



CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE



MAKING WAVES

Aiding India's Next-Generation Aircraft Carrier

Ashley J. Tellis

APRIL 2015



CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

MAKING WAVES

Aiding India's Next-Generation Aircraft Carrier

Ashley J. Tellis

The Carnegie South Asia Program is grateful to the Indian Council for Cultural Relations for its generous support of this publication.

© 2015 Carnegie Endowment for International Peace. All rights reserved.

Carnegie does not take institutional positions on public policy issues; the views represented herein are the author's own and do not necessarily reflect the views of Carnegie, its staff, or its trustees.

No part of this publication may be reproduced or transmitted in any form or by any means without permission in writing from the Carnegie Endowment. Please direct inquiries to:

Carnegie Endowment for International Peace
Publications Department
1779 Massachusetts Avenue, NW
Washington, DC 20036
P: +1 202 483 7600
F: +1 202 483 1840
CarnegieEndowment.org

This publication can be downloaded at no cost
at CarnegieEndowment.org/pubs.

Contents

About the Author	v
Summary	1
Introduction	3
The Strategic Context Underlying Indian Carrier Capabilities	5
Designing India's Future Carriers for Operational Success	8
Where to Focus Cooperation	10
The Fight Function: Indispensable Cooperation	11
The Move Function: Desirable and Potentially Indispensable Cooperation	16
The Integrate Function: Indispensable and Highly Rewarding Cooperation	19
Co-Developing a Capital Ship: A Historic Opportunity for Washington and New Delhi	22
Recommended Reading	25
Carnegie Endowment for International Peace	26

About the Author

Ashley J. Tellis is a senior associate at the Carnegie Endowment for International Peace specializing in international security, defense, and Asian strategic issues. While on assignment to the U.S. Department of State as senior adviser to the under secretary of state for political affairs, he was intimately involved in negotiating the civil nuclear agreement with India. Previously, he was commissioned into the Foreign Service and served as senior adviser to the ambassador at the U.S. embassy in New Delhi. He also served on the National Security Council staff as special assistant to the president and senior director for strategic planning and Southwest Asia.

Tellis was the editor (with Bibek Debroy and Reece Trevor) of *Getting India Back on Track: An Action Agenda for Reform* (2014) and is the research director of the Strategic Asia Program at the National Bureau of Asian Research and co-editor of the program's eleven most recent annual volumes, including *Strategic Asia 2014–15: U.S. Alliances and Partnerships at the Center of Global Power*. In addition to numerous Carnegie and RAND reports, his academic publications have appeared in many edited volumes and journals, and he is frequently called to testify before Congress.

* * *

The author is deeply grateful to C. Uday Bhaskar, Vikram Doraiswamy, Gregory S. Jones, Benjamin Lambeth, Michael McDevitt, Raghavendra Mishra, George Perkovich, and Arun Prakash for their detailed and most helpful comments on this paper. Special thanks are also owed to Rebecca White and Holly Yeager for their superb editing of an otherwise dense manuscript, and to Alec J. Sugarman for research assistance and help in preparing the summary.

Summary

The United States and India have agreed to form a working group to explore the joint development of India's next-generation aircraft carrier. While the Indian Navy has already begun design work, wide-ranging cooperation with the United States has enormous potential and offers India the opportunity to acquire the most capable warship possible. Such collaboration would increase the Indian Navy's combat power and would resonate throughout the Asian continent to India's strategic advantage. The most valuable U.S. contributions are likely to materialize in the fight, possibly in the move, and hopefully in the integrate functions.

Bringing Cooperation Into Focus

- The prospect of a major Chinese naval presence in the Indian Ocean transforms India's hitherto secure rear into a springboard from which coercive power can be brought to bear against the Indian landmass.
- The principal objective underlying bilateral cooperation should be to ensure that India's next-generation aircraft carrier—to include its air wing and its capacity for combat operations—will be superior to its Chinese counterparts.
- Though cooperation on the fight, move, and integrate functions is likely to be most indispensable and rewarding, joint development should in principle span all the mission areas involved in carrier design.
- Above all else, the Indian Navy should not succumb to the temptation to make collaborative development merely an exercise in procuring technology.

Recommendations for the United States

The Fight Function

- Explore the possibility of equipping India's carrier with the electromagnetic aircraft launch system (EMALS).
- Offer India access to various advanced aviation systems, such as the U.S. Navy's E-2C/D Hawkeye for airborne early warning and battle management and the fifth-generation F-35C Lightning strike fighter, so as to permit the Indian Navy to secure a combat advantage over its rivals' air wings.

The Move Function

- Consider changes to current U.S. policy to allow for discussions about nuclear propulsion technology in order to, among other things, make the integration of EMALS technology a viable option for India's next-generation carrier.

The Integrate Function

- Support a partnership between the Indian Navy and the U.S. Naval Sea Systems Command, and U.S. private industry as appropriate, to validate the vessel's engineering and production designs, imbibe best practices from the U.S. experience when constructing the carrier, and coordinate on sea trials prior to commissioning the ship.
- Encourage the conclusion of consulting contracts and memoranda of understanding between Indian shipyards and U.S. industry to assist India in incorporating advanced construction techniques when building its new large-deck carriers.

Introduction

Ever since the conclusion of the 2005 U.S.-Indian Civilian Nuclear Cooperation Agreement, many policymakers have wondered what the next big idea to transform bilateral ties might be. Clearly, no successor initiative could ever replicate the momentous character of the nuclear accord because it implicated core national security policies in both countries and removed the singular disagreement that had kept them at odds for over thirty years. Yet there exists presently a remarkable opportunity that holds the promise of making new waves in bilateral collaboration—in the best sense—if only Washington and New Delhi are imaginative enough to grasp it: jointly developing India’s next-generation aircraft carrier. Working in concert to develop this vessel would not only substantially bolster India’s naval combat capabilities but would also cement the evolving strategic bond between the United States and India in a truly spectacular fashion for many decades to come.

No country today possesses the technical capacity to design and build aircraft carriers like the United States. And no country today would profit as much from collaborating with the United States in carrier design and construction as India at a time when its local dominance in the Indian Ocean is on the cusp of challenge from China’s People’s Liberation Army Navy (PLAN), which commissioned its first aircraft carrier in 2012. If the United States were to partner with India now in developing its next large-deck carrier, tentatively christened *Vishal*—the first in a series of standardized designs that would eventually replace both the current Russian (INS *Vikramaditya*) and British (INS *Viraat*) hand-me-downs in the fleet as well as the indigenous *Vikrant* scheduled to enter service in 2018—it will have contributed mightily to helping the Indian Navy meet the emerging Chinese naval threat while simultaneously becoming a net provider of security in the Indian Ocean. U.S. assistance would also send a powerful signal to China and to all the other littoral states that U.S.-Indian defense cooperation is intended to advance their highest mutual national interests, including preserving, as former U.S. secretary of state Condoleezza Rice once phrased it, an Asian “balance of power that favors freedom.” And, finally, it would convey to important—but still skeptical—Indian audiences, especially in the military, that the United States can collaborate with India on vital projects of strategic import in ways that only Russia and Israel have done thus far.

There exists presently a remarkable opportunity that holds the promise of making new waves in bilateral collaboration—in the best sense—if only Washington and New Delhi are imaginative enough to grasp it: jointly developing India’s next-generation aircraft carrier.

Factoring such considerations, U.S. Senator John McCain, in a September 9, 2014, address at the Carnegie Endowment for International Peace in Washington, challenged the U.S. and Indian governments to expand their defense cooperation to include “more ambitious joint ventures, like shipbuilding and maritime capabilities, even aircraft carriers.” This vision was realized during U.S. President Barack Obama’s January 2015 visit to India when the two nations agreed to “form a working group to explore aircraft carrier technology sharing and design.” That this accord finally came to fruition was owed largely to Indian Prime Minister Narendra Modi: disregarding the reservations of some of his senior advisers, and appreciating the singular proficiency of the United States in carrier design, construction, and operations, Modi chose to accept the U.S. offer of partnership and, accordingly, authorized the conclusion of deliberations that had begun during his September 2014 visit to the United States. In so doing, Modi was guided by a clear recognition of the importance of the Indian Ocean for both India’s prosperity and its security—and by his conviction that a strong navy, with the most capable afloat aviation possible, was essential for the realization of India’s strategic aims.

The door has thus been opened for genuine U.S.-Indian collaboration in developing India’s next-generation aircraft carrier. Consummating this aspiration, however, will require the two sides to think ambitiously. This implies

What the Indian sea service should not do is succumb to the temptation of making bilateral cooperation merely an exercise in procuring technologies, such as the electromagnetic aircraft launch system, which it has long eyed for its future “flattops.”

partnering in everything from vessel design to physical construction to sea trials so that the Indian fleet may finally commission the most formidable man-o’-war possible. The Indian Navy, undoubtedly, will lead this effort, which is already under way: its Naval Design Bureau has completed the technology assessment, feasibility studies, and analysis of alternatives, and is now deeply immersed in activities relating to engineering design. At this point, there is a quickly closing window of opportunity for a comprehensive partnership with the U.S. Naval Sea Systems Command and, as appropriate, with U.S. private industry.

Such an accord would bestow great dividends because the wealth of American experience in overseeing the construction of large-deck carriers cannot but benefit the Indian Navy before it finalizes its production design.

What the Indian sea service should not do is succumb to the temptation of making bilateral cooperation merely an exercise in procuring technologies, such as the electromagnetic aircraft launch system (EMALS), which it has long eyed for its future “flattops.” If this remains its only ambition, the fecund collaboration otherwise possible will degenerate into a transactional activity centered on releasing export licenses and consummating discrete procurement deals at the American and Indian ends, respectively. While even such modest interactions would undoubtedly produce a better Indian capital ship, they would constitute a huge opportunity lost in deepening the strategic partnership with the United

States. Even worse, New Delhi will have foregone the potential of developing the most formidable aviation-capable vessel possible.

The Strategic Context Underlying Indian Carrier Capabilities

The Indian Navy has been one of the few fleets to deploy aircraft carriers continuously for more than fifty years. But while this ship retained pride of place in the service's force architecture, it did not have incontrovertible utility when India was largely an inward-looking state. Until the end of the Cold War, the Indian economy enjoyed tenuous links with the global trading system, India's local adversaries—Pakistan and China—did not constitute major naval threats, the extraregional powers operating in the Indian Ocean largely left India alone, and New Delhi's power-political weaknesses implied that, despite the rhetoric, India's strategic interests did not extend far beyond its subcontinent. Consequently, aircraft carrier deployment lacked the value it otherwise might have had if India's geopolitical circumstances had been different.

Thankfully for the navy, however, India's fortunes are changing dramatically for the better—and the emerging strategic environment promises to reward the fleet for preserving its proficiency in carrier operations over the years. Increasing Indian economic growth recently has produced greatly expanded maritime trade, and India's rising national power has sensitized New Delhi to its larger interests throughout the vast Indo-Pacific region—from the east coast of Africa to the Persian Gulf to the Southeast Asian straits and even beyond, to the distant East Asian rimlands. As Prime Minister Modi summarized it succinctly in a March 12, 2015, speech in Mauritius, "India is becoming more integrated globally. We will be more dependent than before on the ocean and the surrounding regions. We must also assume our responsibility to shape its future. So, [the] Indian Ocean region is at the top of our policy priorities." Reinforcing this conviction, the United States is also eager to see India assume a larger role in this strategic space. But most important of all, the PLAN now appears poised to operate consistently in the Indian Ocean, thus giving the traditional terrestrial rivalry between China and India a new and more serious maritime twist.

The prospect of a major Chinese naval presence in the Indian Ocean challenges Indian security in novel ways, transforming a hitherto secure rear into a springboard from which coercive power can be brought to bear in new directions against the Indian landmass. Thanks to its antipiracy patrols in the Gulf of Aden, Beijing has already taken the first steps toward maintaining a near-continuous presence in the western Indian Ocean. Chinese nuclear and

Thankfully for the navy, India's fortunes are changing dramatically for the better—and the emerging strategic environment promises to reward the fleet for preserving its proficiency in carrier operations over the years.

conventional attack submarines have recently undertaken their first operational cruises in the wider basin, and, since 2012, Chinese auxiliary general intelligence ships have systematically conducted oceanographic and bathymetric surveys, almost certainly as a prelude to major (and perhaps regular and extended) deployments of Chinese carrier battle groups (CVBGs), surface action groups, and nuclear attack submarines in the future.

In this context, perhaps no event would be more catalyzing than the appearance of a Chinese aircraft carrier and its associated escorts in the Indian Ocean.

Perhaps no event would be more catalyzing than the appearance of a Chinese aircraft carrier and its associated escorts in the Indian Ocean.

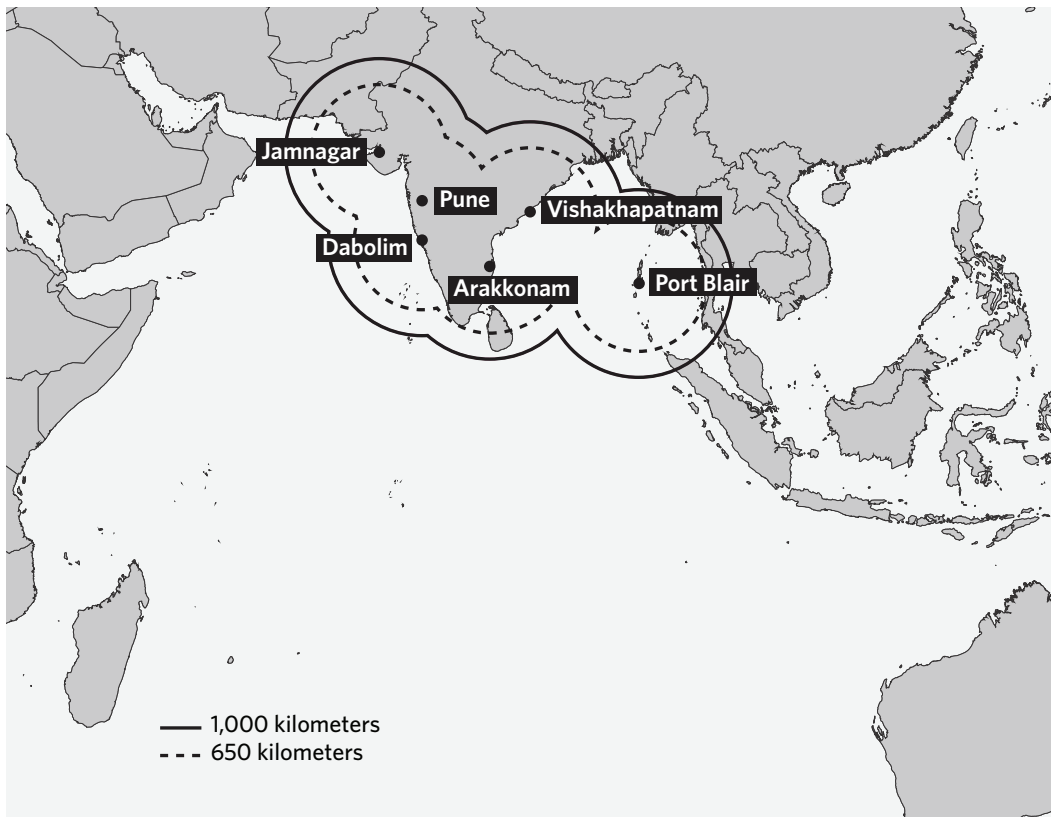
Because carriers make a qualitative difference to the kind of sea control that can be exercised by a nation in support of both gunboat diplomacy and power projection, such a Chinese vessel operating in the vicinity of the Indian peninsula would vivify the heightened naval dangers to New Delhi. The possibility of such a presence, especially during a crisis or a conflict, would justify the acquisition of various

instruments intended to neutralize it—with the most obvious counters being land-based airpower, attack submarines, and of course carrier aviation itself.

India's favorable geography makes land-based airpower a particularly potent instrument in dealing with any future Chinese aircraft carrier in the Indian Ocean. But this solution is most viable only in relative proximity to the Indian coastline. Unless India acquires a dedicated bomber contingent, its best strike fighters today (the Su-30MKI, for example) have useful operating radii of 650–1,000 kilometers (400–620 miles) from their home bases, depending on the missions and flight profiles involved. Air refueling can, depending on tactical circumstances in the Indian context, extend these ranges by some 25 to 30 percent. But it cannot compensate for the critical limitations that afflict land-based fighters in general: the increased but unproductive mission time required to reach far-flung targets compared to potentially nearby carrier airpower, not to mention the operational delays incurred when important targets have to be reattacked because of mechanical failures or successful enemy interception.

As a rule, therefore, the farther away military action occurs from the Indian peninsula, the more indispensable carrier aviation becomes (see figure 1). Preparing for such a contingency is, in fact, utterly reasonable because if a PLAN flotilla in the Indian Ocean is to be parried by force, Indian naval strategists would seek to neutralize it as far away from their homeland as possible. Furthermore, if Indian commerce from Europe, Africa, and the Far East has to be protected along the country's sea lines of communication at great distances from the mainland, an Indian CVBG would be invaluable.

These carrier capabilities, however, would also have great utility closer to the Indian landmass in any major crisis or conflict involving China because it is possible, even likely, that the Indian Air Force (IAF) could be unavailable due to its commitment to air defense and ground attack along the disputed Himalayan border—far away from India's maritime frontiers. Even if IAF assets were available, carrier-based capabilities would be highly desirable

Figure 1: Representative Reach of India's Land-Based Strike Fighters

Source: Author's calculations

because they would complicate PLAN operations by forcing the Chinese fleet to guard against attacks from its seaward side, even as it coped with threats emanating from the Indian peninsula.

The case for a capable contingent of quiet nuclear attack submarines to deal with the emerging Chinese challenge in the Indo-Pacific has never been stronger. Indian attack submarines will invariably prove to be formidable in the countercarrier role—with nuclear vessels having advantages in speed and endurance over their conventional counterparts, assuming they meet the appropriate quieting thresholds. But their ready availability for this mission cannot be presumed, given their expected small numbers in the Indian inventory, their likely commitment to anti-submarine warfare (ASW) missions (including possibly in support of the Indian CVBG), and their preoccupation with other tasks that may be essential in a conflict. If India is to deploy a subsurface force capable of undertaking the silent high-speed runs necessary to intercept a fast-moving surface flotilla without being detected, while also being capable of conducting at other times the ultraquiet operations associated with anti-submarine and acoustic intelligence collection missions, it will need

The case for a capable contingent of quiet nuclear attack submarines to deal with the emerging Chinese challenge in the Indo-Pacific has never been stronger.

to acquire additional Russian submarines with acoustic stealth levels of the Improved Akula I- or Akula II-class nuclear submarines or better—rather than the leased Akula I currently in service.

At any rate, the Indian Navy has already determined that it requires land-based airpower and nuclear attack submarines as a complement to—but not as a substitute for—its aircraft carriers when dealing with the dangers posed by a Chinese naval presence in the Indian Ocean over the long term, because of the myriad benefits of possessing organic naval aviation for other wartime and peacetime contingencies. The central analytical task, then, consists not of evaluating the desirability of aircraft carriers relative to the alternatives, but rather of identifying how the United States and India should cooperate to develop the kind of next-generation carrier capabilities that New Delhi deems desirable.

Designing India's Future Carriers for Operational Success

The principal objective that should guide bilateral cooperation in carrier development is the need to ensure that India's next-generation aircraft carrier—to include its air wing and its capacity for combat operations—will be superior

The principal objective that should guide bilateral cooperation in carrier development is the need to ensure that India's next-generation aircraft carrier—to include its air wing and its capacity for combat operations—will be superior to its Chinese counterparts.

to its Chinese counterparts. China has been a late entrant into carrier aviation, but it appears determined to make up for lost time. Beijing currently deploys an extensively refurbished Kuznetsov-class vessel of approximately 65,000 tons, the *Liaoning*, which is likely to serve as the baseline for its future carrier forces. The *Liaoning*, now used mainly for training missions, is larger than the INS *Vikramaditya*, a Kiev-class ship of about 45,000 tons. But both vessels, being formerly Soviet aviation cruisers, are only capable of short take-off but arrested recovery (STOBAR) operations: the deployed aircraft launch under their own power using

a ski ramp for added lift, but they use arresting cables to terminate their landing run when returning to the ship.

After building its first indigenous carrier, the *Vikrant*, as a relatively small STOBAR platform, the Indian Navy has sensibly decided that its successor will be a larger, approximately 65,000-ton vessel capable of catapult-assisted take-off but arrested recovery (CATOBAR) aviation operations. This is indeed a wise choice because, given the vast ocean areas of interest to India and the expectation that its CVBGs will have to operate more or less independently, such carriers can host larger air wings composed of high-performance fighters capable of carrying heavy ordnance loads, integrate the requisite number of support aircraft, and mount substantial cyclic air operations, meaning the rapid launch and recovery of aircraft.

A carrier larger than the ship currently contemplated might have been even better because it would have had the capacity to host an even bigger air wing in comparison to its Chinese competitor. But so long as the Indian vessel can conduct CATOBAR air operations, in contrast to China's STOBAR-only capabilities, the Indian Navy will still retain the edge. Together with the superior training, doctrine, and other complementary capabilities that India now possesses, such a carrier capability would improve the Indian Navy's chances of securing sea control even against an otherwise formidable Chinese opponent operating in the Indian Ocean region.

The laws of physics only make large carriers a more sensible choice for India, given its vast operating areas and its diverse operational objectives, which include air warfare, anti-submarine warfare, anti-surface warfare, mine warfare, amphibious warfare, and land-attack operations. For starters, it is more economical, in terms of installed horsepower per ton of displacement, to propel a larger vessel at 30-plus knots than a smaller one. And, thanks to the square-cube law, an aircraft carrier's useful hull volume increases at a rate greater than its structural weight, thus allowing for a balanced design that maximizes flight deck size; expands the number of aircraft that can be carried; increases the size of the armored box that protects ordnance, propulsion, command and control, and other vital spaces; and in general improves passive protection throughout the ship. At the end of the day, however, the large carrier's greatest advantage is its potential for increased sortie generation and, by extension, higher-tempo cyclic operations, which permit the force to unleash greater firepower relative to its opponent.

If it is assumed, as a rule of thumb, that one aircraft can be spotted on a carrier for every 1,000 tons of displacement, the navy's Vishal-class ships will be able to routinely host a notional air wing of at least some 50 aircraft (the smaller number allowing for safety margins): 35 strike fighters, three airborne early warning (AEW) platforms, eight ASW and utility helicopters, and four support aircraft, aerial tankers, or electronic warfare (EW) platforms. Over time, a squadron of unmanned combat aerial vehicles—for particularly dangerous tasks such as the suppression of enemy air defenses or for long loiter missions such as reconnaissance and surveillance—would be plausible as well.

An Indian carrier air wing hosting high-quality assets in such numbers would represent significant combat capabilities, especially when the weapons and sensors of its escorts are factored into the equation. A CVBG of this kind would be able to conduct air, surface, and anti-submarine warfare operations simultaneously against all regional adversaries as well as against any future Chinese carrier operating STOBAR aviation in the Indian Ocean. When the Indian Navy finally deploys the three Vishal-class vessels it hopes for, these capabilities will only expand further, enabling its CVBGs to hold their own against future Chinese CATOBAR carriers operating in proximity to India, while undertaking additional responsibilities such as supporting amphibious and mine-warfare operations as well as executing significant land-attack

missions with tactical aviation against any local competitor. Success in all cases will still depend on a broad range of continental capabilities, to include shore- and space-based sensors along with long-range maritime patrol aircraft and unmanned aerial vehicles. But the combat power embodied by such large-deck carriers will bestow on the Indian Navy a capacity for extrapeninsular sea control that it has not enjoyed before.

Where to Focus Cooperation

Because helping the Indian Navy to develop these capabilities in the context of rising Chinese power remains a U.S. interest, bilateral cooperation in carrier development should in principle span all the mission areas involved in the vessel's design (see table 1).

Table 1: Potential Areas of U.S.-Indian Cooperation

Functional Areas	Substantive Focus	Importance of Bilateral Cooperation
Float	Hull Structures Weight Hydrodynamics Stability General Arrangements	Desirable-to-Critical
Fight	Flight and Hangar Deck Design Aircraft Launch Systems Combat Aircraft Sensors Self-Defense Systems	Indispensable
Move	Propulsion Machinery Arrangements and Control Electrical systems Heating, Ventilation, and Air Conditioning Auxiliary Systems	Desirable Indispensable (If Nuclear)
Enable	Habitability Messing Medical Inventory Control and Storage	Desirable
Survive	Vulnerability Recoverability Susceptibility	Desirable-to-Critical
Integrate	Design Coherence Operational Effectiveness	Indispensable

In practice, however, the most valuable American contributions are likely to materialize in what is known as the “fight” function, possibly in the “move” function, and hopefully in the “integrate” function. Because the Indian Naval

Design Bureau already has a history of designing major surface combatants (and local dockyards are currently building warship hulls of close to 40,000 tons), India will probably not seek U.S. assistance where the “float” element of carrier design is concerned. Yet it would profit from cooperation even in this area—if only in peer review of its engineering designs—because India has not fabricated large-deck carriers before, whereas the United States is an acknowledged leader in designing and constructing such vessels.

An identical judgment holds where the “enable” and “survive” functions are concerned: the former refers to the human services necessary to run a ship, while the latter involves both human and technical elements that bear on minimizing the vessel’s vulnerability, enhancing its damage-control capability, and assessing its susceptibility to degradation in varying conditions. While U.S. collaboration in these areas would be desirable, it would be less pressing, given India’s familiarity with the British and Russian ship designs already in its inventory.

The most valuable American contributions are likely to materialize in what is known as the “fight” function, possibly in the “move” function, and hopefully in the “integrate” function.

The Fight Function: Indispensable Cooperation

The United States can tender its most valuable assistance to the Indian Navy in the fight function—a mission area that involves both design as well as technology. The large, approximately 65,000-ton size of the Vishal-class carriers offers the Indian Navy a chance to design a flight deck that sustains relatively high-tempo simultaneous launch and recovery operations, while correcting the most egregious design flaws of the INS *Vikramaditya* and *Vikrant* (and *Liaoning*) flight decks, namely, their converging takeoff runs.

An aircraft carrier exists principally to launch its primary weapon—ordnance-laden aircraft—and the speed with which it can conduct cyclic operations makes a fundamental difference to the kind of operational superiority it enjoys in combat. The ability to generate sorties rapidly, then, remains the holy grail of carrier operations and it depends, human factors being held constant, mainly on the flight deck size and design; the number, size, and reset speed of the catapults; and the capacity to service aircraft speedily on recovery.

The *Vishal*’s general size should permit a flight deck of over 900 feet in length and a recovery area of over 650 feet on an angled deck, thus enabling the operation of all current and prospective high-performance aircraft. Yet the flight deck’s precise design will be critical because, ideally, it should permit the largest number of aircraft to be spotted—to prevent delays associated with retrieving aircraft from the hangar deck below—without obstructing any of the catapults; without interfering with recovery operations (including emergency barricade arrestment); and without requiring excessive respotting of

recovered aircraft prior to servicing, refueling, and rearming. Meeting these criteria requires the enlargement of deck-edge parking spaces, the development of “pit stop” approaches to aircraft servicing, the careful placement and sizing of elevators and the island on the flight deck, and the rationalization of fuel and ordnance flow (as well as of repair facilities) in order to advance the objective of maximizing sortie generation when required operationally.

The number and type of catapults and their positioning on a carrier obviously have a direct impact on its ability to launch aircraft rapidly. A Vishal-class ship can easily be equipped with four catapults if required, because the launch and arresting systems (to include the barricade) will take up only minuscule quantities of its internal volume or internal deck space. The EMALS—the newest U.S. innovation, which promises revolutionary advances in launch capability and is currently the object of Indian craving—is almost three times smaller in volume and weighs less than half the steam catapult it replaces, with great advantages to topside weight. But its costs are exorbitant, it has not yet been fielded on any deployed U.S. carrier, and there are still significant export control issues that affect its potential sale to India.

The advantages of EMALS, however, are seductive for any operator seeking to maximize sortie generation: the system can launch heavier high-performance aircraft, can be exquisitely calibrated in real time to differences in the launch load, has a lower peak-to-mean tow force ratio (and hence imposes less

stress on the airframe), is highly efficient in terms of thrust density while being mechanically simpler, cycles faster for repeated aircraft launches, and is—in theory—more reliable and requires fewer personnel to operate, thus contributing to further savings in space and cost.

The system, however, requires enormous amounts of electricity for its operation, which suggests that a nuclear-powered vessel is the ideal host. It is conceivable that a combined diesel- and gas-powered carrier could also do the job, but given the demands on electricity associated with habitability, sensors, and other ship operations, powering

the EMALS would likely require a number of additional generators simply for that purpose. In any case, its costs notwithstanding, an EMALS-equipped Indian carrier would enjoy tremendous advantages over its regional rivals, and if the Indian Navy chooses to incorporate at least three catapults into the vessel—two at the bow, one at the waist—it would gain impressive operational flexibility.

Irrespective of the type of catapult selected—and the Indian Navy might have to settle for sourcing steam catapults from the United States if it cannot develop an appropriate nuclear reactor for its new ships (an issue discussed further below)—at least three would be required if the carrier is to secure the operational advantages deriving from high sortie generation. All catapults are susceptible to transient malfunctioning: in fact, the EMALS currently has a

An EMALS-equipped Indian carrier would enjoy tremendous advantages over its regional rivals, and if the Indian Navy chooses to incorporate at least three catapults into the vessel—two at the bow, one at the waist—it would gain impressive operational flexibility.

much higher failure rate than is desirable for shipboard operations. While the system's reliability is certain to increase as the technology matures further, the Indian Navy would benefit from integrating a minimum of three catapults aboard its carriers—no matter what their cost—so that at least two launch systems are always available in case one goes “cold” or “soft” during combat operations.

Because the Indian strike group's capacity to secure tactical superiority over its Chinese counterpart will depend fundamentally on its ability to extract maximum performance from its aircraft carriers, it would be well served not simply by acquiring cutting-edge technologies such as EMALS and the new electric advanced arresting gear but by actually working closely with its American counterparts to incorporate these capabilities into an enhanced flight deck design that maximizes the ships' striking power.

Achieving this objective will hinge indisputably on the character and the potency of the deployed air wing—and, here again, U.S. aviation systems can make a significant difference. The success of all carrier—indeed, of all naval—operations depends on effective scouting: the ability to detect an opponent first and to unleash offensive action before one's own presence is noticed and invites attack. Although diverse passive systems also play a critical role in threat detection, fixing and tracking the adversary's air and surface components prior to engagement invariably requires active emitters, usually AEW systems.

Because the Indian Navy has hitherto deployed small carriers, its principal AEW assets have been heliborne systems, primarily the Russian Ka-31 Helix B. The role of the Helix is to expand the CVBG's surveillance envelope by detecting either low-altitude or more distant targets that escape detection by surface radars because of the earth's curvature. Heliborne AEW, however, is a poor choice for the Indian Navy's next-generation carriers because its poor endurance, short flight radius, limited operating altitude, and low radar refresh rates, despite improving lower-altitude coverage, do not substantially enlarge the size of the CVBG's surveillance bubble beyond the range of its surface radars.

The solution to this critical deficit, which has plagued Indian carrier aviation for the longest time, is the U.S. Navy's E-2C/D Hawkeye airborne early warning and battle management system, a platform that is capable of being deployed aboard India's future CATOBAR carriers. With its operating altitude of over 25,000 feet (compared to some 10,000 feet for a helicopter) and its mission endurance of over six hours unrefueled—more than twice that of a helicopter—the aircraft's extended radar horizon and its powerful active and passive detection systems combine to provide 360-degree detection coverage of fighter-sized targets (as well as other surface threats and even submarine masts) more than 200 miles from its own position. Furthermore, its ability to maintain station—and support a combat air patrol—at great distance from the carrier implies that it can enlarge the surveillance envelope enormously, while

actually supervising the offensive and defensive battle, to protect the CVBG in a way that heliborne AEW simply cannot.

Given the risks of counting on the availability of the IAF's shore-based airborne warning and control systems in a conflict, acquiring high-quality organic airborne early warning and battle management systems for the Indian Navy's new carriers is a critical priority: these platforms would enhance the carriers' protection and offensive capability simultaneously, while bestowing on them both independence and flexibility.

Deploying capable combat aviation remains the next complementary task for invigorating the Indian Navy's next-generation carrier. Although the navy's primary carrier aircraft currently, the MiG-29K Fulcrum, is a versatile multirole fighter, it is not superior to the Chinese J-15 Flanker D—the reverse-engineered Russian Su-33 that is likely to become the primary strike fighter aboard China's emerging carriers. The J-15 has a longer operating radius, enabling it to project combat power farther away (or to defend its carrier at a greater distance); its KLJ-4 or Slot Back series radar has a longer detection and tracking range compared to the MiG-29's Zhuk series system, thus permitting earlier target detection and engagement; and its primary beyond-visual-range (BVR) air-to-air weapon, the PL-12, is reputed to have greater range than the Russian AA-12 carried by the MiG-29K and from which it was cloned—allowing the Chinese fighter, therefore, to fire first, at least in theory. The Indian Navy's advantages in this context no doubt remain pilot quality and superior tactics and proficiency in carrier operations, but these virtues will not survive unchallenged indefinitely.

Because carrier air wings are relatively small, and losses in combat cannot be readily recouped, it is important that each airplane deployed aboard India's carriers be of higher sophistication *and* maintainability than those of India's potential adversaries. Qualitative superiority of both aircraft and pilot provides uncontested operational advantages, while maintainability—meaning the reliability of the airframe and its combat subsystems as well as the ease of diagnostics and repair—contributes toward the ability to turn an aircraft around quickly for repeated sorties, thus making it a vital combat multiplier, particularly for small- or medium-sized air wings. These characteristics converge to imply that India's future carriers must deploy true fifth-generation fighters if they are to secure a combat advantage over the J-15s (which will likely be further improved with avionics pilfered from the Russian Su-35 now slated to enter the Chinese inventory) or newer Chinese stealth aircraft such as the J-20 and J-31 (which will migrate eventually to Beijing's aircraft carriers).

As India contemplates this challenge, it would do well to consider the U.S. F-35C Lightning as the principal strike fighter aboard its next-generation carriers. The F-35C may not be as fast or as maneuverable as some of today's best

Because carrier air wings are relatively small, and losses in combat cannot be readily recouped, it is important that each airplane deployed aboard India's carriers be of higher sophistication *and* maintainability than those of India's potential adversaries.

tactical aircraft, but it has no sea-based peer where stealthy BVR anti-air and anti-surface warfare are concerned. Its unmatched onboard radar capability and sensor fusion, ability to carry diverse long-range weaponry, and redoubtable electronic warfare systems permit it to penetrate even dense adversary barrier air patrols to achieve either “first look, first shot, first kills” in the air-to-air regime or successful standoff weapons release in the air-to-surface regime—even in the presence of current and prospective Chinese AEW systems. When the F-35C operates synergistically with the E-2C/D, its lethality only increases because it can engage varied targets without ever having to use its own active sensors and thereby betray its own presence.

Unfortunately for India, there are few alternatives to the Lightning: the fifth-generation Russian T-50 has no naval variant, whereas other possible candidates—such as the French Rafale, the notional Indian advanced medium combat aircraft, or even an evolved Su-30MKI—would be poor substitutes when considering both sophistication and maintainability, the critical qualities that matter if the Indian Navy is to deploy an air wing that is superior to its regional competitors over the long term.

The Su-30MKI, for example, even if it were to be navalized to mimic the Su-33, would still be handicapped by its unreliable avionics. The Rafale too, for all its aerodynamic strengths, is a maintenance-intensive platform, and it is atrociously expensive to boot: the F-35C in the eighth lot of its low-rate initial production is priced at \$115.7 million per aircraft—a cost that is certain to contract further as the Lightning is produced in larger numbers—whereas the Rafale, a combat aircraft that is one generation older, is apparently being offered to the IAF for its medium multi-role combat aircraft requirement today at about \$120 million apiece.

When costs are thus factored into the equation, the F-35C still retains an edge. Of the few competitors worth considering for the Indian carrier, only the F/A-18E Super Hornet, at a flyaway cost of some \$65 million per aircraft, beats the F-35C hands down where price is concerned. The F/A-18E, undoubtedly, has formidable sensors and deploys weapons similar to the F-35C, but being a fourth-generation aircraft (which also happened to lose out in the IAF’s recent fighter competition) could make it somewhat unattractive as the principal strike fighter for the Indian Navy’s new carriers, given the emerging threat environment in the Indo-Pacific.

On balance, therefore, the case for the F-35C as the primary aviation weapon aboard the Vishal-class carriers remains strong. But if India were to pursue this option for its future carriers, it would need to pay particular attention to the aircraft-ship interface because the F-35C’s exhaust temperatures and noise levels would affect both flight deck design and operating procedures, making the need to accommodate the unique characteristics of future fifth-generation aircraft an important consideration from the get-go when designing these large-deck carriers.

Cooperating with the United States to build capacity to fight most effectively opens the door to the possible creation of air wings consisting entirely of American-designed aircraft for the first time.

Although the air warfare threats emerging from a future Chinese carrier in the Indian Ocean will be formidable, the dangers posed by China's submarine force would be even greater. The Indian Navy has already moved swiftly to prepare for this challenge, among others, by acquiring the U.S. P-8I Poseidon for long-range, high-altitude, area ASW, and it will eventually deploy a variant

of the U.S. MH-60R ASW helicopter aboard its surface fleet for tactical missions. These systems could be supplemented by new U.S. towed sonar arrays on India's major combatants, but the Indian Navy's air ASW capabilities will remain significantly constrained so long as it does not acquire the advanced avionics subsystems usually found aboard comparable U.S. platforms. The Indian unwillingness to sign the bilateral "foundational" agreements that enhance interoperability and ensure technological safeguards remains a major reason for this lacuna, and it should be rectified expeditiously if India is to utilize its newly acquired U.S.-origin ASW capabilities most effectively.

Cooperating with the United States to build capacity to fight most effectively, then, opens the door to the possible creation of air wings consisting entirely of American-designed aircraft for the first time. This cooperation should also permit India to acquire various advanced sensors and self-defense systems—search and fire-control radars, electronic warfare systems, and point-defense weapons—for its future carriers, if they are suitable.

The Move Function: Desirable and Potentially Indispensable Cooperation

India's needs in the other functional areas are more modest, with one significant exception: the move function.

If the future Indian carrier is propelled by gas turbines alone (as the *Vikrant* is), or by combined diesel and gas plants, the need for assistance will be minimal because maritime gas turbines and diesel engines are already manufactured domestically in India (some under U.S. license). If India chooses to incorporate nuclear propulsion, however—as the navy seems to be considering—the challenges obviously increase. Nuclear-powered carriers have great operational advantages, including sustained, high speed; they do not need regular refueling—the Nimitz-class carriers of the U.S. Navy, for example, are refueled just once in their fifty-year life spans; the bunker space saved as a result of nuclear propulsion permits them to carry three times more ammunition and four times more aviation fuel; and they can produce large quantities of electric power, which is indispensable for new catapult systems, such as EMALS, and would be highly valuable when new weapon technologies, such as electromagnetic rail guns and free-electron lasers, mature.

For all its benefits, however, nuclear power increases the acquisition and life-cycle costs of an aircraft carrier considerably, raising difficult cost-effectiveness issues that the Indian Navy will have to confront. If the service intends to incorporate the advanced EMALS in appropriate numbers into its new carriers, however, it is likely to have no choice—as a practical matter—but to accept the increased cost of a nuclear-powered vessel because no other propulsion system will be able to generate the quantity of electricity required for combat operations and habitability, while still remaining within the targeted full-load displacement of the ship's design. From an operational point of view, therefore, one of the key choices before the Indian Navy boils down to either conventional propulsion plants supporting steam catapults or a nuclear power source driving the EMALS.

If the service settles for the latter option, the design and source of its carrier's nuclear reactor become critical issues. The Indian Navy has already developed, in collaboration with the Bhabha Atomic Research Center and the Defense Research and Development Organization, a naval nuclear reactor that currently powers India's first ballistic missile submarine, the INS *Arihant*. Although accurate data about the submarine's engineering characteristics are hard to come by, it appears that the nuclear plant aboard the vessel is a pressurized water reactor fueled by low-enriched uranium—some sources claim highly enriched uranium—and producing an output of 83 megawatts electric (MWe). This reactor, as well as the submarine itself, was developed with extensive Russian assistance, and numerous reports in both the Indian and international press over the years have alluded to the significant difficulties encountered by India during the development phase.

The question now is whether the *Arihant*'s nuclear reactor can be used to drive the Vishal-class carriers currently being designed by the Indian Navy. Unfortunately, no obvious answer is possible, in part because many of the technical characteristics of the *Arihant*'s reactor—including its energy output—are not clear. If the reactor's output is indeed 83 MWe, its thermal energy would have to be enormous, perhaps something on the order of four to five times the electric power produced by the plant.

The thermal efficiency of land-based power reactors is generally assumed to be around 33 percent, implying that about one-third of their generated heat is converted into electricity. Naval nuclear reactors, on the other hand, have much lower thermal efficiencies—on the order of about 20 to 25 percent—because, unlike power reactors that aim for the steady production of maximum amounts of electricity, shipboard propulsion systems emphasize flexible power operations in order to produce the variable speeds appropriate to a given tactical situation.

Given the lower thermal efficiencies of naval reactors, therefore, the *Arihant*'s 83 MWe rating—if indeed electric—translates into a stupendously sized 332 to 415 megawatts thermal (MWt) plant. Although reactors of such power can be found on U.S. aircraft carriers (the USS *George H. W. Bush*, for example, is

equipped with two reactors, each reputedly rated at 550 MWt), even large submarine nuclear propulsion plants rarely exceed 200 MWt. In fact, the reactors on board the U.S. Ohio-class ballistic missile submarines and the Seawolf-class nuclear attack submarines are exceptional in that they are 220 MWt units.

If the *Arihant's* reactor, therefore, produces as much as 415 MWt, it is theoretically possible for a single unit of this kind to run a 65,000-ton Vishal-class vessel, even though every nuclear-powered carrier today employs two reactors to ensure redundancy and the availability of sufficient power for all other requirements beyond physically propelling the vessel. In any event, the availability of such a high-powered reactor, assuming it meets all the other requirements of safety and reliability, implies that the Indian Navy's task suddenly becomes simpler because the principal challenge of powering the *Vishal* through nuclear energy involves mainly adapting a submarine reactor for a surface ship and possibly integrating two units of identical design into the vessel. Although the engineering challenges here will be significant, they are not insurmountable because a surface ship operates in a more forgiving environment than a submarine.

If, however, the *Arihant's* reactor is an 83 MWt (and not an 83 MWe) unit—as is more likely—the Indian Navy will be faced with the difficult prospect of designing a new reactor to run its Vishal-class carriers. That is because the submarine's relatively small power plant, which currently drives a 6,000-ton submersible, will be unable to power a vessel that is over ten times in size and that operates in an environment where overcoming surface wave resistance requires greater-than-proportionate amounts of power to move a ship over a given distance than in the case of a submarine, other things being equal. It is also highly unlikely that the *Arihant's* reactor design can be simply scaled up or easily combined in a daisy chain of multiple units to power the new aircraft carrier.

All of this implies that if the Indian Navy is to equip its new carriers with advanced systems like EMALS and produce the requisite amounts of electricity required for propulsion, habitability, and combat operations, it will require a new reactor design that uses uranium at much higher levels of enrichment than is customary in Russian submarines—if the fleet is to minimize the refueling required over the carrier's lifetime.

Naval nuclear reactor design is obviously an area where U.S. proficiency is unparalleled, given the unqualified success of the U.S. Navy's nuclear propulsion program over the decades. Recognizing this fact, many senior Indian naval officers have inquired over the years about the possibility of bilateral collaboration with a view to improving their indigenous capacity to design naval nuclear propulsion systems. Unfortunately for India, however, details about naval reactor designs are highly classified and the United States has never shared this information with any country except Great Britain, where it is protected with a zeal that is matched only by the safeguards applied to nuclear weapons.

If India, therefore, is to secure any U.S. assistance in this functional area, it will require major shifts in current U.S. government policy. Because naval

nuclear reactors are not safeguarded systems, India will find it impossible to purchase U.S. hardware or components for them. But there may be a case for considering other forms of intangible assistance to India's naval nuclear reactor program, perhaps by offering peer review of indigenous Indian designs, giving New Delhi some visibility into U.S. nuclear engineering solutions, or providing occasional hand-holding that enables Indian naval reactor designers to resolve various technical challenges.

Given the sea change in attitudes and presumptions that have ensued from the 2005 nuclear deal, it is possible to imagine some kind of bilateral technical consultations on the design and integration of India's indigenous reactors for its carriers—but only if the Obama administration proves willing to make the major policy changes necessary to enable such discussions. If New Delhi desires such assistance, however, it would be well advised to press this request soon and at the highest levels.

In some sense, such a conversation would represent a natural evolution of the civilian nuclear cooperation agreement, which was meant to deepen the strategic partnership between the United States and India across the board and especially in regard to defense engagement: the possibilities of military nuclear cooperation, outside the arena of nuclear weapons and delivery vehicles, therefore, remain a subject that should be explored, given that the United States has even aided a country such as China—which is, in fact, its rival—far more consequentially in the past. Absent such collaboration, India will be compelled to rely either on its own resources or on continued Russian assistance for its naval reactor program; both options embody nontrivial risks to safety, while the latter produces geopolitical disadvantages for the United States.

The Integrate Function: Indispensable and Highly Rewarding Cooperation

When all is said and done, closer bilateral cooperation in the integrate area will yield the Indian Navy the highest rewards, beyond anything else it may do with respect to acquiring specific carrier technologies from the United States. An aircraft carrier, after all, is a system of systems par excellence, incorporating dedicated ship-related subsystems (for example, propulsion, navigation, communications, shops and stores, damage control, and fuel storage), dual ship-aircraft related subsystems (berthing, messing, magazines, replenishment, photo labs, petroleum, oil and lubricants, and meteorology), and dedicated aircraft-related subsystems (catapults, aircraft/weapon elevators, aircraft handling, takeoff and recovery aids, flight and hangar deck controls, crash and salvage, and air intelligence), all in one single package.

The success of the vessel's design and its ensuing combat capability, accordingly, does not derive simply from the excellence of each of its distinct

components, but rather from how they perform when combined into an organized whole. Assessing the viability of the overall unified design from both an architectural and an operational perspective is a challenging exercise, and one in which long-standing experience in carrier construction as well as combat operations makes a huge difference. If the Indian Navy is willing to permit the U.S. Naval Sea Systems Command to collaborate with it in validating its final

When all is said and done, closer bilateral cooperation in the integrate area will yield the Indian Navy the highest rewards, beyond anything else it may do with respect to acquiring specific carrier technologies from the United States.

design, imbibing best practices from the U.S. experience when constructing the carrier, and coordinating closely as the finished vessel completes sea trials prior to commissioning into the fleet, India's next-generation aircraft carrier will have become a great example of the enormous potential inherent in U.S.-Indian defense cooperation.

Obviously, more than government-to-government cooperation will be required for success in this arena. Much of the technical expertise relating to nuclear carrier construction in the United States lies in the private sector, with prime contractors such as Newport News Shipbuilding,

the sole designer and builder of aircraft carriers for the U.S. Navy, and with hundreds of subcontractors, who are responsible for the design and manufacture of various critical components. Accessing the expertise of these entities will probably require consulting contracts under the rubric of the U.S. government's Foreign Military Sales program.

But, even if such arrangements can be successfully concluded, other challenges are likely to persist. Whether Indian naval architects will be comfortable with U.S. governmental and private entities poring over their designs remains an open question. Equally problematic is the Indian Navy's warship design regimen itself, which has traditionally involved a "telescopic" method of shipbuilding in which hull construction is initiated before the vessel's final design parameters and the configuration of its key subsystems are settled. Historically, such an approach contributed significantly to cost overruns and pervasive delays in warship delivery. If the telescopic approach is replicated in the construction of the *Vishal*, there is every likelihood that cost escalation and construction delays will rule the day. Equally importantly—from the perspective of U.S.-Indian cooperation—the kind of collaboration that might otherwise prove to be most useful in the integrate area will lie beyond reach because, in the absence of stable designs, cooperative review will be difficult, costly, and even unproductive. Finally, the question of whether American carrier design expertise, which has focused since 1975 on building huge carriers of about 95,000 tons, will be compatible with India's frugal engineering approach to the design and construction of smaller vessels is also relevant and cannot be ignored.

These issues are obviously complex and must be confronted candidly. Yet the Indian Navy, more than any of its sister services, has always been open to foreign collaboration, whether at the level of design, components, or systems integration. And because it has never built an aircraft carrier of such size and

complexity before, jettisoning its traditional telescopic approach in order to partner with the United States to the maximum degree offers the Indian Navy the hope of acquiring the most capable warship possible.

The gains from such collaboration would extend not merely to the navy but to Indian shipbuilding as a whole. Given the planned size of the *Vishal*, there is a compelling case to be made for building the carrier at a private facility, such as the Pipavav Shipyard Limited in Gujarat, in western India, with its huge dry and wet docks, rather than at the government-owned shipyard in Cochin, on the southwestern coast, which is currently involved in the construction of the *Vikrant*. The *Vikrant*'s construction has already demonstrated the myriad problems at Cochin, as the shipyard struggles to complete the 40,000-ton hull. The prospect of building a follow-on vessel of some 65,000 tons there, then, provides little room for optimism. The Pipavav shipyard faces other challenges: despite possessing an impressive infrastructure, the facility has unfortunately no experience in warship construction.

One solution that deserves careful consideration is for large yards like Pipavav to negotiate joint ventures with U.S. prime contractors, such as Newport News Shipbuilding, to prepare them for a long-term program in carrier construction. The Pipavav shipyard apparently has already signed a memorandum of understanding with the Babcock International Group in the United Kingdom as part of its efforts to secure the construction contract for the Indian Navy's next-generation aircraft carrier. If India is to profit from U.S. expertise, however, an arrangement that involves Newport News Shipbuilding would be urgently in order.

In any event, and irrespective of where the Indian Navy's next big carrier is finally constructed, building it through modular techniques—where discrete segments are manufactured ashore with their innards complete before being fitted to their adjacent blocks in a dry dock—rather than through the traditional method—where an empty welded hull is launched into the water and then machinery and equipment are installed—will result in faster construction and reduced acquisition costs. Indian shipyards are already slowly acquiring a capability for the modular construction of warships. But collaborating with U.S. partners such as Newport News Shipbuilding, which pioneered new “vertical build” methodologies during the construction of the latest U.S. Ford-class aircraft carriers, would result in beneficial improvements to India's larger shipbuilding industry.

Even before the construction of India's next-generation large carriers begins, however, a more prosaic matter must be attended to: India's continuing lack of deep-draft harbors. The few deep-draft facilities that do exist are mostly civilian and are intended to host and service supertankers and large container vessels. Consequently, India's current aircraft carriers, the INS *Viraat* and the INS *Vikramaditya*, already face constraints in their ability to dock alongside piers or

The Indian Navy, more than any of its sister services, has always been open to foreign collaboration, whether at the level of design, components, or systems integration.

remain in anchorages off many Indian ports. Modernizing India's naval bases to accommodate big aircraft carriers of the Vishal class, therefore, remains the first order of business as both sides prepare to explore the possibilities of broader U.S.-Indian cooperation in carrier development.

Co-Developing a Capital Ship: A Historic Opportunity for Washington and New Delhi

The opportunity for the United States and India to collaborate in building India's next-generation aircraft carrier should not be frittered away by piddling ambition or a failure of imagination. The chance to co-develop a weapon system so large and consequential does not come every day; if it is seized energetically, it could yield rewards that are far greater than what

The opportunity for the United States and India to collaborate in building India's next-generation aircraft carrier should not be frittered away by piddling ambition or a failure of imagination.

has been promised by other projects in the Defense Trade and Technology Initiative, which also seek to strengthen ties among both countries' defense industries and their militaries. Simply put, partnering to build a large-deck aircraft carrier and all its organic combat systems is a very big deal—industrially, operationally, and strategically. The barriers to productive cooperation in this instance are undoubtedly significant, but they are more likely to reside in India than in the United States. If Washington and New Delhi, however, can collectively focus on overcoming these challenges, the United States will have made a signal contribution to transforming the Indian Navy's carrier combat capabilities.

Sustaining India's wherewithal for effective carrier operations, however, will require attention to more than just the aircraft carrier itself. Improving the capabilities of its escorts and land-based support systems also deserves due attention. Even then, the supply of advanced American technologies, however important, will still remain insufficient: shared doctrine, training, and intelligence are equally vital for ensuring the continued superiority of the Indian Navy over its Chinese counterpart in the Indian Ocean. To assure this outcome, the current pattern of military-to-military interactions ought to be bolstered further. The U.S. and Indian Navies should plan an ambitious schedule of small and large exercises that involve carrier battle groups on both sides, concentrating particularly on honing their respective skills in anti-air, anti-surface, and anti-submarine warfare. These activities should not be restricted to bilateral interactions alone but, as has slowly become the norm in recent years, should involve all the key regional partners such as Japan, Australia, Singapore, and eventually even Vietnam.

As such cooperation gathers steam, the goal that should not be lost sight of is interoperability. Unfortunately, this concept acquired a bad odor in India during the tenure of the United Progressive Alliance (UPA) government, despite then prime minister Manmohan Singh's best intentions. Today, thankfully, Prime Minister Modi has been forthright about his ambition to work closely with the United States—including strong defense cooperation across the board. That conviction makes achieving the goal of interoperability, particularly between the U.S. and Indian Navies in the Indian Ocean, much more feasible. But it will require India, among other things, to reconsider the UPA government's opposition to signing various bilateral defense agreements, which has had the effect of preventing Washington from being able to supply India with various high-end defense systems that would enable the armed forces of the two countries to operate together effectively.

Creating this capacity for combined operations would not in any way prejudice India's freedom of action. As Senator McCain noted in a November 5, 2010, address at the Carnegie Endowment for International Peace, "The decision about whether to cooperate with the United States will always rest with India's democratic leaders; greater interoperability simply creates more options for how to cooperate if India chooses to do so."

If the opportunity for the United States to partner with India in developing its next-generation aircraft carrier thus results in greater technology transfer, more expansive industrial collaboration, and better operational synergies, not only will the Indian Navy have increased its combat power as a result, but the ensuing geopolitical message would resonate throughout the Asian continent to India's strategic advantage. Incurring these benefits, however, requires the United States and India to approach the issue of aircraft carrier technology and design as an opportunity for close and comprehensive collaboration and not simply as a contractual negotiation over the sale or purchase of singular components or technologies.

Walking down such a road will demand trust and constancy in each capital. But if both countries can take those steps, the co-development of India's future large-deck carriers would dramatically enlarge the boundaries of defense cooperation beyond anything that has been achieved so far. It would also herald the dawn of a more vibrant strategic partnership that serves both American and Indian interests at a time when Chinese power in the Indian Ocean promises to become an ever more troubling feature of Asian geopolitics.

Simply put, partnering to build a large-deck aircraft carrier and all its organic combat systems is a very big deal—industrially, operationally, and strategically.

Recommended Reading

Behera, Laxman Kumar, and S. N. Misra. 2012. "India's Naval Shipbuilding Industry: Key Gaps and Policy Options." *Defence Studies* 12, no. 3. www.tandfonline.com/doi/pdf/10.1080/14702436.2012.703846.

Doyle, Michael R., Douglas J. Samuel, Thomas Conway, and Robert R. Klimowski. 1995. "Electromagnetic Aircraft Launch System—EMALS." *IEEE Transactions on Magnetics* 31, no. 1. 528–33.

Lambeth, Benjamin S. 2005. *American Carrier Air Power at the Dawn of a New Century*. Santa Monica: RAND Corporation. www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG404.pdf.

Naval Surface Warfare Center. 2011. *The Navy Ship Design Process*. U.S. Naval Sea Systems Command. Carderock Division, Maryland. www.navsea.navy.mil/nswc/carderock/docs/4368_Ship_Design_Process_B_Section_A.pdf.

Subramanian, T. S. 2009. "Nuclear Arm." *Frontline* 26, no. 17.

Tellis, Ashley J. 1987. "Aircraft Carriers and the Indian Navy: Assessing the Present, Discerning the Future." *Journal of Strategic Studies* 10, no. 2. www.tandfonline.com/doi/pdf/10.1080/01402398708437294.

U.S.-China Economic and Security Review Commission. 2014. *China's Navy Extends Its Combat Reach to the Indian Ocean*. Washington, DC: U.S.-China Economic and Security Review Commission. http://origin.www.uscc.gov/sites/default/files/Research/Staff%20Report_China%27s%20Navy%20Extends%20its%20Combat%20Reach%20to%20the%20Indian%20Ocean.pdf.

Carnegie Endowment for International Peace

The **Carnegie Endowment for International Peace** is a unique global network of policy research centers in Russia, China, Europe, the Middle East, and the United States. Our mission, dating back more than a century, is to advance the cause of peace through analysis and development of fresh policy ideas and direct engagement and collaboration with decisionmakers in government, business, and civil society. Working together, our centers bring the inestimable benefit of multiple national viewpoints to bilateral, regional, and global issues.

The **Carnegie South Asia Program** informs policy debates relating to the region's security, economy, and political development. From the war in Afghanistan to Pakistan's internal dynamics to U.S. engagement with India, the Program's renowned team of experts offer in-depth analysis derived from their unique access to the people and places defining South Asia's most critical challenges.

BEIJING

BEIRUT

BRUSSELS

MOSCOW

WASHINGTON

THE GLOBAL THINK TANK



CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

CarnegieEndowment.org