriers than currently planned, but somewhat fewer of the large-deck type. The question to be investigated is whether the strategic dilemmas facing

the navy can be eased by a new mix of platforms capable of delivering sea-based air power in support of American foreign policy objectives.

### Alternatives to Existing Strategy

It is not enough to argue that a particular program is cheaper than other options. There must also be a sound strategic rationale for its selection. Therefore the case for a different mix of carriers must begin with a reexamination of the missions that naval forces are called on to perform and the contribution that a new class of ships could make toward accomplishing those missions.

Since its emergence during the Second World War as the navy's premier capital ship, the aircraft carrier has been a vital military tool in support of American foreign policy. In the early postwar period, carrier task forces performed both nuclear deterrence and conventional maritime roles. Naval aviators moved quickly to ensure that carrier-based squadrons were assigned a share of the responsibility for delivering nuclear weapons against targets in the Soviet Union in the event of a U.S.-Soviet war.<sup>32</sup> Ballistic missile submarines subsequently assumed most of the responsibility for the navy's share of that mission, but the navy has continued to design its carrier task forces for the most demanding contingency imaginable, namely projecting power directly against the Soviet Union. Implicit in this orientation is the assumption that naval task forces capable of operating close to the Soviet Union will also be well-suited for the less challenging (and less glamorous) sea control and presence missions.<sup>33</sup>

This orientation toward power projection in the context of global war scenarios is unfortunate, because the sea control and presence missions are more important than recent debates over naval strategy would seem to suggest. Sea control is the ability to have unimpeded access to allies and trading partners and, in the event of war, to deny such access to an opponent. Control of the seas has enabled the United States, like Great Britain before it, to become the world's preeminent military and commercial power.<sup>34</sup> Control of the seas is also a precondition for the accomplishment of all of the navy's other missions.<sup>35</sup>

The ability to destroy Soviet ships and planes before they could leave their home ports and bases would be an important contribution to the sea control mission in the unlikely event of another global war, but such attacks could be executed better by relatively inexpensive, conventionally armed cruise missiles than by risking an entire carrier battle group (representing a capital investment of more than \$10 billion when planes and escort vessels are included). In the meantime, the navy will require an ability to counter Soviet naval forces in areas far from the Soviet Union and to project power against nations other than the Soviet Union. While it would be preferable to assign

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these latter tasks to the most capable ships that can be built, continued pursuit of the goal of as many large-deck carriers as funds will allow may mean that some missions will not be performed at all for want of ships to cover them.

Like sea control, the importance of the "presence" mission has often been underestimated. "Presence" derives its value from the power projection capability of the ships dispatched to "show the flag." Unlike power projection, the value of such a presence is often measured in terms of what does not happen, rather than what does. Naval task forces, especially those organized around a carrier, are singularly well-equipped to maintain a military presence intended to deter foreign powers from taking steps inimical to American interests or to compel an adversary to halt whatever it is doing that threatens American interests. They are mobile, fast, and can assemble formidable military capabilities within a compact and self-contained formation. They can maintain high states of readiness for long periods at distant locations. Using the "sea highway," they can travel to the remotest parts of the world, projecting power or threatening to do so.<sup>36</sup>

The principal difficulty encountered by the United States in using naval forces to control the sea lanes and establish a presence in areas where important interests are at stake is that it has not had enough of those forces, even with the increase in fleet size during the Reagan years. In January 1986, precisely when a carrier battle group was urgently needed near the Persian Gulf to deter the Iranians from hostile actions against U.S. merchant shipping, the *Saratoga* was being withdrawn from the Arabian Sea so that she could join the *Coral Sea* in the Mediterranean as part of the Reagan administration's efforts to step up pressure on Libya in the aftermath of the terrorist attacks on the Rome and Vienna airports toward the end of 1985.<sup>37</sup> If it is to cope with simultaneous contingencies scattered over two or more oceans, the navy needs more independently deployable battle groups than it has at present, and more than it is likely to have for the foreseeable future if we insist on having all battle groups centered on the most powerful carrier possible. More independently deployable task groups will require more carriers, but there is no way that the navy can quickly increase the number of large-deck carriers at its disposal. Is there, however, any alternative to continued reliance on the large-deck carrier?

**S**mall and medium-sized carriers were studied intensively during the 1970s, in part because the contraction of defense resources at that time placed a premium on finding new and less expensive ways of projecting sea-based air power. Both the Ford and Carter administrations considered designs for new types of carriers, including medium-sized conventional-takeoff-and-landing carriers and smaller VSTOL ships. Neither administration could persuade Congress that either the medium-sized conventional carrier or the smaller VSTOL ship provided a viable alternative to continued construction

of *Nimitz*-class vessels. The crucial question is thus whether anything has changed in the interim to justify resurrecting a proposal that was rejected in the past.

Two considerations were decisive during the debate over the carrier force that was conducted during the 1970s: the concern that only small monetary savings would be realized from substituting medium-sized carriers for large ones, and the concern that there would be a significant decline in effectiveness because smaller carriers would be unable to carry the navy's largest and most capable aircraft. Medium-sized carriers did not prove to be the bargain that their proponents claimed because, in part, hull steel is one of the least expensive components of the overall cost of a vessel. Size itself is less relevant to the cost of a vessel than the equipment and weaponry that it carries. In the case of a medium-sized carrier, significant costs are associated with the catapults and arresting gear needed for conventional flight operations. These costs accrue regardless of the vessel's size.

While there was only a small cost difference between large and medium carriers, proponents of the former successfully argued that there would be a significant difference in performance. Successful operation of conventional aircraft off a ship requires at least 30 knots of wind over deck plus considerable launch platform stability, especially in heavy seas. Larger, faster carriers could create these conditions more often than smaller carriers, allowing more consistent flight operations. Proponents of large carriers also argued that their preferred ship was more survivable than a medium-sized carrier, not only because it could absorb more hits without being disabled, but also because it could carry more numerous and more sophisticated defensive aircraft.<sup>38</sup> In the end, Congress not only supported the large carrier but mandated that all future capital ships be nuclear-powered.<sup>39</sup>

Not only medium carriers, but small ones, too, were studied during the 1970s. The outcome was again the same. In 1970, the Chief of Naval Operations, Admiral Elmo Zumwalt, proposed a new class of vessel, designated the Sea Control Ship, which would displace about 10,000-14,000 tons and carry several SH-3 Sea King helicopters for antisubmarine warfare and a few AV-8 Harrier VSTOL aircraft for self-defense. Later in the 1970s, Zumwalt's successor as CNO, Admiral James Holloway, proposed a VSTOL carrier that would be about twice the size of the Sea Control Ship and which would operate both improved Harriers and ASW helicopters.<sup>40</sup>

These proposals were advanced at about the time that the first of the *Nimitz*-class carriers began entering the fleet. Neither of the VSTOL alternatives was acceptable to either the navy or to Congress, mainly because advocates of large carriers were again able to argue that only small monetary savings would be realized at a large cost in effectiveness.

The navy in the 1970s could hardly be faulted for preferring the combination of *Nimitz*-class carriers and sophisticated aircraft such as the F-14 and the

A-6 over smaller ships carrying first-generation VSTOL aircraft with their much shorter range and smaller payload. VSTOL technology, however, has changed dramatically over the past 15 years. Costly catapults and arresting gear and expansive flight decks are no longer necessary to operate sophisticated aircraft. Such aircraft can now take off and land vertically or with very short running starts. This greatly expands the kinds of launch platforms available to operate maritime air assets.

The AV-8 Harrier was the first jet aircraft to incorporate VSTOL technology. During the 1970s, ground- and sea-based versions were produced in Great Britain for both the Royal Air Force and the Royal Navy. Since then, improvements in VSTOL technology have significantly narrowed the performance differential between the Harrier and conventional aircraft. The most modern VSTOL jet aircraft currently available is the Harrier II, produced jointly by British Aerospace and McDonnell Douglas for the U.S. Marine Corps. Designated the AV-8B, its primary mission is to provide close air support for Marine units during amphibious operations and direct support of ground forces from austere forward bases.<sup>41</sup> The AV-8B has roughly doubled the range and payload of earlier Harrier models.

The technological advances achieved to date have by no means exhausted the potential for further progress. An improved version of the Harrier II is currently under development which should result in a more sophisticated aircraft capable of both anti-air and anti-ship missions. The Harrier III will include a more powerful engine, and with some modification a sophisticated radar could be added. The latter would allow the Harrier to operate both radar-guided and heat-seeking missiles for air defense, plus sea-skimming missiles for anti-ship warfare.<sup>42</sup>

If VSTOL aircraft could be substituted for conventional jets, the navy could realize substantial savings in both its shipbuilding and aircraft-procurement budgets. VSTOL aircraft do not require large-deck carriers to conduct flight operations, nor do they require the catapults and arresting gear necessary to launch and recover most naval aircraft. The flexibility to operate from smaller, less costly vessels, in turn, opens up numerous possibilities for deploying air power at sea. For example, the 40,000-ton *Wasp*-class amphibious assault ship has already been designed to handle VSTOL aircraft. Three squadrons (36 aircraft) of AV-8Bs could be deployed on such a ship, two for air defense and one for ground attack, and 16-20 tilt-rotor aircraft, such as the V-22 Osprey, could be added to perform missions such as anti-submarine warfare, sea surveillance, and electronic warfare.

A single *Nimitz*-class carrier costs approximately \$3.5 billion for the ship alone, and \$7 billion if the embarked air wing is included. By contrast, during fiscal 1989 the fourth ship in the *Wasp*-class was procured for \$737.5 million.<sup>43</sup> Even with the addition of enhancements such as a "ski jump" launch ramp

to increase payload and range of the Harrier aircraft, a new VSTOL carrier could likely be obtained for roughly \$1 billion. In addition, *Wasp*-class vessels require only four years to build, rather than the seven required for *Nimitz*-class ships. In effect, for the price of one *Nimitz*-class carrier, three or even four *Wasp*-class carriers could be built. It should also be possible to complete several such carriers before the *Stennis* joins the fleet in 1996.

In light of the austere budgets ahead, the costs of a carrier's air wing will be just as important as the cost of the ship herself to decisions about the future size and shape of the navy. In this regard, the Harrier and Osprey aircraft that would be carried aboard the proposed VSTOL carrier would be a bargain compared to those currently in use aboard the navy's large-deck carriers. Priced in 1989 dollars, an AV-8B costs about \$22 million, while the Osprey is expected to cost between \$20-25 million. By comparison, an F/A-18 costs about \$32 million and an F-14 about \$73 million.<sup>44</sup> Even with the enhancements to the AV-8B and the modifications to the V-22 discussed earlier, these aircraft will still be less costly than current conventional carrier aircraft, not to mention future generations of carrier-based aircraft.

**A** fleet of VSTOL carriers would reduce the demands on the navy's budget, but they would still be an enormous investment in their own right. What functions could such ships perform, and could they make a contribution to the sea control and presence missions commensurate with their cost? In our view, the principal function of a VSTOL carrier should be to provide air defense of friendly ships, which would allow the navy to use existing assets to form additional independently deployable task groups, thereby improving its ability to perform the sea control and presence missions. The navy currently has many ways to project power ashore or against hostile vessels in addition to the sophisticated attack aircraft carried by its large carriers, e.g., ship-launched cruise missiles, Marine amphibious units, and naval gunfire. But it has found it difficult to use these assets effectively because of a reluctance to commit them to situations in which they might be attacked from the air. Properly defended from hostile aircraft, battleships, cruisers, amphibious assault ships, and even destroyers and frigates would be available to form new task groups that could operate independently rather than in the shadow of the large-deck carriers. While the primary mission of a VSTOL carrier would be fleet air defense, the VSTOL air wing described earlier would be capable of more than just antiair missions. Aircraft from the VSTOL carrier would complement and add depth to the ground-attack, antiship, and ASW capabilities of the task group to which she had been assigned.

Because it is a subsonic aircraft, some analysts have questioned whether the AV-8B can perform well enough as an air defense fighter to protect ships at sea against attacks by high-performance aircraft. Although it is slower than most jet combat aircraft, the Harrier has some compensatory capabilities. By



employing a technique known as vectoring in forward flight (VIFF), the Harrier can acquire remarkable maneuverability not attainable in other aircraft. In tests conducted by the U.S. Marine Corps, Harriers have engaged in simulated aerial combat against supersonic aircraft. "In almost every instance, the Harrier pilot was capable of holding his own and on numerous occasions, 'victories' were demonstrated against F-14, F-15, and F-18 opponents."<sup>45</sup> Defense officials in both the United States and the Soviet Union have been so impressed with the potential of VIFF to revolutionize air warfare that they have initiated research programs to determine if it can be incorporated into conventional aircraft.<sup>46</sup>

A second critique of the VSTOL carrier has its origins in the experience of the British during the Falklands War. Many observers have cited that war as evidence of the shortcomings of VSTOL carriers, pointing in particular to the difficulties encountered by the British in using Harrier aircraft to defend their fleet.

The Argentines shot down no Harriers in air-to-air combat, but four were lost to accidents and two to antiaircraft fire.<sup>47</sup> However, the British lost two destroyers, two frigates, one landing ship, and one merchant vessel to attacking Argentine aircraft.<sup>48</sup> These losses were inflicted by an adversary presenting a much less sophisticated threat, measured in terms of both number and quality of attacking aircraft, than would the Soviet Union.

The U.S. Navy, in its official report on the lessons of the Falklands War, acknowledged the "outstanding performance of the Harrier under very arduous combat conditions," but it also concluded that the principal problem for the British was their lack of "adequate fleet air defense in depth, including the essential keystone of Airborne Early Warning and long-range air defense fighters with multiple missile capability."<sup>49</sup> There are, however, reasons to believe that the airborne early warning problem is not insurmountable.

First, three of the Nato partners—Great Britain, Italy, and Spain—have built VSTOL carriers which they plan to operate in the North Atlantic and the Mediterranean in the event of a Nato-Warsaw Pact war. If the United States did not believe these ships were survivable, it would not be in our interest to encourage allies to commit scarce resources to expensive platforms that would be lost early in a future war. Not only does the United States encourage its allies to take on these missions, we encourage them to expand their naval responsibilities in waters easily accessible to Soviet planes and submarines in order to free the U.S. Navy's own task forces for use elsewhere.<sup>50</sup>

Three *Invincible*-class VSTOL carriers are currently in service in the Royal Navy. The British plan to commit two of these ships to sea control missions in the North Atlantic would put them in the thick of the battle against Soviet naval and air forces.<sup>51</sup> One carrier and 14 escort vessels would provide both antiair and antisubmarine defense for the Nato strike fleet intended to defend

Norway from a Soviet advance. A second carrier plus escorts would patrol the eastern Atlantic to protect convoys from North America.<sup>52</sup>

Spain and Italy have also built VSTOL carriers which they plan to commit to the Mediterranean in the event of a Nato-Warsaw Pact war. The *Principe de Asturias*, which recently entered service with the Spanish Navy, is based on the U.S. Navy's design for a sea-control ship. Displacing 16,200 tons, she carries eight Harrier-type aircraft and 12 helicopters. In the event of war, she would be operated with Spanish-built *Perry*-class frigates to form an antisubmarine group.<sup>53</sup> Italy's *Giuseppe Garibaldi* is smaller than either the *Principe de Asturias* or the *Invincible*, but is more heavily armed than either with guns and guided missiles. Her role in a Nato-Warsaw Pact war would be to serve as the core of a sea control group.<sup>54</sup>

One reason why Nato members expect their VSTOL carriers to survive, even in high-threat environments such as the North Atlantic and the Mediterranean, is that the airborne early warning mission can be covered in part by land-based aircraft carrying the Airborne Warning and Control System (AWACS).<sup>55</sup> There is no reason why a similar solution could not be applied in the Indian Ocean and the western Pacific. AWACS aircraft based in Diego Garcia, Guam, and in the Philippines could provide considerable coverage for American VSTOL carriers.

Alternatively, innovative technology may provide a solution to the airborne early warning problem. In the early 1980s, the navy considered a twin-engine VSTOL jet aircraft with a conformal radar for a variety of reconnaissance and surveillance missions, including airborne early warning, electronic warfare, and battlefield surveillance and targeting. There may be ways to adapt tilt-rotor aircraft such as the V-22 Osprey so that they can perform the AEW mission.<sup>56</sup> Serious consideration of new kinds of naval task forces may open the door to research programs that would otherwise be neglected.

In sum, a VSTOL carrier such as the one described above would be a versatile ship capable of performing several important missions in both high- and low-threat environments. Combined with a battleship and a *Ticonderoga*-class Aegis-cruiser, she would provide a potent task force capable of both power projection and presence missions that could operate independent of the existing carrier groups. Combined with an amphibious assault group, she would provide an impressive means of "showing the flag" in situations in which American citizens or property were threatened by a hostile government. Linked with a group of destroyers and frigates, she would form the core of a sea control group capable of both anti-air and antisubmarine missions. Combinations of this kind would greatly enhance the utility of the existing surface assets, by providing the navy with the additional independently deployable task forces it needs for the sea control and presence missions.

## A Twenty-First Century Navy

The optimum mix of large-deck and VSTOL ships will depend on both the level of international tensions and the foreign policy commitments accepted by the United States in the years ahead. For illustrative purposes, we will compare a fleet of 12 large-deck and 6 VSTOL carriers with the navy's long-held hope for a force of 15 large-deck carriers. At current funding levels this force will not be achieved, if at all, until 1996 at the earliest. A mixed fleet of 18 large-deck and VSTOL carriers would mean that the navy would routinely have available six independently deployable task groups, each centered around a carrier. With six task groups available as opposed to the current four, the navy could routinely deploy two carriers each in the Mediterranean and the western Pacific, and one each in the Caribbean and the Indian Ocean. An 18-carrier fleet would improve the navy's ability to support the nation's foreign policy commitments but without increasing operating tempo to a level that damages morale and hinders the retention of skilled personnel.

A mixed fleet of large-deck and VSTOL carriers would also have the advantage of being less costly to procure and easier to sustain over the long term. Tables 2 and 3 compare the shipbuilding costs and timetables for a fleet of 15 large-deck carriers and for a mixed fleet of 12 large-deck and six VSTOL carriers. Table 2 shows the shipbuilding program necessary over the next 20 years to reach and maintain the goal of 15 large-deck carriers. It takes into account both expected retirements and the planned withdrawal of carriers scheduled for the Service Life Extension Program. As table 2 indicates, maintaining a 15-carrier force through the first decade of the next century will require persuading Congress to appropriate funds between now and 2001 for the construction of six new *Nimitz*-class carriers (at a minimum of \$3.5 billion each), in addition to those already planned, plus an additional \$5 billion for the modernization of five older carriers under the Service Life Extension Program.

Table 3 shows a similar 20-year building program directed toward a 12/6 mix of large-deck and VSTOL carriers. Under this program, the navy would have 16 carriers at its disposal by the mid-1990s and an 18-carrier force before the end of the decade. A comparison of the building programs described in tables 2 and 3 suggests that an 18-carrier mixed force would also save approximately \$9 billion in construction costs over the next twenty years.<sup>57</sup> It should be noted that these are shipbuilding costs only, and do not count the savings anticipated because the air wings for the VSTOL ships would be less expensive than those for the large-deck carriers. Finally, since it takes only four years to build a VSTOL ship as opposed to seven for a *Nimitz*-class

carrier, force levels could be adjusted more easily than in the case of an all-large-deck-carrier force.

**Shipbuilding Program Necessary to Achieve and  
Maintain 15 Large-Deck Carrier Fleet**

Year	Under Construction		Transition		Fleet
	New	SLEP <sup>(1)</sup>	Add	Retire	Total
1989	CVN-74	CV-63			14
1990	CVN-75	CV-64	CVN-72 CV-63	CV-43	14
1991	CVN-76				14
1992			CVN-73	CV-41	14
1993	CVN-77	CVN-65	CV-64		14
1994					14
1995					14
1996		CV-66	CVN-74 CVN-65		15
1997	CVN-78		CVN-75	CV-61	15
1998	CVN-79		CVN-76	CV-60	15
1999	CVN-80	CV-67	CV-66		15
2000			CVN-77	CV-59	15
2001	CVN-81				15
2002			CV-67	CV-62	15
2003					15
2004			CVN-78		16
2005		CVN-68	CVN-79	CV-63	15
2006			CVN-80	CVN-65	15
2007					15
2008		CVN-69	CVN-81 CVN-68	CV-64	15

Summary: 8 new ships required at \$28 billion.<sup>(2)</sup>

7 ships to undergo SLEP at \$7 billion.

Total cost of Program: \$35 billion.<sup>(3)</sup>

(1) The SLEP schedule in this table is based on current U.S. Navy projections for its carrier fleet.

(2) Based on cost figures for the *Stennis* (CVN-74), construction cost for a new large-deck carrier is about \$3.5 billion.

(3) Cost figures in this table are based on the price of construction and/or SLEP of the vessels only. The airwings that would be embarked on the carriers would cost extra.

**Table 2**

**I**n the 1950s it may have been enough to structure American naval forces in anticipation of global war with the preeminent threat of that era, namely the Soviet Union. The navy of the 1990s confronts a different strategic environment. The diffusion of modern military technology means that many states possess the kind of military power that can seriously threaten

**Proposed Shipbuilding Program for a  
Mixed Fleet of Large-Deck and VSTOL Carriers**

Year	Under Construction			Transition		In the Fleet	
	New Large	SLEP Large	New VSTOL	Add	Retire	Large	VSTOL
1989	CVN-74	CV-63 (1)				14	0
1990	CVN-75	CV-64	VST-1	CVN-72 CV-63	CV-43	14	0
1991			VST-2			14	0
1992				CVN-73	CV-41	14	0
1993			VST-3	CV-64		15	0
1994			VST-4	VST-1		15	1
1995				VST-2	CV-61	14	2
1996		CV-66	VST-5	CVN-74		14	2
1997	CVN-76		VST-6	CVN-75			
				VST-3		15	3
1998	CVN-77			VST-4	CV-60	14	4
1999		CV-67		CV-66		14	4
2000				VST-5	CV-59	13	5
2001				VST-6	CVN-65	12	6
2002				CV-67	CV-62	12	6
2003						12	6
2004				CVN-76	CV-63	12	6
2005		CVN-68		CVN-77		12	6
2006						12	6
2007						12	6
2008		CVN-69		CVN-68		12	6

Summary: 4 new large-deck carriers at \$14 billion.

6 new VSTOL carriers at \$6 billion.

6 ships to undergo SLEP at \$6 billion.

Total cost of program: \$26 billion.

(1) The *Kitty Hawk* (CV-63) entered SLEP in July 1987.

**Table 3**

American interests. Within this new strategic environment, the navy must be prepared not only for global war but also for many peacetime contingencies. By pursuing a force of 15 large-deck carriers, the navy opted to devote a large share of its resources to perhaps the least likely of the many contingencies for which it must prepare—namely projecting power directly against the Soviet Union in the context of a U.S.-Soviet war. In doing so, it compromised its ability to cope with lower intensity, but more likely scenarios involving states such as Libya, Iran, and North Korea.

If the carrier battle forces were the principal means for both deterring and defending against a Soviet attack on western Europe or the Persian Gulf, then a strong case could be made in favor of continued pursuit of 15 large-deck

carriers. But even though the battle forces would make an important contribution to the West's efforts in the event of another global war, carrier-based air power is neither the most important deterrent to such an attack nor is it likely to be the decisive factor in such a war.

Instead, a strong case can be made that the greatest contribution to deterrence of a U.S.-Soviet conflict that the navy can make (aside from that of its ballistic missile-firing submarines) is through crisis management in situations involving Third World countries. It is in the Third World that most wars occur, and it is there that the risks of confrontation between the superpowers are greatest. Naval forces are well-suited to respond to crises and to contribute to American foreign policy objectives in such situations. This capability should not be sacrificed to continued pursuit of a difficult to reach and difficult to sustain force of 15 large-deck carriers.

The carrier force we propose recognizes that there will continue to be an important role for large-deck carriers for many years to come. We do not propose halting the construction of these ships, only that the navy move away from exclusive reliance on them for sea-based air power. A *Wasp*-class VSTOL carrier embarking advanced Harrier aircraft would give the navy a very capable smaller carrier with which to supplement the large-deck fleet.

A mixed carrier force, in turn, would permit a balance between several important missions. Since more than half the carrier force would be made up of large-deck vessels, the navy would retain a considerable capability to conduct forward offensive operations in the event of a global war. And with 18 instead of 15 (or fewer) carriers available, more task forces would be available for forward deployment in peacetime while remaining within the limits set by the anticipated zero-growth budgets of the 1990s.

Regardless of what mix of carriers is chosen, critical choices about the navy of the future cannot be deferred for much longer. The navy's carrier force is aging, its responsibilities are expanding, but its budgets are not. A future course must be charted now.

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## Notes

1. John Lehman, *Aircraft Carriers: The Real Choices*. The Washington Papers, VI, #52 (Beverly Hills, Calif.: Sage Publications, 1978), p. 16.

2. The prospects for the defense budget are discussed in more detail in House Committee on Armed Services, *News Release*, 7 July 1988, p. 6; George Wilson, "Pentagon Bracing for Two 'Waves,'" *Washington Post*, 13 November 1988, p. A26; George Wilson, "Associates Say Tower Would Cut Weapons," *Washington Post*, 2 December 1988, p. A21; and Stephen Alexis Cain, "The FY 1990/1991 Defense Budget: Preliminary Analysis," (Washington: Center on Budget and Policy Priorities, 1989). See also Congressman Les Aspin's comment that "zero real growth . . . is the very best that the Pentagon can hope for": (House Armed Services Committee, News Release, 9 December 1988, p. 8).

3. Institute for Strategic Studies (London), *The Military Balance, 1982-1983*, p. 118.

4. At the end of the 1970s, construction on the *Vinson* was well along, but work on what would become the *Theodore Roosevelt* had just started. In August 1978 President Carter vetoed the defense authorization bill because it contained funds for a fourth *Nimitz*-class carrier, and it was not until October 1979 that the President agreed not to use the veto again to prevent construction from going forward (Richard Burt,

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"Carter Rejects Supercarrier in Favor of Smaller Vessel," *New York Times*, 9 January 1979, pp. A1, A8; George Wilson, "Carter Gives Up on Blocking New Navy Carrier," *Washington Post*, 2 October 1979, p. A3.

5. Data on fleet size are taken from *Statistical Abstract* (1968, 1977), and from Institute for Strategic Studies (London), *The Military Balance, 1968-1969 and 1977-1978*. In October 1977, the number of large-deck carriers increased from 12 to 13 with the addition of the *Eisenhower*. The composition of the carrier fleet is presented in table 1.

6. Norman Friedman, *The U.S. Maritime Strategy* (Annapolis: Naval Institute Press, 1988), p. 202.

7. John Finney, "Pentagon Challenges Navy on 'Super-Carrier' Future," *New York Times*, 20 July 1975, pp. 1, 34; Finney, "Dreadnought or Dinosaur?," *New York Times Magazine*, 18 January 1976, p. 31.

8. See, for example, Admiral James L. Holloway III (Ret.), "Naval Aviation Flies into the Future," *Sea Power*, July 1980, p. 20.

9. These points are developed further by Finney, *New York Times Magazine*, 18 January 1976.

10. Notable examples of such extended deployments were the 144 days spent continuously at sea by the *Nimitz* during 1980, and the 154 days spent continuously at sea by the *Eisenhower*, also during 1980, as part of the Carter administration's efforts to maintain two carrier battle groups on station continuously in the Arabian Sea, both as a warning to Iran and to add credence to the Carter Doctrine (Richard Halloran, "Admirals Say U.S. Navy Can't Handle Its New Jobs," *New York Times*, 20 April 1981, p. 6).

11. Family separations are the most frequently cited reason given by sailors for leaving the navy (Richard Halloran, "Navy Plans to Reduce Time Carriers Are Overseas," *New York Times*, 30 April 1985, p. 7; George Wilson, "Family Values, Not Finances, Are Downing Military Pilots," *Washington Post*, 6 October 1985, pp. A1, A12).

12. The Service Life Extension Program involves an extensive overhaul and refit that is intended to add 15 years to the normal 30-year life of a carrier. The navy schedules a carrier to be out of service for about three years while in SLEP. For a description of the work involved, see "CV-SLEP Program," *Naval Policy Briefs*, January/February 1981, pp. 2-3.

13. The *Vinson* was delivered in 1982, the *Theodore Roosevelt*, in 1986. The *Lincoln* and the *Washington* are scheduled to be delivered in 1990 and 1992, respectively. Long-lead funding was approved in the FY 1988 and FY 1989 defense budgets for the *Stennis* and the *United States* (CVN-75). If, as expected, production on the *Stennis* goes forward, she would be delivered in 1996. The delivery date for CVN-75 is more difficult to predict.

14. See Halloran, *New York Times*, 30 April 1985.

15. Richard Halloran, "Reagan Selling Navy Budget As Heart of Military Mission," *New York Times*, 11 April 1982, pp. 1, 14; Wayne Biddle, "Could the Navy Keep 600 Ships Afloat?" *New York Times*, 7 July 1985, Sec. 4, p. 4.

16. The navy often claims that there are 15 carriers in the fleet at present, but this is misleading since the *Kitty Hawk* is currently undergoing an extensive refit/modernization as part of the Service Life Extension Program and is not available for deployment. The *Constellation* is scheduled to enter the Service Life Extension Program this year, followed by the *America* in 1996. Extensive refits similar to SLEP will also be performed on the *Ranger* and the *Enterprise* during the 1990s. Fifteen deployable carriers will not be available until 1996, when the *Stennis* is expected to join the fleet (see table 1).

17. See Biddle, *New York Times*, 7 July 1985; see also table 1.

18. Ted Nicholas and Rita Rossi, *U.S. Weapons Systems Cost, 1988*, 8th ed. (Fountain Valley, Calif.: Data Search Assoc., 1988), p. 92.

19. Office of the Secretary of Defense (hereafter OSD), *Program Acquisition Costs by Weapon System: DoD Budget for FY 88/89*, February, p. 95.

20. "Strong and Silent," *Newsweek*, 12 September 1988, pp. 27-28.

21. Bernard Weinraub, "Navy Sees It Must Shape Up to Go On Shipping Out," *New York Times*, 19 February 1978, Sec. 4, p. 4; House Armed Services Committee (7 July 1988), p. 8.

22. See, for example, Biddle, *New York Times*, 7 July 1985.

23. *The Maritime Strategy*, Special Supplement, U.S. Institute Proceedings, 1986, p. 5.

24. See, for example, the interview with then-Navy Secretary John Lehman in *Naval Forces*, No. 1, 1986, pp. 18-21. See also Halloran, *New York Times*, 11 April 1982.

25. During peacetime, the navy requires three carriers for each one that is forward deployed: for every carrier deployed forward, two others remain in or near their home ports for maintenance and training. In an emergency, all carriers could be pressed into service, with varying delays, depending on how much time would be required to complete necessary repairs, but this level of performance could be sustained only for a short period.

26. Frank Elliott, "The Navy in 1987," U.S. Naval Institute Proceedings, May 1988, p. 148.

27. Molly Moore, "Questions Over Battleship Role Resurface," *Washington Post*, 23 April 1989, pp. A1, A6, A7.

28. See Wilson, *Washington Post*, 6 October 1985; Halloran, *New York Times*, 30 April 1985.
29. Elliott, *Proceedings*, May 1988, p. 147.
30. Everett Pyatt, "Prepared Statement," *Hearing on National Defense Authorization Act for FY 88/89—H.R. 1748*, House of Representatives, Committee on Armed Services (Washington: U.S. Govt. Print. Off., 1987), pp. 131-132. See also John F. Lehman, "The 600-Ship Navy," *The Maritime Strategy*, Special Supplement, U.S. Naval Institute *Proceedings*, 1986, p. 38.
31. Molly Moore, "Pentagon May Lose Weapons," *Washington Post*, 15 April 1989, pp. A1, A5.
32. Paul Hammond, *Super Carriers and B-36 Bombers*, Inter-University Case Program, #97, 1963; Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases*, University of Denver, Graduate School of International Studies, Monograph Series in World Affairs, 4, #3, 1966-1967.
33. Officially, the navy describes the sea control and presence missions as co-equal in importance to power projection. Note, however, the reaction within the navy in 1978 when then-Secretary of Defense Harold Brown directed the navy to deemphasize preparations for projecting carrier-based air power against Soviet military installations in favor of greater emphasis on the sea control and presence missions. For details, see the following articles, all by Bernard Weinraub in the *New York Times*: "Brown Seeks to Cut Involvement of the Navy in Nonnuclear War," 27 January 1978, p. A8; "Defense Chief Vexed by Criticism in the Navy, 17 February 1978, p. D11; "Claytor Criticizes Pentagon Aides on Plans to Reduce the Navy's Role," 28 March 1978, p. 10; "Dispute Over Navy Role Termed Biggest Defense Fight Since 1949, 4 April 1978, p. 16.
34. Friedman, p. 55.
35. Elmo R. Zumwalt, Jr., *On Watch: A Memoir* (New York: Quadrangle Books, 1976), p. 330; see also Holloway, p. 19.
36. These points are developed in more detail in Holloway, pp. 18-24; and Friedman, p. 116.
37. Ward Sinclair, "Iran Halts, Searches U.S. Ship," *Washington Post*, 13 January 1986, pp. A1, A19; Don Oberdorfer and David Ottaway, "U.S. Engages Libya in a War of Nerves," *Washington Post*, 14 January 1986, p. A11.
38. See, for example, John W. Finney, "A Navy Staff Study Calls Big Carriers Less Costly," *New York Times*, 26 November 1975, p. 54; Drew Middleton, "Navy Planning Two More \$1 Billion Carriers Amid Debate over Their Effectiveness in a Major War," *New York Times*, 26 March 1976, p. 15.
39. See, for example, B. Drummond Ayres, Jr., "Move to End Funding for Atomic Carriers Rejected by House," *New York Times*, 8 August 1978, pp. A1, A16; "House Blocks Bid to Kill Nuclear Aircraft Carrier," *Wall Street Journal*, 14 September 1979, p. 8; Wilson, *Washington Post*, 2 October 1979, p. A3.
40. Norman Polmar, *The Ships and Aircraft of the U.S. Fleet*, 14th ed. (Annapolis: Naval Institute Press, 1987), pp. 101-103.
41. OSD, *Program Acquisition Costs by Weapon System*, February 1988, p. 97.
42. Norman Friedman, "Radar Key to Harrier Sales," U.S. Naval Institute *Proceedings*, November 1988, p. 147; *Jane's All the World's Aircraft 1987-1988*, 78th edition (London: Jane's Publishing Co., 1987), p. 132.
43. OSD, *Program Acquisition Costs by Weapon System*, p. 14.
44. *Ibid.*, pp. 12, 14, 20; George Frank, "V-22: A New Angle in Transportation," *Los Angeles Times*, 4 July 1989, p. C3.
45. Francis R. Mason, *Harrier*, 2nd ed. (Annapolis: Naval Institute Press, 1983), pp. 118-119.
46. Turning on a Dime—in Midair," *U.S. News and World Report*, 20 February 1989, pp. 56-58.
47. John Godden, ed., *Harrier: Ski Jump to Victory* (McLean, Va., Pergamon-Brassey's, 1982), p. 17.
48. U.S. Navy, *Lessons of the Falklands*, Summary Report (Washington: 1983), p. C1.
49. *Ibid.*, pp. 29, 2.
50. In 1986, Navy Secretary John Lehman encouraged the British to retain H.M.S. *Hermes* as a fourth carrier rather than retire her. On this point, see the interview with Lehman in *Naval Forces*, p. 22.
51. The Royal Navy operates three VSTOL carriers, but only two are available at any one time because there are only two air wings of Sea Harriers. The carriers are thus deployed two at a time, with the third in port for refit. The two air wings rotate to the two carriers available for sea duty.
52. "NATO'S Sinking Feeling," *The Economist*, 6 June 1981, p. 51.
53. Norman Friedman, "World Naval Developments, 1987," U.S. Naval Institute *Proceedings*, May 1988, p. 223.
54. *Ibid.*
55. The use of land-based AWACS aircraft for sea control missions in the North Atlantic is discussed in Deborah Shapley, "New Study of Land-Based Aircraft Questions Need for Aircraft Carriers," *Science*, 2 June 1978, pp. 1024-1025.
56. Jerry Mayfield, "Ames to Begin V/STOL Model Tests," *Aviation Week and Space Technology*, 21 April 1980, pp. 73, 75; D.J. Pay, "Carriers Sail On," U.S. Naval Institute *Proceedings*, June 1989, p. 59.
57. Shipbuilding costs are described in the summary section at the bottom of each table.