CHINA'S AIRCRAFT CARRIER AMBITIONS

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This article will address two major analytical questions. First, what are the necessary and sufficient conditions for China to acquire aircraft carriers? Second, what are the major implications if China does acquire aircraft carriers?

Existing analyses on China's aircraft carrier ambitions are quite insightful but also somewhat inadequate and must, therefore, be updated. Some, for instance, argue that with the advent of the Taiwan issue as China's top threat priority by late 1996 and the retirement of Liu Huaqing as Vice Chair of China's Central Military Commission (CMC) in 1997, aircraft carriers are no longer considered vital.[1] In that view, China does not require aircraft carriers to capture sea and air superiority in a war over Taiwan, and China's most powerful carrier proponent (Liu) can no longer influence relevant decision-making. Other scholars suggest that China may well acquire small-deck aviation platforms, such as helicopter carriers, to fulfill secondary

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1. See Ian Storey and You Ji, "China's Aircraft Carrier Ambitions: Seeking Truth from Rumors," *Naval War College Review*, 57, no. 1, Winter 2004, pp. 77-93.

security missions. These missions include naval diplomacy, humanitarian assistance, disaster relief, and anti-submarine warfare.[2] The present authors conclude, however, that China aircraft carrier ambitions may be larger than the current literature has predicted. Moreover, the major implications of China's acquiring aircraft carriers may need to be explored more carefully in order to inform appropriate reactions on the part of the United States and other Asia-Pacific naval powers.

This article updates major changes in the four major conditions that are necessary and would be largely sufficient for China to acquire aircraft carriers: leadership endorsement, financial affordability, a relatively concise naval strategy that defines the missions of carrier operations, and availability of requisite technologies. We argue that in spite of some unresolved issues, these changes suggest that China is likely to acquire medium-sized aircraft carriers in the medium term for "near seas" missions and for gaining operational experience, so that it can acquire large carriers for "far seas" operations in the long term.

These four major conditions, or variables, can be either dependent or independent, depending on the circumstances. Generally speaking, central leadership endorsement of the idea of acquiring aircraft carriers may depend on whether the required money and technologies are available and whether an appropriate naval strategy is formulated. There are some circumstances, however, in which central leadership endorsement may, in fact, make money and technologies more readily available and appropriate strategy more forthcoming.[3] Because of such variation in the relationship among these four major conditions (variables), each will be discussed separately.

The article has five sections. The first four examine changes in the four major conditions of leadership endorsement, financial affordability,

2. See Andrew S. Erickson and Andrew R. Wilson, "China's Aircraft Carrier Dilemma," *Naval War College Review*, 59, no. 4, Autumn 2006, pp. 13-45.
3. Besides these two types of circumstances, there is one very exceptional circumstance in which the central leadership may endorse a particular naval platform in spite of lack of money and appropriate technologies and naval strategy. An example is Mao Zedong's endorsement of China's strategic ballistic-missile submarine programme in the mid-1960s, which proved to have very little operational value but incurred tremendous cost. This article, however, will discuss necessary and sufficient conditions under more normal circumstances of the first two types.

appropriate naval strategy, and requisite technologies. The concluding section discusses the major implications if China actually acquires aircraft carriers.

LEADERSHIP ENDORSEMENT

Liu Huaqing, the People's Liberation Army Navy (PLAN) commander 1982-88 and a CMC member (and its Vice Chair, 1992-97) from 1988 to 1997, strongly advocated carrier operations;[4] however, this idea was not endorsed by members of the central civilian leadership, like Jiang Zemin. Lack of funding and requisite technologies may have played a role, as also the relatively low dependence of China's economy on external sources of energy and raw materials. More important, however, the proposal contradicted the "new security concept" Jiang endorsed in 1997, which highlighted "soft" approaches to China's maritime as well as land neighbours. This concept contributed significantly to China's signing of a declaration of a Code of Conduct over the South China Sea in 2002 and the Treaty of Amity and Cooperation in 2003 with Association of Southeast Asian Nations (ASEAN) members, as well as the founding of the Shanghai Cooperation Organisation (SCO) in 2001.[5] Because of these political and diplomatic initiatives, the primary missions Jiang assigned to the People's Liberation Army (PLA) during his reign were rather narrow and limited, confined primarily to the defence of national sovereignty; the integrity of China's territorial land, air, and waters; and deterrence of Taiwan from declaring formal independence.

Hu Jintao succeeded Jiang as the Chinese Communist Party General Secretary in 2002 and became the CMC chair in 2004. He has required the PLA to fulfill more expansive and externally oriented missions that were absent in Jiang's era: to secure China's newly emerging interests in outer, maritime, and electromagnetic space, and to contribute to world peace through international peace-keeping and humanitarian relief. Hu has also

4. See Liu Huaqing, *Liu Huaqing huiyilu* [Liu Huaqing's Memoirs] (Beijing: Liberation Army Press, 2004), pp. 477-481.
5. This organisation includes China, Russia, and the Central Asian countries that separated from the former Soviet Union.

endorsed a "far seas operations" concept for the PLAN, one that implies some new level of power-projection capability.[6]

Such a change is understandable for two reasons, both due to the recent years of rapid economic growth. First, China has begun to develop a stronger sense of vulnerability stemming from its growing dependence on external energy and raw materials, and it has become more interested in the sea-lanes that bring in these resources. Second, investments overseas and the number of its citizens working there are both growing. These factors should have made the idea of acquiring aircraft carriers more acceptable to the central civilian leadership following Jiang's retirement.

There are several indicators that this idea has been endorsed by the central civilian leadership. On March 6, 2007, a PLA Lieutenant General revealed to the media at the annual National People's Congress that a project to develop aircraft carriers was proceeding smoothly. Ten days later, the Minister of China's Commission of Science and Technology in National Defence, Zhang Yuchuan, stated that China would build its own aircraft carriers and that preparation was well under way.[7] More recently, a spokesperson of China's Ministry of National Defence, Maj. Gen. Qian Lihua, claimed that China has every right to acquire an aircraft carrier.[8] But more important, China's Defence Minister, Gen. Liang Guanglie, recently told the visiting Japanese Defence Minister, Yasukazu Hamada, that China will not remain forever the only major power without an aircraft carrier.[9] All of these statements suggest that China has the intention to acquire aircraft carriers. These forthright comments on such a politically sensitive issue would have been impossible had they not been endorsed by the central Party leadership.[10]

6. Hu Jintao, as cited in Tang Fuquan and Wu Yi, "A Study of China's Sea Defense Strategy," *Zhongguo junshi kexue* [China Military Science], no. 5, 2007, p. 93.
7. See *Wen Wei Po* (Hong Kong), March 7, 2007; and *China Review News*, March 17, 2007, available at chinareviewnews.com.
8. "China Hints at Aircraft Carrier Project," *Financial Times*, November 16, 2008; "Experts Defend Naval Rights," *China Daily*, November 19, 2008.
9. See "China Confirms Intent to Build Aircraft Carrier," *Agence France-Presse*, March 23, 2009.
10. According to informed sources in Guangzhou, at least one high-ranking PLAN officer from the South Sea Fleet was reprimanded and discharged for advocating in front of Jiang Zemin the development of aircraft carriers to handle the Spratlys issue. This had happened during one of Jiang's inspection tours of the fleet.

FINANCIAL AFFORDABILITY

One major reason for China's past hesitation to acquire aircraft carriers was a lack of funding. When Mao proposed at a CMC meeting on June 21, 1958, to build "railways on the high seas"—ocean-going fleets of merchant ships escorted by aircraft carriers—China's defence budget was a mere Yuan/Renminbi (RMB) 5 billion. Of that, only RMB 1.5 billion could be allocated to weapons acquisition, and out of this share, the PLA Navy (PLAN) received less than RMB 200 million. A 1,600-ton Soviet-built Gordy-class destroyer cost RMB 30 million, and the PLAN could afford only four of them.[11]

The carrier project was again placed on the policy agenda in the early 1970s, but financial constraints still prevented the initiation of a serious programme. From 1971 to 1982, China's annual defence budget averaged about RMB 17 billion. Out of less than RMB six billion allocated for weapons acquisition each year, the PLAN could expect to receive only several hundred million, whereas one Type 051 destroyer cost RMB 100 million. With the endorsement of Party leader Hua Guofeng in the late 1970s, China planned to acquire an 18,000-ton light aircraft carrier, either through import or co-production, and it was to carry the British Vertical/Short-Take-Off-and-Landing (V/STOL) Harrier aircraft. The project had to be scrapped, because the price asked by British suppliers was too high. Furthermore, Deng Xiaoping, succeeding Hua as the paramount leader, decided to cut defence spending in order to free up resources for the civilian economy.[12]

From the middle to the late 1980s, Liu Huaqing lobbied feverishly for carrier operations. He proposed feasibility studies in the Seventh Five-Year Plan (FYP), for 1991-95; research and development on key aspects of platform and aircraft in the Eighth FYP; and production in the early 2000s. His plan to acquire a mediuim-sized carrier for limited, air defence-dominant missions

11. See Lu Ting, "China's Finance Is Sufficient to Fulfill the 'Aircraft Carrier Dream,'" *Junshi wenzai* [Military Digest], no. 5, 2008, pp. 12-13.
12. Ibid., p. 13.

Taking into consideration the lower labour and material costs in China, the cost of building a medium-sized, conventionally powered, 60,000-ton carrier similar to the Russian Kuznetsov class is likely to be above $ 2 billion.

was shelved partly because of insufficient funding for air defence.[13] While the defence budget had been increasing since the early 1990s, its growth could not catch up with the rising cost of aircraft carriers, as modern designs integrated more advanced aircraft, air defence systems, and electronics. Funding priority was instead given to developing submarines. By 2007, however, China's finances had improved remarkably, with government revenues reaching $750 billion—lower than the $2.6 trillion for the United States but higher than Japan's $500 billion. China's foreign exchange reserves now ranked first in the world, reaching $1.4 trillion. As a result, China's annual formal defence budget had grown to $46 billion (RMB 350.9 billion). According to the official estimate, about a third of China's formal defence budget, or $15.3 billion that year, was used for weapons acquisition. Given that naval modernisation is currently a high priority, the PLAN is probably now receiving several billion dollars a year just for weapons acquisition, and this figure is likely to grow in the coming years.[14] Aircraft carriers come in a wide variety of sizes, costs, and capabilities. Taking into consideration the

13. See, Liu Huaqing's Memoirs, p. 480; "Lay a Good Basis for Naval Arms and Equipment Modernization Construction" (speech delivered to the First Navy Conference on Armament and Technologies Work, on January 11, 1984), in *Liu Huaqing junshi wenxuan, shangjuan* [Selected Military Works of Liu Huaqing, Book One] (Beijing: Liberation Army Press, 2008), pp. 269-70; "Naval Strategy and Future Sea Operations" (report delivered at the National Defence University on April 29, 1986), in Selected Military Works, pp. 473, 477; and "Employ Navy Development Strategy to Guide Arms and Technologies Research and Development Work" (speech delivered to the Fourth Navy Conference on Armament and Technologies Work, on January 10, 1987), in Selected Military Works, pp. 522-23.
14. China's 2008 formal defence budget was $57.229 billion (RMB 417.969 billion), a 17.6 percent increase from 2007. The figure had risen to $70.3 billion (RMB 480.6 billion) for 2009, a 14.9 percent increase from the previous year. For 2008, government revenue had reached RMB 6.1317 trillion, or about $897.76 billion, a 19.5 percent increase from the previous year. China's foreign exchange reserve had grown to $1.95 trillion for the same year. See "China's Defense Budget to Grow 17.6% in 2008," Xinhua, March 4, 2008; Ministry of Finance, "A Report on 2008 Central and Local Budgetary Execution and Draft Budgetary Plan for 2009" (delivered to the National People's Congress), Xinhua, June 15, 2009; and "2008 Chinese Foreign Exchange Reserve Capital Stays Safe in General," Xinhua, March 13, 2009.

lower labour and material costs in China, the cost of building a medium-sized, conventionally powered, 60,000-ton carrier similar to the Russian Kuznetsov class is likely to be above $ 2 billion.[15] But that cost is just the start, as a carrier needs aircraft and escorts. A Russian Su-33 carrier-based combat aircraft costs $50 million, so a carrier air wing of about 50 Su-33s, several Airborne Early-Warning (AEW) planes, and a number of Anti-Submarine Warfare (ASW) and search-and-rescue helicopters may cost more than $3 billion. A Russian Sovremenny-class guided-missile destroyer costs about $600 million, so an escort force consisting of a number of guided-missile destroyers, frigates, and supply ships may cost more than $4 billion. That makes the likely total cost of one carrier battle group about $10 billion; the price of two carrier battle groups, which is the number that China is likely to acquire, would be around $20 billion. That cost, spread over a period of ten years of development, would constitute only a moderate proportion of the projected naval weapons acquisition budget during that time. The annual cost for regular training, maintenance, repairs, and fuel for two carrier battle groups can be estimated at about 10 percent of the construction cost of the carrier, or $200 million for each of the two battle groups. This is based on a useful rule of thumb derived from US experience. Such a figure can be readily covered by another third of the annual naval budget, which is specifically allocated for such a purpose. This proportion, like the weapons acquisition proportion, is also likely to grow over the years as the defence budget grows because of rapid economic growth.[16]

NAVAL STRATEGY

Leadership endorsement and financial affordability are necessary for China to acquire aircraft carriers, but they are not sufficient. A fairly concise naval strategy that defines the missions of the carrier battle groups is also needed.

15. The Kuznetsov class can also be considered a large-sized carrier, comparable to the US Kitty Hawk class but much less capable.
16. For a Chinese estimate of operational cost, see Lu, n.11 pp. 14-15. See also Meng Fansheng, "Budgetary and Management Research on the Operating Cost of Aircraft Carrier," *Shengcanli yanjiu* [Productivity Research], no. 14 (2007). Lu concludes that the cost of operating two Chinese aircraft carrier groups would be more than RBM 10 billion or about $1.5 billion per year. This number appears high to the American authors of this paper, and we suspect that it includes infrastructure and other factors not usually included in US estimates.

It is, however, more problematic than the two previous conditions.

"Near-coast defence" defined China's naval strategy from the 1950s until the early 1980s. It highlighted counter-amphibious landing operations earlier against the Taiwan Guomindang government's attempt to recapture the Mainland and later against a possible Soviet invasion from the seas, and, as a result, it did not require aircraft carriers. In the late 1980s, a "near seas active defence" strategy, largely operationalised by Liu Huaqing, was endorsed to replace near-coast defence. This strategy requires the PLAN to develop credible operational capabilities against potential opponents in China's three "near seas"—the South China Sea, East China Sea, and Yellow Sea—or the space within and slightly beyond the "first island chain," which extends from Kurile Islands through the main islands of Japan, the Ryukyu Archipelago, Taiwan, and from the Philippines to Borneo.

According to Liu, at least two major issues within this expanded operational space require aircraft carriers: "to solve the need for struggle against Taiwan [independence] and to resolve the dispute over the Nansha [Spratlys] Archipelago]." In operational terms, Liu believed that "whether the attack type or the V/STOL type, they [aircraft carriers] are for the purpose of resolving issues of [fleet] air defense and sea attack." Liu particularly stressed that "the objective for us to acquire aircraft carriers is not to compete against the US and the Soviet Union."[17] This implied that what Liu wished to acquire was a medium-sized, conventionally powered platform for limited, air defence dominant missions, not a large, nuclear-powered one for expansive, sea/land-attack-dominant missions.[18]

Of the two major issues, Liu clearly privileged the Spratlys dispute. For instance, he highlighted the need to compare the cost-effectiveness of employing carriers and carrier-based combat aircraft as opposed to land-

17. Liu, n.13, p. 479. Liu also mentioned the role of carriers in sea-lane control operations in times of war. Such a role is not discussed here, mainly because it is more or less related to naval and air operations conducted to resolve the issues of Taiwan and the Spratlys. See Liu Huaqing, "The Question on Operations concerning Sea Transportation Lines" (speech delivered at the Navy Conference on Campaign to "Protect and Sabotage Transportation," June 20, 1987), in Selected Military Works, p. 581.
18. To operate heavy strike aircraft in large numbers, a carrier needs to be big, fast, and able to generate copious quantities of steam for aircraft catapults. These attributes heavily favour a large, nuclear-powered ship.

based aviation divisions. He was particularly concerned about lack of air cover for naval operations over the Spratlys. However, naval operations over Taiwan can be covered by land-based combat aircraft, even though, as Liu mentioned, without carriers, air operations over Taiwan could be more costly because more airfields and land-based combat aircraft are needed due to the reduced loitering time in the air.[19] The 1996 Taiwan Strait crisis and the 1997 retirement of Liu Huaqing, which helped to consolidate further Jiang Zemin's position as the CMC chair, clearly contributed to the shelving of the PLAN's carrier project.[20]

While articulating the near seas active defence strategy in the 1980s, Liu Huaqing stated that the PLAN would operate within and around the first island chain, or in China's near seas, for a long time to come. But he also suggested that the growth of the economy and strengthening of science and technology would translate into expansion of Chinese naval power in the long run. This, in turn, would allow the PLAN to extend its operational range from the near seas to the "middle and far seas" or the space between the first and second island chains, the latter stretching from northern Japan to the Northern Mariana Islands, Guam and farther southward, and beyond. This would also allow the PLAN to "strike the enemy's rear" through exterior-line operations if China's coast, or interior line, were attacked by an opponent. Liu, however, placed emphasis on the primacy of "near seas operations" and regarded "middle and far seas operations as [only] supportive and auxiliary."[21]

By 2004, however, such an emphasis seems to have shifted somewhat. China's naval analysts, for instance, now argue that China's naval strategy

19. Liu, n. 13, p. 480.
20. See Storey and You, n. 1.
21. See Liu, n. 13, p. 437; Senior Captain Wu Dianqing, "Xiao Jinguang and Liu Huaqing: Conception of China's Aircraft Carriers by Navy Commanders of Two Generations," *Zhishi bolanbao* [Extensive Knowledge News], November 19, 2008. For the role of carriers in sea-control operations within the first island chain, see also Liu Huaqing, "The Situation Requires Us to Handle Well the Research on Naval Development Strategy" (speech delivered at the Navy Research Seminar on Naval Development Strategy, January 1987), p. 528, and "Naval Armament Plan Needs Long-Term Consideration," March 31, 1987, both in Selected Military Works.

China's naval analysts, for instance, now argue that China's naval strategy should shift from near seas to far seas operations. They hold that such operations are necessary because of China's increasing vulnerability relating to distant sea-lanes and choke points.

should shift from near seas to far seas operations.[22] They hold that such operations are necessary because of China's increasing vulnerability relating to distant sea-lanes and choke points. China's ever-expanding ocean-going fleet of merchant ships, especially tankers, also needs to be protected, as do China's growing overseas investments, and the increasing number of Chinese citizens living and working overseas. Moreover, China's prosperous coastline and resource-rich exclusive economic zones and territories need to be secured,. These areas, however, are difficult to secure, because they are so long and wide and their flanks are so exposed. This problem extends into such close forward positions as China's near seas, which are partially blocked by the first island chain, and the few exits through straits and channels are mostly narrow and controlled by others, making it difficult to gain initiative by manoeuvring out through them. Many of the navies operating in these near seas are quite formidable, including the US, Japanese, Russian, Taiwanese, ASEAN-state, and Indian Navies. They render the PLAN more vulnerable, and they limit, and even reduce, the effectiveness of, the near seas active-defence strategy for both deterrence and war-fighting.[23]

According to China's naval analysts, to alleviate vulnerability and enhance effectiveness, the PLAN needs to break out of interior-line constraints associated with the narrow and near seas within and around the first island chain. Acquiring capabilities to operate in the far seas, the vast space beyond the first island chain, would allow the PLAN to regain initiative and momentum. While "interior-line operations require near seas

22. Ye Xinrong and Zuo Liping, "Strategic Reflections regarding the March of the Navy from Near Seas to Far Seas," *Junshi xueshu* [Military Art Journal], no. 10 (2004).
23. Ibid., p. 31; Zhang Wei and Zheng Hong, "On Strategic Necessities and Opportunities for Developing Our Navy," *Military Art Journal*, no. 10, 2004, p. 34; Liang Fang, "Status and Role of the Oceans in National Security and Policy Response," *Military Art Journal*, no. 1, 2005, p. 66.

capabilities, exterior-line operations are based on far seas capabilities. . . . Far seas capabilities make it possible to carry out offensive operations and ambush and sabotage operations in the far and vast naval battlespace beyond the first island chain, and would have the effect of shock and awe on the enemy." Forward operations and offense are central to naval combat, because oceans have few invulnerable physical objects on which to base the defence, whereas naval platforms, once crippled, are hard to restore. An emphasis on offence also helps to optimise naval force structure. It is also more cost-effective, because as strikes become more long-range, precise, and powerful, and, therefore, more lethal, defence becomes more expensive to maintain. History also shows that a strategy of close and static defence led to the decisive defeat of the Qing Navy in the first Sino-Japanese War, in 1894.[24]

In the worst case, the PLAN may come into direct contact with the US and Indian Navies in competition for vital sea-lanes in the South China Sea and Eastern Indian Ocean and for such choke points as the Malacca Strait.

The far seas strategy suggests that the PLAN needs to develop power-projection capabilities that can operate effectively in the more distant Western Pacific Ocean and the Eastern Indian Ocean. It also implies that the PLAN may come in direct confrontation with the US Navy in the Western Pacific—in, for instance, a competition for sea access and denial in a crisis over Taiwan. Moreover, in the worst case, the PLAN may come into direct contact with the US and Indian Navies in competition for vital sea-lanes in the South China Sea and Eastern Indian Ocean and for such choke points as the Malacca Strait. These scenarios may require the PLAN to acquire large, nuclear-powered aircraft carriers, very different from the medium, conventionally powered carriers for limited missions envisioned by Liu Huaqing. A key variable that may determine whether China would acquire medium, conventionally powered carriers or the large, nuclear-powered ones is whether the requisite technologies are available.

24. For quotation, see Ye and Zuo, n. 22, p. 31. For others, see Cheng Xiaochun and Hu Limin, "Revelations of the Sino-Japanese War on Rejuvenating the Navy in the New Period," *Military Art Journal*, no. 10 2004, p. 29; and Liang, Ibid. p. 67.

AVAILABILITY OF REQUISITE TECHNOLOGIES

Before discussing the specific carrier development route that the PLAN might follow, it is useful to spend a moment talking about aircraft carriers in general.

Thinking About Aircraft Carriers

There are four main types of aircraft carriers operating worldwide today, as defined by their method of launching and recovering aircraft. The first—the most capable but also the most expensive—is the "Catapult-Assisted Take-Off But Arrested Recovery" (CATOBAR) design. Originally created by the United Kingdom but perfected by the United States, this design philosophy is currently employed by the United States and France. Because catapults (currently using steam, though electromagnetic catapults have been proposed) are necessary for heavy aircraft capable of long range or heavy payloads (which, in turn, can perform a wider variety of missions at greater range), the CATOBAR carrier is generally considered a prerequisite for a significant carrier-borne power-projection capability.

The second carrier design is the "Short Take-Off But Arrested Recovery" (STOBAR) type. This design uses a rolling take-off—often assisted by a ski-jump ramp—but aircraft return on board via arrested recovery. Most current non-US aircraft carriers are of this type, including the Russian Kuznetsov class, a unit of which, the *Varyag*, has been acquired by China. A STOBAR carrier is generally much simpler to build and maintain than a CATOBAR design but less capable, though it may still be a large, fast ship. A STOBAR is less appropriate for the strike role, so a decision to forgo catapults may indicate intent to not perform the strike mission.

The third design, "Short Take-Off Vertical Landing" (STOVL), combines a rolling take-off—often assisted by a ski-jump ramp—with vertical recovery. This is the system Spain and the United Kingdom have used on their most recent units. Britain is currently evaluating a variant called "Shipborne Rolling Vertical Landing," or SRVL, for its new Queen Elizabeth

class.[25] As a general rule, aircraft capable of vertical landing can also take off vertically, but the performance penalty is high; a rolling, ski jump-assisted take-off maximises load or range. A STOVL design is likely be smaller than other types, but it still requires high speed to generate wind over the deck. The STOVL design severely limits strike and long-range missions, but it is easier to build and maintain than types better suited to those tasks. STOVL generally represents the minimum capability needed for fighter-based air defence.

The fourth and final type is the "Vertical Take-Off and Landing" (VTOL) carrier. Compared to STOVL, a VTOL design forgoes even more aircraft operational capability and allows for a slower (and, thus, less expensive) ship. Selecting VTOL over STOVL generally means either that the ship is intended to operate only helicopters, is designed for a function (e.g., amphibious assault) that constrains performance, or is really envisioned only for non-combat or general support missions. For fixed-wing aircraft, the difference between STOVL and VTOL is generally the presence in the former of a ski-jump ramp at the front of the flight deck and the ability to make enough speed to generate wind over the deck.

Several general rules of thumb are useful when thinking about aircraft carrier size and capabilities:

- The more missions a carrier is to perform, the more aircraft it needs and the bigger the ship must be.
- The longer the range or heavier the payload of the aircraft, the more likely the carrier will need catapults and arrested recovery.
- The bigger the flight deck, the bigger the aircraft that can be operated. Also, the faster the carrier, the bigger the aircraft that can be operated. (Faster carriers require bigger propulsion spaces, so these factors are complementary.) Some missions are best performed by bigger aircraft.
- Strike is a long-range, heavy-load mission, as is aerial refuelling.
- One pays a penalty for VTOL capability. Even if the design of the aircraft

25. This is specifically to increase "bring back," the amount of weight (e.g., ordnance) with which the aircraft can land. SRVL involves landing the VTOL-capable aircraft (e.g., the F-35), while moving forward at 35 knots relative to the ship, to increase the amount of lift produced by the wings. This could be expected to affect adversely the ability to park aircraft on the deck.

does not involve performance compromises, which is a big assumption, it still takes extra fuel to take-off vertically, because "there's no such thing as a free launch," and there will be much more restrictive weight limits on what one can "bring back" on landing—unused ordnance may have to be jettisoned. VTOL is at best inefficient, and at worst, affects overall combat capability.

- A large carrier is more efficient—that is, it carries more aircraft per ton of displacement and can handle planes on board better than a small carrier.

Taken together, these considerations are powerful tools in analysing what a PLAN carrier might look like, based on discussions of design features, on the one hand—that is, "What can they do with what they intend to buy?"—and missions, on the other—that is, "What do they need to buy to do what they say they want to do?" For example, the Russian-built *Varyag* is a ski jump-equipped STOBAR design, displacing 60,000 to 65,000 tons and with a long, thousand-foot flight deck. This makes it a relatively large carrier, smaller than an American *Nimitz* but larger than the French *Charles de Gaulle*, roughly comparable to both the American Kitty Hawk class and the British Queen Elizabeth. Note that one must be careful comparing displacements: with large, capacious ships like carriers, the difference between empty, full, and standard loads can be tens of thousands of tons.

Due to the lack of catapults, fixed-wing aircraft on the *Varyag* are essentially constrained to air superiority—fleet air defence or offensive air—or relatively short-range strike.[26] The *Varyag* was intended to operate with a steam propulsion plant capable of thirty-two knots, but when sold

26. The *Varyag* does have an oddly positioned jet-blast deflector—an essential determinant of where an aircraft can be positioned to start its take-off run—a considerable distance from the bow, possibly indicating a capability to operate heavy aircraft requiring a longer takeoff run. See en.wikipedia.org/, s.v. "Russian Aircraft Carrier Admiral Kuznetsov," for an illustration.

to China it reportedly had no engines.[27]

Russia officially categorises this type as a "heavy aircraft-carrying cruiser"; the limited abilities of its embarked aircraft and its Russian-style heavy missile load are consistent with this description.[28] Its usual suggested role is to support and defend strategic missile-carrying submarines, surface ships, and maritime missile-carrying aircraft. In other words, while it may have some anti-ship capability, both in its aircraft and its missiles, it is not really designed to support long-range strike missions.

It appears that in the short run, China is likely to acquire a medium-sized carrier for limited, air defence-dominant missions.

Medium-Carrier Options

Maj Gen Qian Lihua stated, in his November 2008 comment already cited, that if China acquires an aircraft carrier, it will serve mainly the purpose of near-seas active defence. Thus, it appears that in the short run, China is likely to acquire a medium-sized carrier for limited, air defence-dominant missions. For a medium, conventionally powered carrier intended for these purposes, the requisite technologies are generally available. China has been analysing the *Varyag* since 2002.[29] The Chinese design and construction of super container-ships, tankers, and liquefied natural gas carriers should also be useful experience for building the hulls of aircraft carriers, although carriers are much more complex ships. China also has the simulation and

27. Frankly, this claim is problematic. The propulsion machinery for a ship this size is large and heavy; it is installed early in construction, with the rest of the ship built around it; and without its weight, the ship would have serious stability issues. It is more likely the ship has at least some propulsion gear but that the plant is inoperable due to incomplete manufacture, later salvage, or some manner of vandalism. Alternatively, it is possible the engineering spaces are filled with concrete or other ballast, but this begs the question of why the ship was completed in the first place.
28. The Montreux Convention, which prohibits the transit of aircraft carriers through the Dardanelles, is often cited as the reason for this designation. While that is no doubt a factor, Russian naval doctrine emphasises that aircraft carriers support other surface units, not the other way around. In other words, the category accurately describes the function of the vessel.
29. Note that while the *Varyag* is a large ship—larger than the French carrier *Charles de Gaulle*—the air wing complement of the Kuznetsov class is relatively small, at about fifty aircraft, of which half are helicopters.

testing facilities necessary for research and development, such as large-scale ship-model basins and wind tunnels, and it has been gaining engineering and technical assistance from Russia and Ukraine, countries that have experience in designing and building medium-sized aircraft carriers. Furthermore, specialised construction materials, such as high-grade steel, can either be indigenously developed or acquired through import. Moreover, China has made substantial progress in information, automation, new materials, and maritime and space technologies, many of which can be integrated into carrier construction. Finally, while major technical bottlenecks exist and need to be resolved, China has experience in producing heavy steam and gas turbines, of which several units can be grouped together to provide sufficient speed and range.

For take-off and landing, China is likely to choose a STOBAR design. China's naval analysts have identified several benefits of a STOBAR design over a CATOBAR design. A STOBAR design, for instance, minimises the space needed for water and fuel storage, maximises the energy available for the ship's propulsion, offers simpler production and maintenance, and reduces vulnerability to mechanical breakdowns, because of the absence of the steam catapult.[30]

Because the missions for medium carriers are more those of air cover for naval operations than those of more distant sea and land attack, air superiority fighters with some sea/land-attack capabilities would be sufficient. In this case, purchasing the Russian STOBAR-capable Su-33 combat aircraft, which can carry eight air-to-air missiles and one or two Anti-Ship Cruise Missiles (ASCMs), seems to be a realistic option, and, indeed, China has been negotiating with Russia for such a purchase.[31]

In the meantime, China's aircraft carrier ambitions may be larger than the current literature has predicted. China may also attempt to upgrade

30. See Li Jie, "Aircraft Carrier-Based Aircraft: Catapult or Ski-Jump Takeoff?" *Xiandai junshi* [Contemporary Military], no. 6 (2006); Liu Jiangping, Jiang Yongjun, and Yang Zhen, "Medium-Sized Aircraft Carrier Has Prominent Advantages," *Dangdai haijun* [Modern Navy] (November 2006). Senior Captain Li is an analyst at the PLAN's Naval Military Art Studies Institute in Beijing; Modern Navy is a publication of the PLAN's Political Department.
31. Reuben Johnson, "China Considers Next-Generation Su-33s for Aircraft Carrier Programme," *Jane's Defence Weekly*, October 28, 2008.

a land-based combat aircraft of its own, such as the indigenous J-10 or the J-11B (a Chinese variant of the Russian Su-27), into a carrier-based aircraft. At a minimum, such an attempt would probably involve reinforcing the landing gears, wings, and fuselage of the aircraft for arrested recovery, which puts heavier stress on these components than standard runway landings.[32] Similarly, China may purchase carrier-based Ka-31 Airborne Early Warning (AEW) helicopters from Russia. The Ka-31 can patrol for two to three hours on end, with a detection range of 150 km for sea targets and 100-150 km for low-altitude aircraft and ASCMs, and it can direct engagement against 15 targets at one time. Assisted by shipborne phased-array radars, these ranges and capacity are sufficient for limited missions in the near seas. It is also likely that China may upgrade its shipborne Z-8 (a variant of the French Super Frelon) to a carrier-based AEW platform and develop carrier-based Unmanned Aerial Vehicles (UAVs) with electro-optical, infrared, and radar sensors for intelligence collection, surveillance, and reconnaissance at sea. UAVs can patrol for a long time at high altitude and are difficult to detect.[33] The Chinese approach to carrier development is likely to be incremental. Therefore, China may attempt to gain engineering and operational experience by moving from smaller and simpler platforms to larger and more complex ones. This means that the option of building small V/STOL carriers should not be completely excluded.[34] On the other hand, many Chinese naval analysts argue that the missions that small

The Chinese approach to carrier development is likely to be incremental. Therefore, China may attempt to gain engineering and operational experience by moving from smaller and simpler platforms to larger and more complex ones.

32. See Wei Xiaohui and Nie Hong (Nanjing Aeronautics and Astronautics University), "Research on New Technologies to Attenuate the Landing Impact on Carrier-Based Aircraft Landing Gears," *Hangkong Xuebao* [Aeronautics Journal], no. 2 (2007); Bi Yuquan and Sun Wensheng (Aeronautical Mechanics Department, Qingdao Campus of the Naval Aeronautical Engineering Academy), "Preliminary Analysis of the Ski-Jump Takeoff Performance of a Type of Aircraft," *Feixing lixue* [Flight Mechanics], no. 4, 2006.
33. Huo Ke, "China Should Study and Produce Ship-Borne AEW Aircraft on Its Own," *Jianzai wuqi* [Shipborne Weapons], December 12, 2007.
34. See Erickson and Wilson, n.2

For far seas operations, AEW platforms are particularly indispensable.

carriers can accomplish are too limited, because the number and types of aircraft they carry and their operational radii are too limited. To secure China's 18,000-km coastline, the "three million square km of maritime territories," and the nation's expanding maritime interests, as well as to further learning and adaptation, these analysts believe, building medium-sized carriers is more appropriate as the first step in realising China's aircraft carrier ambitions.[35]

Large-Carrier Options

For far seas operations, a medium-sized carrier may not be adequate. A STOBAR design, for instance, limits aircraft take-off weight and shifts the full burden of take-off propulsion onto the aircraft, thus increasing the amount of fuel consumed at that stage. This restricts the fuel and weapons payload that an aircraft can carry, thereby reducing its range, loitering time, and strike capabilities. STOBAR is also more affected by wind, tide, rolling, and pitching. Furthermore, it needs more flight-deck space for take-off and landing, thus, limiting the parking space and having an adverse effect on take-off frequency-based crisis reaction. In comparison, the CATOBAR design, which is mostly associated with large carriers, minimises aircraft fuel consumption on take-off, thus, enabling better payload, range, loitering time, and strike capability. Its runway requirement, while greater than in a V/STOL design, is also minimal, thus, allowing more flight-deck parking and faster launches, even simultaneous launch and recovery, resulting in quicker crisis response.

CATOBAR designs can also launch heavier fixed-wing AEW and ASW aircraft.[36] For far seas operations, AEW platforms are particularly indispensable. China's military analysts, for instance, are impressed by the

35. Anonymous naval specialists cited in "Is China's Aircraft Carrier Journey Still Very Long?" *Zhongguo guofang bao* [China National Defense News], April 7, 2009; CCTV *Jinri guanzhu* [Today's Concerns], interview with Zhang Zhaozhong and Li Jie, April 20, 2009. China National Defense News is a franchise of Liberation Army Daily; Zhang, a Rear Admiral, is a Professor at China's National Defence University.

36. See Deng Taihong and Wang Yingchao, "Exploring the Origins of the Differences between US and Russian Aircraft Carriers in Active Service," *Shipborne Weapons*, June 6, 2008; Liu, Jiang, and Yang, n. 30.

American E-2C, which can patrol up to six hours, monitor a sea area of 12.50 million sq km, and track 2,000 targets, directing engagements against 40 of them simultaneously. They believe that with its detection range of 741 km for surface targets, 556 km for aircraft, and 270 km for missiles and its ability to patrol 180-200 km away from the carrier battle group, the E-2C, together with the combat patrol aircraft, establishes a 300 km outer air defence perimeter, deeper than the range of most ASCMs.[37] Without a similar air defence perimeter, Chinese analysts believe, a Chinese carrier battle group would be a "sitting duck," particularly if it engages highly stealthy US combat aircraft.

Similarly, far seas operations require far more capable carrier-based combat aircraft than does near seas active defence. Such an aircraft should be capable of high speed, large combat radius, long-range sea/land attack, and stealth.[38] Finally, the tremendous thermal energy that a large carrier consumes, particularly for propulsion and catapult-steam generation, suggests that a nuclear power plant is preferable to a conventional one.

Because China has had no experience in building and operating an aircraft carrier, acquiring a working, medium-sized carrier may be a necessary stage to gain such experience in the near future. Nonetheless, China's naval analysts are particularly impressed by the large US carriers, including their most advanced iteration, the Gerald R. Ford class, and its related technologies.[39] Further, there are indicators that research has been done on tackling some major technical issues for constructing large carriers.[40] The process of acquiring such carriers, however, is likely to be costly and protracted.

37. Deng and Wang, "Exploring the Origins"; Hou, "China Should Study and Produce Ship-Borne AEW Aircraft on Its Own."
38. Liu, Jiang, and Yang, n. 30.
39. See Li Jie, "Future Aircraft Carriers Are More Powerful," *Jiefangjun bao* [Liberation Army Daily], March 16, 2009, p. 8.
40. See Li Meiwu, Cui Ying, and Xue Fei, "Electromagnetic Catapult System: The Optimal Takeoff Method for Aircraft Carrier-Based Aircraft," *Jianchuan kexue jisu* [Ship Science and Technology], no. 2 (2008); and Ding Guoliang, Hu Yefa, and Liu Xiaojing, "Maglev Electromagnetic Catapult System Structure Design and Magnetic Field Analysis," *Jijie gongchenshi* [Mechanical Engineer], no. 7 (2008). It is also believed that the heavier and stealthier J-14 fourth-generation combat aircraft, which is under development, has a carrier-based variant.

In spite of unresolved issues, China is getting closer to realising its aircraft carrier ambitions in terms of leadership endorsement, financial affordability, naval strategy, and requisite technologies.

WHAT ARE THE IMPLICATIONS?

In spite of unresolved issues, China is getting closer to realising its aircraft carrier ambitions in terms of leadership endorsement, financial affordability, naval strategy, and requisite technologies. China is likely to develop medium-sized aircraft carriers in the medium term for near seas missions and to gain operational experience so that it can develop larger carriers for far seas operations in the long term. In this section, we offer some thoughts on the potential missions of such ships, the factors that go into defining those missions, and the regional implications.

An aircraft carrier is not a solo-deploying ship. To be survivable in an intense combat environment, it needs escorts to protect it. While China has acquired new surface combatants with sophisticated anti-surface and anti-air capabilities, it continues to lag behind in the area of ASW. Unless one is willing to assume that the PLAN does not believe in the anti-surface utility of submarines—a conclusion at odds with its own submarine acquisition efforts—the lack of anti-submarine escort capability implies at least one (and perhaps all) of the following:

- China intends to address its lack of ASW capability in the future and is willing to accept increased risk in the short term, or
- China thinks that it has a solution to the ASW problem, or
- China does not envision its aircraft carriers as becoming the targets of submarines.

All three are likely true to some degree, and, indeed, they may be interrelated. Aircraft carriers are long-lead time projects, and it may be that China's decision-makers have decided to start that programme first, accepting that they may end up fielding a carrier before its ASW support is ready. Or they may have decided that they have a solution to the ASW problem in the form of mines—implying in turn that they believe they can

control the location of the battle—or through speed and manoeuvre, which itself may be an argument for a big, fast nuclear carrier.

Or perhaps China does not expect to use its aircraft carriers against a first class opponent with submarine capability. For that matter, perhaps China does not expect to use its carriers in combat at all. Many missions (such as those detailed below) would either involve smaller regional powers, unable to mount a significant submarine threat, or be strictly for peace-time. The United States has traditionally viewed aircraft carriers as instruments of high-intensity combat, but their utility in other areas is significant. Imagine, for instance, a carrier providing surface-search capability via a small number of airborne assets. While high-intensity carrier operations require frequent replenishments of jet fuel, low-intensity operations could continue for weeks with minimal support, while maintaining a surge capacity if needed.[41] Since China lacks overseas bases, it may be willing to make do with a relatively small increase in capability in a given situation and, hence, be willing to operate carriers in ways the US Navy is unlikely to consider. For this reason, it will be very interesting to see how many and what types of aircraft the PLAN decides is appropriate for its carriers.

It is important to note that while China understands the potential vulnerability of aircraft carriers to concerted attack, the problems facing China and those facing the United States are not similar.[42] US Navy aircraft carriers operating in the Western Pacific face a sophisticated reconnaissance-strike complex of over the-horizon radars, supersonic cruise missiles, and anti-ship homing ballistic missiles. A PLAN aircraft carrier operating in the same geographic area has none of these concerns; rather, a PLAN carrier has these systems backing it up.

With the above points as a backdrop, one can readily envision five PLAN carrier missions:

- SLOC protection. In recent years, China has become concerned regarding

41. There are issues with maintaining pilot proficiency in such a mode, which may limit surge capacity.
42. See Andrew S. Erickson and David D. Yang, "Using the Land to Control the Sea? Chinese Analysts Consider the Anti-ship Ballistic Missile," *Naval War College Review*, 62, no. 4, Autumn 2009, pp. 53-86.

The only nations in the region likely to be able to stand up against even a modest Chinese air wing are Japan, South Korea, and, going a little farther afield, India.

its sea lines of communication through the Strait of Malacca and other areas outside the range of its land-based air power. Even more recently, Chinese warships have undertaken anti-piracy missions in the Gulf of Aden. Whether the mission is constabulary or combative in nature, an aircraft carrier provides useful capabilities, including facilitation of extended surface-search capabilities via fixed-wing and helicopter assets, and "visit, board, search, and seizure" via helicopter. Moreover, such a mission would likely be welcomed by the international community—including, the United States.

- Deployment to overseas crisis locations. Because Chinese overseas interests have grown extensively, such deployment serves to deter threats to Chinese overseas interests and reassure security of these interests.
- Exclusive economic zone/territorial enforcement. China has extensive territorial claims in the South China Sea, including the Spratly Islands. Small amounts of air power in these areas—even just to maintain a surface picture—could confer a tremendous advantage.
- Humanitarian aid and disaster relief. The 2004 Indian Ocean tsunami demonstrated the utility of aircraft carriers in disaster relief operations, both as helicopter-staging platforms and for the use of the power-generation, water purification, and medical capabilities aboard. Using a Chinese carrier in such a contingency would potentially produce a great deal of prestige and goodwill for China, perhaps even more than would a ship specifically designed for disaster relief, reassuring regional neighbours as to Chinese intentions. Again, such a humanitarian deployment by the PLAN would likely be welcomed by the international community.
- Taiwan contingency. The prospect of the use of an aircraft carrier in support of an invasion or coercion campaign is often cited. Given the PLAN's lack of proficiency in ASW, a PLAN carrier participating in

such a scenario would make a tempting target for opposing forces. Nonetheless, it would have the potential to complicate the problem by increasing the axes of attack, especially if US entry into the conflict could be forestalled. Even if a feint (after all, China's close mainland air bases could generate far more sorties than could one or two carriers), a carrier's presence would likely prompt the United States or Taiwan to "honour the threat" and allocate forces accordingly, which could be significant in a short conflict.

Lacking such support mechanisms, a Chinese carrier is likely to stay closer to home, but it may still require a Chinese support presence overseas.

For the first four missions listed above, a carrier seems like overkill, or at best a sub-optimal use of resources. In strict terms, that is true, but China attaches great symbolic value to a Chinese aircraft carrier as physical evidence of the nation's coming of age as a great naval power. China may feel it gains more through incidental use of an aircraft carrier in humanitarian aid/disaster relief or other non-combat missions than it would with purpose-built (but less prestigious) platforms.

FINAL THOUGHTS

For regional conflicts short of full-scale warfare, a Chinese aircraft carrier has the potential to complicate seriously the calculations of competitors in the region. The only nations in the region likely to be able to stand up against even a modest Chinese air wing are Japan, South Korea, and, going a little farther afield, India. A PLAN carrier would have the effect of extending Chinese air capabilities without requiring overseas air bases. Nonetheless, while a nuclear carrier may be home ported in China, supplying it with jet fuel, food, ammunition, and other consumables becomes harder with distance. The US Navy solves this problem with an extensive series of overseas logistics bases and large, fast replenishment ships that support the operations of carriers, themselves operating largely from the continental United States. Lacking such support mechanisms, a Chinese carrier is likely to stay closer to home,

but it may still require a Chinese support presence overseas.

For the United States, a PLAN aircraft carrier is probably of little day-to-day concern, at least until the PLA develops an ASW capability. In peace-time, the US Navy is unlikely to consider a Chinese carrier a threat, and it may perhaps even welcome Chinese assumption of great-power naval responsibilities in such maritime constabulary operations as counter-piracy. In war-time, for the foreseeable future, a Chinese air wing is unlikely to threaten US naval forces seriously, and China's limited ASW capability provides persuasive options to an American commander. This is not to say that a Chinese carrier would not complicate American planning, however, even threats that can be neutralised require allocation of resources to do so.

In the short to medium terms, therefore, China's acquisition of aircraft carriers offers more opportunities than challenges. Medium-sized carriers would be for limited, air defence dominant missions in local conflicts within the first island chain. They could be easily contained, being exposed and made vulnerable by their large profiles in so limited an operational space. Developing such carriers would also divert funding from building advanced submarines or advanced missiles that arguably pose greater threats. Also, carriers could perform non-traditional security missions that are compatible with the goals of other navies in the Asia-Pacific region, thus, contributing to maritime security cooperation.

In the long-term, however, if China can overcome the technological obstacles and gain the operational experience needed to build large, nuclear-powered carriers in substantial numbers and correct the deficiencies in its anti-submarine capabilities, the PLAN may pose more challenges than opportunities. Several such carrier-based strike groups could project Chinese power beyond the "far seas" to the still more distant and vast "near oceans" and "far oceans" The much improved sensors, sustainability, stealth, networking, range, and strike capabilities and self-protection of such highly integrated battle groups could drive the cost of containing and fighting them much higher.