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China's Increasing Air Power: Implications for the Republic of Korea Air Force

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Beijing's military air components are finally on the verge of giving

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the country's leaders something they have dreamed of since before the founding of the People's Republic of China: a reliable instrument of national power. This has significant implications for the security architecture of northeast Asia. China is poised to increase its power and influence in the region, and has the potential to play an even more positive role than it has in recent years. Indeed, cooperation between China and South Korea has generally been excellent, and the two nations share tremendous interests, particularly in the economic sphere. Unfortunately, in an effort to pursue its own national interests, which include placing stability above all else, prioritizing the security of its border with North Korea, and making sure that developments on the Korean peninsula do not undermine China's interests, China limits the ability of other nations to place pressure on North Korea to curtail its nuclear brinksmanship and other destabilizing and wholly irresponsible behavior. This is particularly regrettable, as North Korea remains the primary military threat to South Korea, and has developed a large air force and other military services to challenge it. As a thriving capitalist democracy that serves as a model to the world in economic and technological development, South Korea should by all rights be allowed to flourish in the same peaceful environment that many similarly advanced nations enjoy. Regrettably, the nation's geopolitical location has long precluded this. Given the enduring military threat from Pyongyang, and expectations of deference from Seoul by Beijing, it will be essential for South Korea to secure and defend its own interests by carefully monitoring regional military trends, such as the growth and development of Chinese air power, and maintaining sufficient air, land, and sea power to ensure that its interests are taken seriously. This paper will therefore survey the development of Chinese air power and offer further implications for the Republic of Korea and its Air Force.

I. Background and Order of Battle

China's People's Liberation Army (PLA) is divided into the ground forces (66% of personnel), the People's Liberation Army Navy (PLAN) (11%), the People's Liberation Army Air Force (PLAAF) (17%), and

the strategic missile forces (Second Artillery) (4%).[1] The PLAAF also has a surface-to-air missile (SAM) and antiaircraft artillery (AAA) corps and three airborne divisions assigned to the 15th Airborne Army. It has multiple academies and research institutes. According to the U.S. Department of Defense, "The PLAAF has received eight battalions of upgraded Russian SA-20 PMU-2 long-range (200km) SAM systems since 2006. The SA-20 system reportedly provides limited ballistic and cruise missile defense capabilities. Russian press reporting suggests another eight battalions could be delivered within the next two years."[2]

The PLA Air Force (PLAAF) and PLAN Air Force (PLANAF), finally beginning to recover from grave setbacks suffered during Mao's Cultural Revolution, currently possess 2,300 operational combat aircraft, of which over 700 are capable of conducting operations against Taiwan without aerial refueling.[3] China still relies on massive imports of Russian planes and their components, especially jet engines. The PLAAF uses 120 H-6 (B-6) twin-engine, medium-range bombers, derivatives of Russia's *Tupolev* Tu-16/Badger, as its medium- to long-range strategic and tactical air strike platform, and continues to produce slightly improved versions of this aircraft. The PLANAF uses the H-6D variant, which is equipped with YJ-6/C-601 ASCMs.[4] The obsolescent H-6 bomber suffers from low payload and short range. However, it may have been given a new mission to destroy radars, command and control sites, and other fixed points on Taiwan: the H-6H variant has been fitted with YJ/KD-63 LACMs.[5] Other H-6 variants already carry YJ-6/C-601, YJ-61/C-611, and YJ-81/C801L cruise missiles.[6] In recent H-6 variants, guns

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1) Percentages derived from International Institute for Strategic Studies, *The Military Balance 2006* (London: Routledge, 2006), p.264. Cited in Dennis J. Blasko, "The 2007 Report on the Chinese Military: The Top 10 List of Missing Topics," *Joint Forces Quarterly,* Issue 47, 4th quarter 2007, p.49.

2) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.50.

3) Office of the Secretary of Defense, *Military Power of the People's Republic of China 2006,* Annual Report to Congress, p.46.

4) "XAC H-6," *Jane's All the World's Aircraft,* 10 March 2009(www.janes.com).

5) According to *Jane's*, the "First H-6H flown on 2 December 1998 and made the first successful air launch of a YJ-63 in November 2002", "XAC H-6," *Jane's All the World's Aircraft,* 10 March 2009(www.janes.com).

underwing pylons for cruise missiles have replaced guns "(two on H-6D and H-6H; four on H-6G; six on H-6K)."[7] According to the U.S. Department of Defense, "China is upgrading its B-6 bomber fleet (originally adapted from the Russian Tu-16) with a new variant which, when operational, will be armed with a new long-range cruise missile."[8]

The 2006 China Defense White Paper emphasizes the need for PLAAF to transition from a past mission of territorial air defense to both offensive as well as defensive operations. Indeed, over the past two decades, great efforts have been expended into turning the air force from the old subsidiary supporting role to one of a more active and offense-capable missions. This has involved both a more aggressive procurement program and renewed domestic defense industrial renovation to produce a new-generation of fighter aircraft and re-fitting and modernization of the air force bomber fleet.[9] These include 4th-generation Russian fighter aircraft and transporters such as Su-27, Su-30, Mig-29, and Il-76; air defense systems; and its domestically produced new fleet of fighter aircraft (J-10). Production of the H-6/*Badger* bomber has been resumed, with the new variant capable of carrying anti-ship cruise missiles such as YJ-62.[10]

The PLA accepted shipments of 26 Su-27s in 1992, 24 in 1995-96, 28 in 2002.[11] The PLAAF currently operates 150+.[12] Shenyang has

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6) Thomas G. Mahnken, *The Cruise Missile Challenge* (Washington, DC: Center for Strategic and Budgetary Assessments, 2005), p.17.

7) According to *Jane's*, the "First H-6H flown on 2 December 1998 and made the first successful air launch of a YJ-63 in November 2002", "XAC H-6," *Jane's All the World's Aircraft,* 10 March 2009(www.janes.com).

8) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.50.

9) John Wilson Lewis and Xue Litai, "China's Search for a Modern Air Force," *International Security* 24:1 (Summer 1999), pp.64-94; Erik Lin-Greenberg, "Offensive Airpower with Chinese Characteristics: Development, Capabilities, and Intentions," *Air & Space Power Journal* (Fall 2007), pp.67-77.

10) Phillip C. Saunders and Erik Quam, "Future Force Structure of the Chinese Air Force," in Kamphausen and Scobell, eds., *Right-Sizing the People's Liberation Army,* pp.377-436; Richard Fisher, Jr., "China's 'New' Bomber," *International Assessment and Strategy Center,* 7 February 2007.

11) "Sukhoi Su-27," *Jane's All the World's Aircraft,* 31 December 2009(www.janes.com).

12) "Sukhoi Su-30 MK 2 Flanker," *Jane's Fighting Ships,* 20 January 2009(www.

assembled over 100 aircraft kits indigenously as the J-11, which has served as a test bed for China's indigenous WS-10A turbofan engine, and perhaps even for its associated indigenous radar and fire control system as well as the PL-12 active-guided air-to-air missile (AAM).[13] Ten Su-30 two-seat, twin-engine multi-role fighter aircraft, currently China's most capable multi-role aircraft/fighters, were received in 2000, 28 in 2001, 38 in 2003, and 24 in 2004, for a total of 100 Su-30s to date. Thus, China might have gained 268 fourth generation aircraft by 2004.[14] China's improved Su-30MK2 variant with anti-ship strike capability and an improved electronic-warfare and -countermeasures suite has been developed specifically for naval aviation; 24 are now in service. According to *Jane's*, "Kh-35 anti-ship missiles may be fitted to some [Su-30MK2] aircraft in due course."[15] A Su-30MK3 variant has additionally received an improved engine and new radar. *Jane's* assesses these latter Su-30 variants to offer the PLA "world-class all-weather strike" capabilities for the first time,[16] and suggests that all China's Su-30s may ultimately be upgraded to the MK2 standard.[17]

As many as 20 of China's JH-7 (also designated FB-7 or FBC-1 Flying Leopard), a two-seat, twin-engine fighter-bomber surface-strike aircraft, are in the PLANAF inventory and complement such multi-role and strike aircraft as the J-10 and Su-30MKK.[18] The improved formal production variant JH-7A, commissioned in 2004, is assessed to have

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janes.com).

13) "Air Force — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 5 January 2007, Jane's Information Group(www.janes.com).

14) "Fighter Aircraft," China Defence Today(http://www.sinodefence.com/airforce/fighter/default.asp).

15) "Sukhoi Su-30 MK 2 Flanker," *Jane's Fighting Ships*, 20 January 2009(www.janes.com). For further details on the Kh-35, see "Kh-35/3M24, Kh-35UE (AS-20 'Kayak'), Kh-37," *Jane's Air-Launched Weapons*, 12 November 2009(www.janes.com).

16) "Procurement — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 13 December 2006, *Jane's* Information Group(www.janes.com).

17) "Air Force — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 5 January 2007, *Jane's* Information Group(www.janes.com).

18) Office of the Secretary of Defense, *Military Power of the People's Republic 2009*, Annual Report to Congress, p.50.

achieved the overall performance level of Western fighters introduced in the 1960s-80s.[19] The JH-7A can carry "two C-801K, C-802K or C-803K (YJ-8K, -82 or -83) sea-skimming anti-ship missiles (inboard)"; "EO and anti-radar versions of the C-701 (KD-88) TV-guided anti-ship missile"; or YJ-91 Kh-31P (AS-7 'Krypton') missiles.[20]

China's new indigenous fourth generation J-10 multi-role fighter is now in serial production, in service in PLAAF units, and demonstrated through publicly-documented exercises to be capable of in-air refueling. The J-10 is thought to be based on Israel's discontinued *Lavi* (which itself exploited U.S. F-16 technology) and to approach performance parameters of Washington's F-16 and Brussels' *Eurofighter*[21] with its 125 km radar detection range and ability to fire active-guided PL-12 AAMs as well as to deliver precision-guided munitions (PGMs).[22] China has already purchased a variety of Russian precision guided munitions with which it might equip its aircraft, including the Kh-29 anti-ship missile (10 km range), Kh-31P anti-radiation missile (110 to 200 km range), Kh-59ME anti-ship missile (115 km range), and the KAB-1500 laser guided munition.[23] The J-10 may also use C-801, C-801K/YJ-8K, and C-802 ASCMs.[24]

To support the effective use of the PLAAF and PLANAF, China is attempting to improve its airborne intelligence, surveillance, and reconnaissance (ISR) capabilities, in part by developing several variants of AEW&C aircraft. China is currently developing two major indigenous platforms to improve on previous efforts based on modified *Ilyushin* Il-76 and *Tupolev* Tu-154 variants,[25] including A-50 AWACS aircraft

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19) Evan Medeiros et al., *A New Direction for China's Defense Industry* (Santa Monica, CA: RAND, 2005), p.199.

20) "XAC JH-7," *Jane's All the World's Aircraft,* 12 November 2009(www.janes.com).

21) For detailed explanations of the J-10 estimates, see Richard Fisher, "China's J-10 Jet Fighter: How Much Do We Know?" International Assessment & Strategy Center, 16 January 2007(http://www.strategycenter.net/research/pubID.140/pub_detail.asp).

22) "Air Force — China," *Jane's Sentinel Security Assessment - China and Northeast Asia,* 5 January 2007, *Jane's* Information Group(www.janes.com).

23) "Air Force — China," *Jane's Sentinel Security Assessment - China and Northeast Asia,* 5 January 2007, *Jane's* Information Group(www.janes.com).

24) "CAC J-10," *Jane's All the World's Aircraft,* 12 November 2009(www.janes.com).

purchased from Russia following cancellation of Israel's *Phalcon* sale amid mounting U.S. pressure in 2000.[26] China has reportedly been developing the KJ-2000 indigenous AWACS aircraft based on the A-50 airframe to conduct surveillance, perform long range air patrol, and thereby coordinate naval air operations.[27] China's smaller KJ-200/Y-8 'Balance Beam' airborne early warning (空中早期, AEW&C) maritime patrol/ electronic warfare aircraft, with its electronically steered phased-array similar in appearance to but larger than Sweden's Ericsson Erieye active phased-array radar,[28] is said to complement the KJ-2000 by performing tactical AEW and ELINT more economically.[29] Derived from Russia's *Antonov* An-12/Cub transport and license produced by Shaanxi Aircraft Industry (Group) Corporation, China's more than 100 Y-8s are divided among more than 20 variants that perform such additional missions as radar testing, airlift support, and helicopter and UAV transport. Various sources report that a KJ-200 aircraft crashed on 4 June 2006, killing forty people and possibly setting back the program.[30] If successfully developed, however, these platforms could give China important aerial battle management capacity.

As for further acquisition of fixed-wing aircraft, the U.S. Department of Defense states that:

> Press reporting indicated that China remains interested in procuring Su-33 carrier-borne fighters from Russia. Additionally, Russia and China reportedly re-started negotiations for China's purchase of 34 IL-76 transport

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25) "Shaanxi Aircraft Company SAC Y-8/Y-9 (Special Mission versions)," *Jane's All the World's Aircraft*, 7 December 2006, *Jane's* Information Group(www.janes.com).

26) "Air Force — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 5 January 2007, *Jane's* Information Group(www.janes.com).

27) "KJ-2000 Airborne Warning & Control System"(http://www.sinodefence.com/airforce/specialaircraft/kj2000.asp).

28) "Air Force — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 5 January 2007, *Jane's* Information Group(www.janes.com).

29) "Y-8 'Balance Beam' Airborne Early Warning Aircraft"(http://www.sinodefence.com/airforce/specialaircraft/y8balancebeam.asp).

30) See, for example, "Observation Post of Military Situation," HK Phoenix TV, *Military News*, OSC# CPP20060626715001, 21 June 2006.

aircraft and four IL-78 aerial refueling tankers. While the two sides agreed to the sale for $1.045 billion in 2005, Russia has refused to deliver the planes, citing higher manufacturing costs and concern that China's defense industries may reverse-engineer the aircraft for indigenous production. Russia is attempting to increase the contract to $1.5 billion. China has no other source for large aircraft to augment Chinese military AEW&C capabilities.[31]

In contrast to recent improvements in fixed-wing aviation, helicopters remain an area of weakness for the PLA. This was most directly exposed during the tragic May 2008 Sichuan earthquake, when relief operations were limited significantly by lack of helicopters in general and of heavy lift helicopters in particular. Most platforms in its disproportionately small but growing fleet (roughly 700-800 in the PLA and over 100 in the PLAN)[32] are either imports or copies of foreign models. The PLANAF operates 10-12 Z-8s, a derivative of France's *Aerospatiale SA 321Ja/Super Frelon.* They may carry the C-701/YJ-7 TV-guided anti-ship missile.[33] A Z-8F variant, powered by Pratt & Whitney engines, first flew in 2004. The PLAN also operates a naval version (-C) of the PLA's more than 200 Zhi-9/*Haitun* (Z-9) multi-role army support helicopters, licensed copies of France's Eurocopter AS 365N/*Dauphin* II. They may likewise carry the C-701.[34] Recent Internet photos have shown a Z-9C with a C-70x or FL-X ASCM on it. Also in China's inventory are 10-20 *Kamov* Ka-28/Helix naval helicopters purchased from Russia for its *Sovremenny* destroyers, as well as from its indigenous Type 052B and Type 052C destroyers in recent counter-piracy deployments.[35] China is attempting to further remedy its helicopter

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31) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.50.

32) Dennis J. Blasko, "Chinese Helicopter Development: Missions, Roles and Maritime Implications," paper presented at "Evolving Maritime Roles for Chinese Aerospace Power" conference, Naval War College, December 10-11, 2008.

33) "C-701 (YJ-7, Kosar)," *Jane's Air-Launched Weapons,* 9 June 2009(www.janes.com).

34) "HAI (Eurocopter) Z-9 Haitun," 12 November 2009; "C-701 (YJ-7, Kosar)," 9 June 2009; *Jane's Air-Launched Weapons*(www.janes.com).

35) The Ka-28's VGS-3 submarine-detecting dipping sonar and sonar buoys, and any further improvements in rotary wing aviation, will help the PLAN to address one aspect of its significant weakness in anti-submarine warfare.

deficiency by developing joint ventures with foreign manufacturers such as Eurocopter. Reportedly, China Helicopter Research and Development Institute (CHRDI) is developing an indigenous WZ-10 advanced attack helicopter,[36] with possible army and transport variants.[37]

Having observed the U.S. military's extensive use of UAVs and drones in recent years, China is purchasing foreign models, transforming former piloted aircraft into unmanned combat aerial vehicles (UCAVs), and developing indigenous variants.[38] China's growing arsenal of UAVs also offers the PLA options to penetrate Taiwan's defenses by shutting down its early warning and missile defense radars. Anti-radiation drones or UAVs like Israel's *Harpy*, which has been sold to China, possess stand-off ranges of 400 km or more, and together with the enormous challenges Taiwan faces in defending simultaneously against Chinese ballistic and cruise missile threats, could make Taiwan's investment in missile defenses increasing problematic.

In a demonstration of its ongoing dependence on key foreign technologies and systems, Beijing obtained 100 *Harpy* anti-radar drones from Israel in 2001.[39] These small, stealthy, autonomous flying bombs could play a potent role in a Taiwan contingency by destroying Taiwanese air defense radars. Propeller driven, *Harpys* can loiter over a battlefield for up to two hours at ranges of 400 km from their launch sites. Once a *Harpy* detects a radar emission it has been programmed to attack, it promptly dives directly at that radar antenna and destroys it with a 32 kilogram explosive warhead. Targeted radars must either remain off to avoid attack or risk destruction. According to Israeli sources, China may have reverse-engineered and indigenously produced additional

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36) "WZ-10 Attack Helicopter," China Defense Today(http://www.sinodefence.com/airforce/helicopter/wz10.asp).

37) Unless otherwise indicated, this paragraph is derived from "Procurement — China," *Jane's Sentinel Security Assessment - China and Northeast Asia,* 13 December 2006, *Jane's* Information Group(www.janes.com).

38) Data for this paragraph are derived from "Unmanned Aerial Vehicles," *China Defense Today*(http://www.sinodefence.com/airforce/uav/default.asp and related links).

39) Yitzhak Shichor, "The U.S. Factor In Israel's Military Relations With China," *China Brief,* The Jamestown Foundation, Vol.5, No.12, 24 May 2005(http://www.jamestown.org/publications).

Harpys.[40] The late 2004/early 2005 diplomatic furor between the United States and Israel over Israeli attempts to maintain and upgrade China's *Harpys* underscores the perceived utility of these weapons.[41]

China's reconnaissance UAVs include Guizhou Aircraft Industry Corporation's new generation WZ-9 (WZ-2000); Beijing University of Aeronautics & Astronautics (BUAA)'s WZ-5 and WZ-5A variants (modeled on the U.S. AQM-34N *Firebee*); BUAA's VT-UAV vertical take-off/landing UAV; and the ASN-15, -104, -105, and -206 tactical reconnaissance UAVs. While visually similar to General Atomics' *Predator*, the turbojet-driven WZ-2000 (a prototype of which is reportedly being tested) apparently has "far less endurance."[42] Guizhou is also developing a medium endurance UAV.[43] The ASN series, developed by Xi'an Northwest Polytechnic University ASN Technology Group Company, includes the short-range multi-role ASN-206, capable of conducting ISR electronic warfare and countermeasures, is reportedly "one of the most popular and advanced tactical UAV systems fielded by the PLA." Chinese target drones include the *TianJian*-1 cruise missile simulation version (which reportedly entered service in 2005), Shaanxi's *Chang Kong*-1, -1A, -1B, -1C, and -1E versions (of the Soviet Lavochkin La-17C radio-controlled subsonic target drone), and the Ba-2, -7, and -9 (ASN-2, -7, and -9) radio planes. The Ba-9, developed by Xi'an, "was designed for the training of navy antiaircraft artillery (AAA) crews on surface ships." UAV development appears to be proceeding with growing interest; a wide variety of UAV models were displayed at Airshow China 2008 in Zhuhai.

Technology controls remain a major impediment to rapid growth

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40) See, for example, "Stonewalling Defense Official Hints at Gravity of Crisis with U.S. and China," *Israel Insider*, 29 December 2004(http://web.israelinsider.com/Articles/Diplomacy/4683.htm).

41) The author is indebted to William Murray for his assistance with this paragraph. For the operational context in which Harpys might be employed, see his recent article "Revisiting Taiwan's Defense Strategy," *Naval War College Review*, Vol.61, No.3 (Summer 2008), pp.13-38.

42) "China is No Exception to the Aerospace Fervor," *Aviation Week & Space Technology*, Vol.165, No.19, 13 November 2006, p.20.

43) "Procurement — China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 13 December 2006, *Jane's* Information Group(www.janes.com).

in indigenous Chinese UAV development. According to an internal Chinese government document, dated 8 July 2008, which was obtained by the *Washington Times*, the Chinese plan to develop an advanced UAV using a strategy of combining civilian and military technology.[44] Titled "National Defense Science and Technology Industry Military and Civilian Dual-Use Research and Development Special Project," the document describes a Chinese quest to develop, within two years, a high-altitude, long endurance UAV, which will have both civilian (aerial exploration, ground monitoring) and military (aerial inspection, electronic warfare) applications. At the Zhuhai Air Show in 2008, one of the scale models on display had features similar to the U.S. Global Hawk, just such a high-altitude, long endurance UAV. But for China to even approach such a level of capability in such a short period of time, it will have to seek outside assistance. To that end, the internal Chinese government document notes that China must depend on international cooperation to supplement indigenous research efforts in order to "break through the core technologies of this type of aerial vehicle."[45]

II. Weapons

China's military aircraft are outfitted with a variety of increasingly advanced weapons systems. In some cases, particularly involving cruise missiles, these systems have extended the operational utility of otherwise obsolescent platforms.

At present, China's principal long-range air-launched weapons system is the YJ-63 (C-603) air-launched land-attack cruise missile (LACM). Developed by the China Haiying Electro-Mechanical Technology Academy, the YJ-63 LACM was designed to provide standoff air-launched precision strike capabilities for PLAAF's H-6H bomber (copied from the Russian Tu-16 *Badger*). Some sources claim that the YJ-63 was developed from the HY-2 ship-to-ship or coast-to-ship cruise missile,

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44) "Inside the Ring: China UAV," Bill Gertz, *Washington Times*, 23 October 2008 (http://www.washingtontimes.com/news/2008/oct/23/inside-the-ring-75886460/).

45) Ibid.

which was subsequently replaced by a more advanced version, the YJ-6 (C-601). The latter anti-ship missile was employed on the naval variant of H-6 medium bomber, designated the H-6D. Both the H-6D naval variant and the H-6H PLAAF variant carry two cruise missiles launched from wing pylons. Reportedly deployed in 2004-05, the YJ-63 is said to use a combined inertial and GPS/GLONASS mid-course guidance system and an electro-optical television system for the terminal attack phase, achieving a circular error probable (CEP) of 10-15 m while carrying a payload of 500 kg.[46] Varying reports indicate that the YJ-63 is also capable of man-in-the-loop guidance with target imagery from the electro-optical seeker sent back to the launch aircraft via the H-6's datalink antenna, which is mounted in an under-belly fairing behind the bomb-bay doors.[47]

Other payloads could include the 200-500 km range YJ-63 LACM (two per H-6H medium-range bomber). While the Department of Defense's 2009 report refers to the 1,500 km DH-10 LACM as "ground-launched,"[48] development of an air-launched variant may occur as well. First, the Department of Defense report also states that "China is upgrading its B-6 bomber fleet (originally adapted from the Russian Tu-16) with a new variant which, when operational, will be armed with a new long-range cruise missile."[49] The report indicates that the B-6 variant armed with this air-launched LACM will extend the reach of China's regional precision strike capabilities out to 3,300 km, which is sufficient to reach Guam.[50]

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46) Evan S. Medeiros, Roger Cliff, Keith Crane and James C. Mulvenon, *A New Dimension for China's Defense Industry* (Santa Monica: The Rand Corporation, 2005), p.94. The deployment date comes from http://sinodefence.com

47) See http://www.softwar.net/c801.html, http://www.sinodefence.com, and Douglas Barrie and Robert Wall, "Chinese Cruise Missile Portfolio Expands," *Aviation Week & Space Technology,* 18 September 2005 (http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news//091905p09.xml&headline=Chinese%20Cruise%20Missile%20Portfolio%20Expands).

48) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.22.

49) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.50.

50) "Figure 5. Conventional Anti-Access Capabilities," Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress,

Table 1 (below) details Chinese air-launched cruise missiles

Naval mines represent another potentially potent payload for Chinese military aircraft. Beijing's more than a hundred H-6 bombers, though obsolete for many missions, can each carry twelve to eighteen 500 kg sea mines.[51] Whether the H-6 would be assigned to this mission is

〈Table 1〉 Chinese Air-Launched Cruise Missiles

Name	Range (km)	Payload (kg)	Speed (sub/super-sonic)	Guidance (initial/terminal)
YJ-63/KD-63	200	500	Sub	INS/Sat/DL/ Active/Passive
AS-15/KH-55	3,000	300-400	Sub	INS/TERCOM
DH-10	2,000+	500	Sub	INS/Sat/TERCOM
HN-1	600	400	Sub	INS/Sat/TERCOM
YJ-2/C-802 (YJ-83/C-803)	180 (200)	165	Sub	INS/Active
YJ-1/C-801/ CSS-N-4	50	165	Sub	INS/Active
FL-7	30	365	Super	INS/Active
YJ-16/C-101	50	400	Super	INS/Active
YJ-6/C-601 (C-611)	110 (200)	500	Sub	Pre-programmed/ Active
HY-3/C-301	110-180	500	Super	INS/Active
HY-2/C-201	95	500	Sub	INS/Active

Sources: Sinodefence.com, NTI.org, http://www.nti.org/db/china/wcmdat_table.htm, *Jane's*

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p.23.

51) This estimate is based on the 9,000kg internal payload capacity of the H-6 as reported in "H-6 Bomber"(Sinodefence.com). The estimate of one hundred H-6 aircraft is from "China, Armed Forces," *Jane's Sentinel Security Assessment: China and Northeast Asia,* 12 July 2005(www.janes.com).

unknown, but it has recently been used in a variety of mine-laying drills.[52] China's limited inventory of H-5 bombers could also be pressed into a mining role against Taiwan. China's more than one hundred JH-7/7A fighter-bombers can each carry up to twenty 250 kg bombs.[53] According to *People's Navy*, such aircraft can conduct mine-laying in "near seas" (近海) [out to the First Island Chain, which extends from the Japanese islands through Taiwan and the Philippines].[54] All these aircraft, and more, could just as easily carry mines, which might be nothing more than gravity bombs fitted with magnetic or other fuses.[55] According to one source, "the PLA's current inventory of *Chen*-1 through *Chen*-6 influence mines and the *Mao*-1 through *Mao*-5 moored mines are appropriate for aircraft delivery."[56] Table 2 offers a partial list of Chinese naval mines that may be laid by air.

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52) "Military Report," CCTV-7, 12 January 2009, OSC CPM20090304013025.

53) The payload capacity is based on study of Internet photos.

54) 计生文, 姜毅, 王松涛 [Ji Shengwen, Jiang Yi and Wang Songtao], "金戈铁甲啸海疆—回眸改革开放以来海军装备建设成就" [Steel Weapons, Armor Roar Through the Coastal Areas and Territorial Seas—Looking Back at the Achievements in the PLA Navy's Equipment Effort Since the Beginning of Reforms and Opening Up], 人民海军 [*People's Navy*], 6 October 2008, p.1.

55) China's seventy-six SU-30MKK fighters could conceivably carry several mines, since they are designed to carry Russian free-fall bombs. However, it is unlikely that such a high-value platform (e.g., fourth-generation aircraft) would be used in this role when less sophisticated aircraft would suffice. PLA Navy aviation force J-8s (numbering approximately fifty) and Q-5s (approximately thirty) could also conceivably perform the MIW mission, as could the two hundred obsolete, and even expendable, PLA Navy aviation force J-6s. If the PLAAF assumes the MIW mission, it will have many more candidate platforms, including J-7s (620), J-8s (184), Q-5s (300), and J-6s (350). But if the objective of aerial mining is the quick placement of large numbers of weapons, platforms that carry significant numbers of mines make much more sense than larger numbers of planes that carry only one or two each.

56) Hai Lin, "In 2010 Taiwan Will Be Surrounded with a Sea Mine Battle Array," p.17.

〈Table 2〉 Chinese Air-Delivered Sea Mine Order of Battle (Selected)[57]

Model	Fuse	Type	Case Depth (Meters)	Mission/Target
C-1 500 1000 沉	Audiofrequency, magnetic induction	Bottom	6-30 6-60	Attack surface ships & submarines
C-3 500 1000	Audiofrequency magnetic induction	Bottom	6-50 6-100	Attack large & medium surface ships, submarines
EM-57 500 1000	Acoustic, magnetic	Bottom influence, remote control Advanced range 730 km	6-100	ASW/ASUW
PMK-2	Passive, active, acoustic	(Rocket?) Propelled warhead encapsulated torpedo	400 M (Anchor depth 100-1000M) close-tether capable	ASW
Type 500 500型		Deep training mine		Practice minelaying over sea

57) Data for this table derived from 林长盛 [Lin Changsheng], "潜龙在渊: 解放军水雷兵器的现状与发展" [The Hidden Dragon in the Deep: The Present Situation and Development of PLA Mine Weaponry], 国际展望 [World Outlook], No.9 (May 2005), pp.22-33; 凌翔 [Ling Xiang], 第六章 "扬威海上的中国水雷战舰艇" [Chapter 6: Raise Mighty Chinese Sea Mine Warfare Ships on the Sea], in 当代水雷战舰艇大观 [Modern Sea Mine Warships Spectacle], 当代军舰大观系列丛书之五 [Modern Warship Spectacle Book Series, Vol.5] (Beijing: World Knowledge, 1995), pp.152-161; *Jane's Underwater Warfare Systems,* available at www.janes.com; and Wayne Mason, "Naval Mine Technologies" (briefing, Mine Warfare Association Spring 2009 Regional Conference, Panama City, Fla., 19 May 2009).

III. Doctrinal Guidance and Transformation

At an expanded Central Military Commission (CMC) conference on 24 December 2004, Chairman Hu Jintao introduced a new military policy that defined the four new missions of the PLA: first, to serve as an "important source of strength" for the Chinese Communist Party (CCP) to "consolidate its ruling position"; second, to "provide a solid security guarantee for sustaining the important period of strategic opportunity for national development"; third, to "provide a strong strategic support for safeguarding national interests"; and fourth, to "play an important role in maintaining world peace and promoting common development."[58] The last two missions truly reflect new emphases for the PLA, and the fourth is unprecedented. Hu requires the PLA "to not only pay close attention to the interests of national survival, but also national development interests; not only safeguard the security of national territory, territorial waters, and airspace, but also safeguard electromagnetic space, outer space, the ocean, and other aspects of national security."[59]

Hu has also stated specifically: "As we strengthen our ability to fight and win limited wars under informatized conditions, we have to pay even more attention to improving non-combat military operations capabilities."[60] In an attempt to transform Hu's general guidance into more specific policy, articles in state and military media have argued that to safeguard China's economic growth, the PLA must go beyond its previous mission of safeguarding national "survival interests" (生存利益) to protecting national "development interests" (发展利益).[61] High

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58) "Earnestly Step Up Ability Building within CPC Organizations of Armed Forces," 解放军报 [Liberation Army Daily], 13 December 2004, available at www.chinamil.com.cn; "三个提供, 一个发挥" [Three Provides and One Bring Into Play](news.sina.com.cn).

59) 刘明福, 程钢, 孙学富 [Liu Mingfu, Cheng Gang and Sun Xuefu], "人民军队历史使命的又一次与时俱进" [The Historical Mission of the People's Army Once Again Advances with the Times], 解放军报 [*Liberation Army Daily*], 8 December 2005, p.6.

60) 沈金龙 [Shen Jinlong], "海军非战争军事行动—面临的挑战及对策" [Naval Non-Combat Military Operations—Challenges Faced and Countermeasures], 人民海军 [*People's Navy*], 1 December 2008, p.4.

61) 田秉仁 [Maj. Gen. Tian Bingren], "新世纪阶段我军历史使命的科学拓展" [The Scientific Development of the Historical Mission of Our Army in the New Phase

level PLA officers are now conducting sophisticated analysis of the "non-war military operations" needed to promote these interests.

Also in 2004, the PLAAF received a CMC-approved strategy, "integrated air and space, simultaneous offensive and defensive operations." This codified a series of doctrinal developments underway since at least the late 1980s. In 1988, the PLAAF published 空军战役学[Science of Air Force Campaigns], which outlined three new development directions: 整体抗击 [integrated resistance], 积极反击 [active counter-attack], and 严密防护 [close protection].[62] This doctrinal development continued in the 1990s with the publication of 空军战役学 [Science of Air Force Campaigns], 空军战术学 [Science of Air Force Tactics], the latter of which has entered into the PLAAF curriculum as 空军战术学教程 [Lectures on Science of Air Force Tactics].[63] On 18 October 1999, President Jiang Zemin had directed the PLAAF to become a strategic armed service capable of conducting offensive and defensive operations, in certain cases independently.[64]

The PLAAF and PLANAF must thus prepare for the traditional missions of preparing to coerce Taiwan and further China's other territorial claims in the East and South China seas, while also supporting increasing nontraditional operations. Indeed, China's only major use of air power under Hu's tenure has been in this latter category. According to the U.S. Department of Defense:

> The PLA's new missions are also driving internal discussions about the future of the PLA Air Force (PLAAF). An article from July 2008 argues

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of the New Century], 中国军事科学 [China Military Science] (October 2007), pp. 21-27.

62) Liu Taihang, "Strengthen Studies on Air Force Military Theory for Quality Construction of the People's Air Force," 中国军事科学 [China Military Science], No.4 (1997), p.46; op. cit., Xiaoming Zhang, "The Sixty-Year Endeavor to Increase Chinese Air Power," p.34.

63) 中国空军百科全书编审委员会 [China Air Force Encyclopedia Editorial Committee], 中国空军百科全书 [China Air Force Encyclopedia] (Beijing: 航空工业出版社 [Aviation Industry Press], 2005), pp.108-110.

64) 中国空军百科全书编审委员会 [China Air Force Encyclopedia Editorial Committee], 中国空军百科全书 [China Air Force Encyclopedia] (Beijing: 航空工业出版社 [Aviation Industry Press], 2005), p.5.

that "in the wake of constant extension of our national interests, the change in our peripheral security environment and the struggle in air and space is getting more acute, the strategic needs that national interests impose on air security are also increasing." The article highlighted new or expanded missions that will affect the PLAAF in the future:

- Control the airspace over China's territory, maintain air surveillance over China's maritime interests, defend against "foreign harassing attacks from space," and protect China's national dignity, sovereignty, rights, and interests.

- Provide air security for China's overseas investment, communications and transport, scientific survey, and other efforts related to China's economic modernization.

- Prepare for Taiwan contingencies; support operations against separatists, terrorists, and other criminal forces; maintain China's territorial integrity and social stability; and protect Chinese citizens and property.

- Defeat enemy's air capabilities, ensure China's air defense, and contribute to integrated joint operations during wartime.[65]

The PLAAF now appears to be best placed of all services to assume authority over China's growing military space assets, though it has yet to consolidate this position given the existing role of the General Armaments Department and possibly even competition from the Second Artillery.

IV. Aviation Industry

China's aviation sector has long lagged behind other commercial and defense industrial development efforts. Among other reasons, the PRC inherited no domestic aviation industry; it located the majority of infrastructure in backward hinterlands (where much of it remains today); and (as was not the case with missiles or even satellites) failed to protect it from devastating political excesses (e.g., the factional infighting and utterly unrealistic goals of the Cultural Revolution).

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65) Office of the Secretary of Defense, *Military Power of the People's Republic 2009, Annual Report to Congress*, pp.18-19.

China is finally beginning to achieve comprehensive domestic production capabilities even as it acquires advanced Russian platforms. China has adopted a number of approaches toward acquiring military technologies from Russia.[66] One is to seek licensed production, e.g., of the Su-27 fighter aircraft. A 1995 agreement allowed China to produce 200 Su-27s at its Shenyang aircraft factory. In addition, technology transfers and technical know-how from Russian defense manufacturers have proven instrumental in Chinese development of major weapons systems. This is particularly the case with the new-generation Chinese fighter aircraft such as the J-11, where Russian companies have provided avionics and airframe designs. A second approach is to have Russian defense technicians work in Chinese defense research institutes and factories. As part of a third approach, many Chinese defense technicians have gone over to Russia for training or otherwise working in Russia's major aerospace research and development centers. However, Sino-Russian military cooperation may have encountered significant obstacles in recent years, as partly reflected by a steep decline in Chinese orders. This may be due in part to growing Russia's concerns over what it perceives as rampant and illicit Chinese copying and reverse engineering of key Russian weapons systems. Indeed, the Chinese J-11B has been alleged to be a reverse-engineered Su-27, which also incorporates some indigenous technologies and components. Russian President Dmitry Medvedev reportedly has sought agreement with his Chinese counterpart on protecting Russian defense intellectual property rights.

The co-production and training programs China has demanded as part of the Russian *Sukhoi* jet fighter purchases (and, many believe, also technology copied from Israel's *Lavi* fighter program due to simi-

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66) 李承红 [Li Chenghong], "中俄军事技术合作: 现状, 问题与对策" [Sino-Russian Military Technology Cooperation: Current Status, Problems and Responses], 俄罗斯研究 [Russian Studies] (February 2009), pp.87-116; Jim Mann, "Russia Boosting China's Arsenal," *Los Angeles Times* (Washington Edition), 30 November 1992, p.1; Tai Ming Cheung, "China's Buying Spree," *Far Eastern Economic Review,* 8 July 1993, p.24; John J. Fialka, "U.S. Fears China's Success in Skimming Cream of Weapons Experts from Russia," *Wall Street Journal,* 14 October 1993, p.12; John Pomfret, "China, Russia Solidifying Military Ties," *Washington Post,* 10 February 2000, p.17; Tsai, *From Adversaries to Partners?*

larities in design) have helped elevate PRC defense capabilities and likely facilitated the surprising appearance in December 2006 of China's first indigenous fighter, the J-10, There still remain technological challenges, however, in both commercial and defense sectors, particularly mastery of modern engine technology, which China continues to import. While Russia remains a reliable supplier, U.S. and European export controls stemming from the Tiananmen era have restricted China's access to this critical technology and helped to slow both commercial and defense industrial development.

While China's defense industrial sector remains hampered by organizational limitations, varying degrees of progress are finally being made in a wide range of areas. A 2005 RAND study, for instance, concludes that 'China's aviation industry ··· has made more progress in improving quality and the technological sophistication of aircraft in recent years than in previous decades.'[67] A 2006 *Jane's* report adds, "Since the end of the Cold War, there have been more research and development activities into fighter aircraft in China than anywhere else in the world. There are now at least 16 active purchase, co-production, production or development programmes for combat aircraft and combat helicopters in China."[68] A second *Jane's* report explains that China's "aviation sector is showing the fruits of massive investment," particularly in skilled personnel and cutting edge production facilities as well as machine and development tools.[69]

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67) Unless otherwise specified, data in this paragraph is derived from Evan Medeiros et al., *A New Direction for China's Defense Industry* (Santa Monica, CA: RAND 2005), pp.199, 165, 160, 180.

68) "Procurement — China," *Jane's Sentinel Security Assessment – China And Northeast Asia,* 13 December 2006, *Jane's* Information Group(www.janes.com). These include "Sukhoi Su-30MKK; Su-30MKK2; Sukhoi/Shenyang J-11; Shenyang J-8H; Shenyang XXJ; Chengdu J-10; Chengdu FC-1; Chengdu J-7G; Chengdu XXJ; Xian JH-7A; Xian H-6; Hongdu Q-5; Guizhou LFC-16; CHRDI WZ-10; WZ-11; and the Harbin WZ-9. In addition, China may be developing an advanced long-range strike bomber and has the Chengdu J-7MF lightweight fighter program in reserve. China is also producing or developing about 6 training aircraft: Hongdu JL-8; Hongdu L-15; Guizhou JJ-7; Guizhou JL-9; Chengdu J-10B and the Chengdu FC-1B." See "Defense Production and R&D, China," *Jane's Sentinel Security Assessment – China And Northeast Asia,* 13 December 2006, *Jane's* Information Group(www.janes.com).

China is focusing on informatizing its air force by upgrading older platforms with modern avionics and developing new systems for future-generation fighters. China has also in recent years demonstrated other impressive advances including fielding of a relatively advanced AWACS platform. Nevertheless, China still has some way to go before its military can claim to have leapfrogged significantly ahead in modern jet fighter and related military aviation technology.

According to the U.S. Department of Defense:

> China's commercial and military aviation industries have advanced from producing direct copies of early Soviet models to developing and producing indigenous aircraft. These include improved versions of older aircraft and modern fourth generation fighters. China's commercial aircraft industry has imported high-precision and technologically advanced machine tools, electronics, and other components that can also be used in the production of military aircraft. However, China's ability to surge production in the aircraft industry will be limited by its reliance on foreign sourcing for aircraft engines and avionics, as well as the availability of skilled personnel and facilities.[70]

V. Training

A wide range of Western and Chinese scholars suggest that while PLA hardware is indeed improving rapidly, the "software" of human capability and training needed to deploy and operate it effectively in actual combat continues to lag well behind. Yet, as in so many other areas, training appears to have intensified over the past few years and reached a higher level of diversity and sophistication. This pattern appears to extend to Chinese air operations.

PLANAF training has been increasingly rigorous in recent years, with exercises involving extended duration as well as increasing unfamiliar conditions and on-the-spot decision-making: "pilots fly more long-dis-

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69) "Defense Production and R&D, China," *Jane's Sentinel Security Assessment – China and Northeast Asia*, 13 December 2006, *Jane's* Information Group(www.janes.com).

70) Office of the Secretary of Defense, *Military Power of the People's Republic 2009*, Annual Report to Congress, p.37.

tance, over-water, cross-border missions during the day and night. Many of the flights are at minimum altitude (i.e., below 100 meters) or low altitude (above 100 meters) and in poor weather conditions. Vessels with helicopters have focused on helicopter operations during day and night that are gradually moving further from the vessel."[71] Progress may be exemplified by an SSF exercise in August 2002, which entailed dropping mines from bombers in an unfamiliar location under "realistic" conditions against opposition forces. The exercise involved a combat aircraft group consisting of three bomber groups, an electronic-jamming aircraft, and escort fighters. The electronic-jamming aircraft jammed the enemy's radar, while the combat-aircraft group employed minimum-altitude tactics, quickly dispensing several tens of mines and torpedoes.[72] Another source, probably reporting on the same exercise, discusses "red force" bombers conducting a mine laying mission over the South China Sea being intercepted and attacked by "blue force" fighters.[73]

During the China-Russia "Peace Mission 2005" exercise, the perhaps more advanced PLAAF may have gained insights into the Russian Air Force's sophisticated air combat doctrine, tactics, and long-range strike while its own Su-27 or J-11 fighters reportedly escorted naval operations, its J-8II fighters performed interception missions, and its H-6 bombers dropped precision-guided weapons.[74]

Despite recent efforts, it remains unclear how capable of joint coordination China's different services are, particularly in over-water operations. While the educational requirements for PLANAF pilots, already higher than those for most other PLAN forces, were raised to a PLAN academy bachelor's degree in 2001, the organization as a whole has traditionally been poorly funded and its pilots fly only a fraction of the hours that

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71) Office of Naval Intelligence, *Handbook on China's Navy 2007*, pp.49-50.

72) 桂平电, 吴中秋, 唐幸芳, 贺跃民 [Gui Pingdian, Wu Zhongqiu, Tang Xingfang and He Yuemin], "海军航空兵: 高难科目砺新招" [Navy Airmen: High, Difficult Subjects Sharpen New Recruits], 人民海军 [*People's Navy*], 8 August 2002, p.2.

73) He Yuemin and Xie Xi, "A Unit Organizes Sea-Air 3D Confrontational Exercise to Improve Its Emergency Maneuvering Capability," *Jiefangjun Bao*, 30 August 2002, p.1, FBIS# CPP20020830000027.

74) "Air Force — China," *Jane's Sentinel Security Assessment - China and Northeast Asia*, 5 January 2007, *Jane's* Information Group(www.janes.com).

their peers in the U.S., Japan, and even India do: "it appears that Naval Aviation combat aircraft pilots average around 125 hours. Furthermore, most units normally fly only three days per week. Each training sortie for fighter and attack aircraft also averages around 45 minutes."[75] Integrating operations between a highly regimented and rigidly structured PLAAF and an immature and sea-based PLAN contingent would require technological and service-culture innovations, as well as exercises less carefully scripted than has been usual, to develop the requisite interoperability and inter-service coordination. Significant additional research is required to gauge how much coordination exists within the PLAN between its ground-based naval air and surface/ subsurface assets. This is all the more critical as the type and degree of coordination will necessarily vary depending on maritime mission. China's development and procurement of increasingly advanced aircraft will not automatically solve the lack of practical experience with them.

Aircraft that have historically lagged behind subsurface and surface platforms, e.g. as cruise missile launch platforms, yet China's recent aircraft purchases and development and a new generation of pilots flying longer hours in training has made a difference even here. PLANAF bomber regiments have trained to conduct multi-axis, multi-salvo, long range sea strikes with the South China Sea Fleet. In one such exercise, a total of eight aircraft were claimed to have operated in "complicated weather conditions" during "complex electromagnetic interference" while coordinating missile attack pre-plans with air force and army units; all against "enemy" targets at sea "in batches and from different directions."[76] South China Sea Fleet training and examination has not omitted other important "needs of the actual war" including logistics support under complex maritime conditions.[77] The PLAN's East China Sea Fleet also recently paid "great attention to honing its operational support capability

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75) Office of Naval Intelligence, *Handbook on China's Navy 2007*, p.49.

76) Zhang Guanghui and Sun Li, "Bombers Regiment Intensifies Training to Boost Assault Capability at Sea," *China Military Online*, September 2006(http://english.chinamil.com.cn/site2/militarydatabase/2006-09/12/content_582283.htm).

77) Tian Changjie, "Naval Unit Trains Hard in Mid-Summer," *China Military Online*, July 2006(http://english.chinamil.com.cn/site2/militarydatabase/2006-07/24/content_534863.htm).

in line with the criteria of real operation."[78]

For several years now, both the PLANAF and the PLAAF have been running exercises that involved cruise missile firing over water, including at night,[79] and against surface vessels.[80] PLANAF pilots conduct live fire exercises.[81] Aircraft involved include H-6 bombers and JH-7A fighter bombers. "Emergency missile loading exercises," which may well involve cruise missiles, occur regularly.[82] Some exercises involve "practice cruise missiles" (训练航弹). In a possible reference to practicing using the DH-10 LACM, one aviation division stationed opposite Taiwan in 2008 practiced precision "long-range air-to-ground strikes" during nighttime "toward a distant sea area" using a "particular [new] type of air-to-ground guided missile."[83] That same year, a PLAAF aviation regiment "achieved a hit rate of at least 87% in several dozen precise attacks on radar and missile sites and [moving] ships at sea" despite electronic interference and attacks from opposition forces.[84] In

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78) Zhang Xin, "Support Ship Flotilla in Intensive Training," *China Military Online,* August 2006 (http://english.chinamil.com.cn/site2/militarydatabase/2006-08/28/content_567302.htm).

79) For an over-sea exercise in which aircraft weapons load outs are not specified, see Zeng Baoyu, Wu Aili and Zhao Lingyu, "'Thundering Attack' — Record on the Long Distance Sea And Air Attack Exercise of The Fighter plane Groups by Troops Organized by the Guangzhou Air Force," *Air Force News,* 28 November 2009, p.1. For a South Sea Fleet PLANAF bomber regiment that has been conducting "missile attacks" under "night and complex weather conditions," see Kou Yongqiang, "A Bomber Regiment of the South Sea Fleet Naval Air Force Tempers Capabilities to Fight and Launch Assaults at Any Time," *People's Navy,* 8 July 2009, p.1.

80) Li Tang and Wang Shijun, "On the Scene at South Sea Fleet Aviation Bomber Regiment's Night Tactics Test," *People's Navy,* 24 November 2008, p.2.

81) Chen Yong, "Six Missiles All Hit Targets — Six New Pilots of an Aviation Regiment of the South Sea Fleet Display Consummate Skill," *People's Navy,* 14 January 2009, p.1.

82) Bian Chungang and Xu Hongchun, "Busy Final Training," *Air Force News,* 13 November 2009, p.2; Huang Yanzhuang: "Nighttime Confrontation," *Air Force News,* 23 November 2009 p.3.

83) Liao Qirong and Li Rui, "Achieving Breakthroughs in Nighttime Operations Through Nighttime Training — A Nanjing Military Region Air Force Aviation Division Successfully Launches Precision Strikes Using a New Type of Weapon," *Air Force News,* 4 December 2008, p.2.

84) Bian Chunguang and Zhao Lingyu, "Guangzhou Military Region Air Force Aviation

sum, the potential for PLAAF and PLANAF aircraft successfully striking U.S. CSG forces at night from significant stand-off ranges is difficult to foresee in the near-term. Yet efforts seem to be underway in training to attain such a capability.

China's air components practice naval mine operations with increasing frequency, scale, and diversity. The 1997 U.S. Department of Defense report on PLA development mentions that China's military aircraft practice laying mines by air.[85] Training programs of East and South Sea fleet aviation regiments have recently included minelaying,[86] incorporating different types of aircraft,[87] and under enemy air blockade.[88]

Regiment Organizes Sea Training by Real-war Standards," *Air Force News*, 29 April 2008, p.2.

85) Regarding sea mines, the 1997 report states, "China conducts training exercises using surface ships, submarines, and aircrafts in coastal areas and is well-prepared to conduct both mine laying and mine sweeping operations in these areas," U.S. Defense Dept., *Report to Congress Pursuant to Section 1305 of the FY 97 National Defense Authorization Act* (Washington, D.C.: 8 April 1997), p.5, available at www.fas.org/. The 1998 report states, in part, "The [Chinese] Navy has made some improvements in its sea denial military capabilities, particularly with respect to sea mines and submarines," U.S. Defense Dept., *Future Military Capabilities and Strategy of the People's Republic of China* (Washington, D.C.: 1998), p.13, available at www.fas.org/.

86) See, for example, 高宏伟, 寇永强 [Gao Hongwei and Kou Yongqiang], "战场环境不再似曾相识 — 南航部队苦练远海陌生战场破敌硬功" [Battlefield Environments Will No Longer Be Familiar Ones — South Sea Fleet Aviation Troops Train Hard to Develop Superb Enemy-Defeating Skills to be Used on Unfamiliar Battlefields in Distant Seas], 人民海军 [*People's Navy*], 8 April 2008, p.1; 张秀锦 [Zhang Xiujin], "超额完成年度训练任务: 东航某飞行团十六大精神指引下" [Accomplish Annual Training Assignment above Quota: A Certain East Sea Fleet Aviation Regiment Vigorously Leads the Way after the 16th Party Congress], 人民海军 [*People's Navy*], 19 December 2002, p.2.

87) Kou Yongqiang, "The Building of Fighting Capacity Begins With an Emphasis on Details," *Liberation Army Daily*, 14 February 2008, OSC CPP20080225088001; Qian Xiaohu, Liang Qingcai and Kou Yongqiang, "Forging a 'Naval Aviation Iron Fist': Naval Bomber Regiment Seeks Truth From Facts in Training," *Liberation Army Daily*, 12 February 2006, p.1, OSC CPP20060216502001.

88) 张秀锦, 方立华 [Zhang Xiujin and Fang Lihua], "空中鹰长途袭击深海鱼鲨 — 东航某飞行团大机群陌生海域成功布雷" [Eagles in the Sky Launch Long-Range Attacks on Deep-Sea Sharks — The Air Fleet of a Flight Regiment of the East Sea Fleet of the Chinese Navy Successfully Lays Mines in Unfamiliar Waters], 人民海军 [*People's Navy*], 27 June 2007, p.1.

A South Sea Fleet exercise in August 2002 entailed dropping mines from bombers in an unfamiliar location under "realistic" conditions against opposition forces. The exercise involved a combat aircraft group consisting of three bomber sections, an electronic-jamming aircraft, and escort fighters. The electronic-warfare aircraft jammed the enemy's radar, while the combat-aircraft group employed minimum-altitude tactics, quickly dispensing several tens of mines and torpedoes.[89] Another source, probably reporting on the same exercise, discusses "Red force" bombers conducting a minelaying mission over the South China Sea being intercepted and attacked by "Blue force" fighters.[90] Starting in March 2006, a South Sea Fleet bomber regiment practiced laying "mine blockades far out at sea" (远海布雷封锁).[91] On 6 June 2006, as part of "a simulation training event on carrying out a missile attack on a deep-sea island under poor weather conditions" (复杂气象条件下远海岛礁导弹打击模拟演练), a South Sea Fleet Naval Aviation air regiment "laid sea mines" (海上布雷). Its pilots were also trained in "laying mines far out at sea in the fog" (雾天远海布雷).[92] Also in 2006, a South Sea Fleet Naval Aviation air regiment practiced "laying mines at sea in the rain" (雨天海上布雷).[93] In late August 2008, four recently-retrofitted South Sea Fleet aviation force warplanes simulated "offensive mine-laying in ports and

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89) Gui Pingdian, Wu Zhongqiu, Tang Xingfang and He Yuemin, "Navy Airmen," p.2.

90) He Yuemin and Xie Xi, "A Unit Organizes Sea-Air 3D Confrontational Exercise to Improve Its Emergency Maneuvering Capability," *Jiefangjun Bao* [Liberation Army Daily], 30 August 2002, p.1, OSC CPP20020830000027.

91) 余五海, 章光辉 [Yu Wuhai and Zhang Guanghui], "战鹰, 子夜起飞 — 南航某轰炸机团下半夜飞行训练目击" [Fighting Eagles Take Off at Midnight — Witnessing a Certain South Sea Fleet Naval Aviation Bomber Regiment Conduct Flight Exercises After Midnight], 人民海军 [*People's Navy*], 24 April 2006, p.1.

92) 佘贺, 王世均 [She He and Wang Shijun], "空投64枚炸弹全部命中 — 南航某团复杂气象展现训练高水平" [64 Air-Dropped Bombs All Hit Their Targets — A South Sea Fleet Naval Aviation Air Regiment Trains at a High Level Under Complex Meteorological Conditions], 人民海军 [*People's Navy*], 21 June 2006, p.1.

93) 张建, 李德, 张军红 [Zhang Jian, Li De, and Zhang Hongjun], "突围, 不按 '规则' 出牌 — 北海舰队某型潜艇布雷演练目击记" [To Break Out of Encirclement, Don't Play Cards according to the "Rules": An Eyewitness Report of a Minelaying Drill by a Certain Type of North Sea Fleet Submarine], 人民海军 [*People's Navy*], 18 October 2006, p.1.

sea lanes" "under a complex electromagnetic environment" and various weather contingencies.[94] In early January 2009, an East Sea Fleet H-6 bomber regiment, in accordance with the new Outline for Military Training and Evaluation, "applied new combat methods to training in deep defense penetration in distant seas and completed the low-altitude offensive mine-laying mission." The regiment "explored some new combat methods, such as … nighttime large-armada offensive mine-laying."[95] Also in 2009, CCTV-7 stated that PLA Naval Aviation "water aircraft" "are capable of carrying out … mine laying."[96]

VI. Scenarios

China's air elements have been tasked with preparing for high intensity combat along China's immediate periphery. While they must prepare for a wide variety of contingencies, the primary focus of preparing for high-intensity combat operations remains offensive and defensive measures concerning a Taiwan scenario. According to the U.S. Department of Defense's 2009 report on *Military Power of the People's Republic of China,*

> The PLA Air Force (PLAAF) is converting from a limited territorial defense force to a more flexible and agile force able to operate off-shore in both offensive and defensive roles, using the U.S. and Russian air forces as models. Mission focus areas include: strike, air and missile defense, early warning and reconnaissance, and strategic mobility. The PLAAF also has a leading role in the "Joint Anti-Air Raid" campaign, which appears to form the basis for much of China's planning for anti-access and area-denial operations. Underscoring the ambiguity of offense and defense in PLA theory, the Joint Anti-Air Raid campaign is strategically defensive in nature, but

94) 胡朋, 陈勇 [Hu Peng and Chen Yong], "攻势布雷课题演练取得突破 — 南航某师提高复杂电磁环境下遂行作战能力" [Breakthroughs Are Made in Offensive Mine-Laying Drills — An Aviation Division of the South Sea Fleet Raises the Ability to Fulfill Operational Tasks under a Complex Electromagnetic Environment], 人民海军 [*People's Navy*], 17 September 2008, p.2.

95) "Military Report," CCTV-7, 12 January 2009, OSC CPM20090304013025.

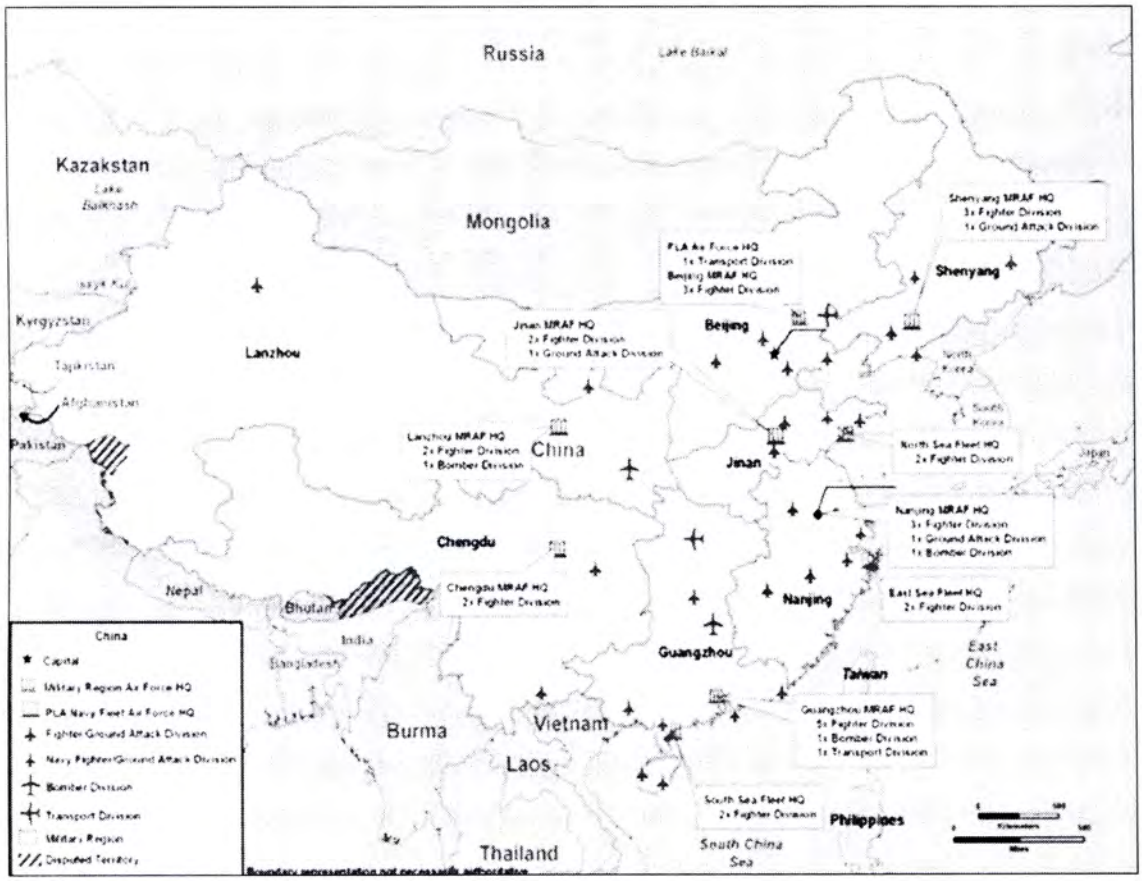
96) CCTV-7 "Military Report," 1130 GMT, 15 April 2009, OSC CPP20090416091001.

at the operational and tactical levels, it calls for attacks against adversary bases and naval forces.[97]

Figure 1 (below) shows the location of China's major air units, many of which are located within unrefueled range of Taiwan.

The cross-Strait air balance has shifted rapidly in Mainland China's favor, and the trends continue. Cruise missiles launched from Chinese aircraft, as well as from other platforms, like ballistic missiles, offer

〈Figure 1〉 China's Major Air Units[98]



97) Office of the Secretary of Defense, *Military Power of the People's Republic 2009*, Annual Report to Congress, p.13.

98) Office of the Secretary of Defense, *Military Power of the People's Republic 2009*, Annual Report to Congress, p.63.

the prospect of disabling Taiwan's airfields, command and control, early warning facilities, and ground-based defenses. This could enable Chinese aircraft in follow-on strikes to penetrate more deeply into Taiwan's airspace with larger payloads with far less opposition from the ROC Air Force.

LACMs and improved ability to launch them from aircraft may enable China to destroy Taiwan's aircraft while they are on the ground or in hardened shelters. Though not yet introduced into force, at least two types of bomber-launched, 500 kg warhead LACMs are being developed with 1,500 km ranges and 10 meter accuracies.[99] Such missiles could presumably threaten hardened aircraft revetments, including even the cave entrances to Taiwan's underground fighter shelters inside the mountain at Cha Shan airbase on the east side of the island. Air-launched LACMs could be used to destroy Taiwan's command and control nodes that would otherwise coordinate and direct the intercept of PRC air attacks, and could be designated to destroy Taiwan's aircraft and airfields with submunitions.

Moreover:

> The air and air defense component of anti-access/ area-denial includes SAMs such as the HQ-9, SA-10, SA-20 (which has a reported limited ballistic and cruise missile defense capability), and the extended-range SA-20 PMU2. Beijing will also use Russian-built and domestic fourth-generation aircraft (e.g., Su-27 and Su-30 variants, and the indigenous F-10 multi-role fighter) to compete for local air dominance. The PLA Navy would employ Russian Su-30MK2 fighters, armed with AS-17/Kh-31A anti-ship missiles, and FB-7 fighter-bombers for maritime interdiction. Acquisition of an air refueling platform like the Russian IL-78 would extend operational ranges for PLAAF and PLA Navy strike aircraft armed with precision munitions, thereby increasing the threat to surface and air forces, bases, and logistics nodes distant from China's coast. Additionally, acquisition and development of longer-range unmanned aerial vehicles (UAVs) and UCAVs, including the Israeli HARPY, expands China's options for long-range reconnaissance and strike.[100]

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99) See, for example, Wendell Minnick, "China Tests New Land-Attack Cruise Missile," *Jane's Missiles & Rockets*, 21 September 2004(www.janes.com).

100) Office of the Secretary of Defense, *Military Power of the People's Republic 2009*, Annual Report to Congress, pp.22-23.

Additionally, while China has the capability to mass significant aircraft opposite Taiwan, the combat radii of most aircraft are still relatively limited:

> China bases 490 combat aircraft within un-refueled operational range of Taiwan, and has the airfield capacity to expand that number by hundreds. Many of these aircraft are upgrades of older models; however, newer and more advanced aircraft make up a growing percentage of the inventory. Although the PLA Navy could use aircraft to strike surface ships, it lacks the numbers of aircraft and operational ranges necessary for aerial combat over blue water. The vast majority of PLA Navy tactical aircraft for aerial combat consists of older F-7/FISHBED and F-8II/FINBACK interceptors. These interceptors do not possess the range to conduct aerial combat far from their airfields. To conduct long-range over water combat, the PLA Navy has one Su-30MK2/FLANKER regiment consisting of just 23 aircraft.[101]

〈Table 3〉 Taiwan Strait Military Balance — Air Forces[102]

	Mainland China		Taiwan
Aircraft	Total	Within Range of Taiwan	Total
Fighters	1,655	330	390
Bombers/Attack	645	160	0
Transport	450	40	40

101) Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.50.

102) Source for figure: Office of the Secretary of Defense, *Military Power of the People's Republic 2009,* Annual Report to Congress, p.62. The report adds the following clarifications: "The PLAAF and the PLA Navy have approximately 2,300 operational combat aircraft. These consist of air defense and multi-role fighters, ground attack aircraft, fighter-bombers, and bombers. An additional 1,450 older fighters, bombers and trainers are employed for training and R&D. The two air arms also possess approximately 450 transports and over 100 surveillance and reconnaissance aircraft with intelligence, surface search, and airborne early warning capabilities. The majority of PLAAF and PLA Navy aircraft are based

Table 3 (below) offers a comparison of mainland Chinese and Taiwan air forces that might be relevant to a combat scenario.

While air-launched cruise missile attacks would most likely be part of a series of preemptive precision strikes, as described above, Chinese aircraft could also be used to lay naval mines in a more protracted and subtle effort to coerce Taiwan. The advantage of aerial mining, as the U.S. military has understood since 1944, is the ability rapidly to emplace large numbers of mines and reseed minefields. The primary disadvantages are the difficulties in establishing air superiority and the opportunity costs of using modern aircraft to perform the mining mission. Although earlier analysts examined China's ability to lay mines via surface ships and submarines, no analysis has seriously considered whether China could sow its mines by aircraft. Aerial mining has enjoyed dedicated platforms since the PLAN created an aviation branch with a minelaying bomber division in April 1949.[103] A mainstay of Chinese maritime periodicals offers detailed accounts of how the United States used aerial mines to hasten Japan's defeat in World War II and later to paralyze North Vietnamese shipping.[104] A professor at the PLA Air Force (PLAAF) Command College makes similar points concerning the value of aerial MIW in an article in China's foremost military journal, the PLA Academy of Military Science publication 中国军事科学 (*China Military Science*).[105] Several Chinese technical papers discuss in minute detail the more esoteric aspects of accurately placing naval mines by aircraft.[106] In the context

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in the eastern half of the country. Currently, 490 aircraft could conduct combat operations against Taiwan without refueling. However, this number could be significantly increased through any combination of aircraft forward deployment, decreased ordnance loads, or altered mission profiles.

103) Yao Jun, ed., 中国航空史 [A History of China's Aviation] (Zhengzhou: Dajia, September 1998), pp.183-89.

104) See "Goals of Offensive Mine-Laying Discussed," Jianchuan Zhishi [Naval and Merchant Ships], No.241(4 September 1999), OSC FTS19991022001765.

105) Min Zengfu, "A Glimpse at 21st-Century Air Combat," *Zhonggguo Junshi Kexue* [China Military Science], 20 February 1995, OSC FTS19950220000008.

106) See, for example, the detailed operational parameters suggested in Yu Hanyu, "An Evaluation of Minelaying by Aircraft." See also the analysis of the effects of parachute drag on the trajectory or a mine dropped from a plane in He Jieying, "Study on the Flight Path of Mine Parachutes," pp.545-50.

of discussing PLA Navy Aviation capabilities, Vice Regimental Commander Zhu Guanghong, North Sea Fleet, recently stated that "Seaplanes have excellent performance at super-low altitude. They can carry out … harbor mine-laying missions."[107] A North Sea Fleet aviation force ship-board aircraft regiment has even been credited with making PLA aviation ASW history by for "the first time using an exercise mine from a helicopter to hit an acoustic target" (首次直升机使用操雷打声靶).[108] Both Gidropribor.com and *Jane's* currently discuss Chinese and Russian-equivalent mines in the context of their being laid from aircraft.[109] A rather lengthy recent article in a Chinese naval journal discusses which mines in China's inventory can be laid by air.[110] Finally, *Campaign Theory Study Guide* advocates "concentrated mine-laying from the air," particularly in "areas which submarines find hard to enter."[111] It stipulates that "the mine-laying blockade force group" usually includes "naval forces and Air Force bombing aviation."[112] It is thus quite clear that China

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107) "Report on Role of China's Naval Air Force", "China Today" program, CCTV-9, 2300 GMT, 22 April 2009, OSC CPM20090423017042.

108) 刘文平, 孙樱, 李斌富 [Liu Wenping, Sun Ying, and Li Binfu], "叱咤海天30载与满清武报国志 填补空白18项痴心反潜为打赢 北航某舰载机团反潜战术主任赵树民 — 堪称'航空反潜先锋'" [Thirty Years of Commanding the Sea and the Sky Filled With a Determination of Serving the Country With Superb Military Skills; Filling in Eighteen Voids by Focusing Whole-Heartedly on Winning in Antisubmarine Warfare; Zhao Shumin, Antisubmarine Tactical Director of an Unidentified Ship-Board Aircraft Regiment of North Sea Fleet Aviation Force — Worthy of Being Called an "Aviation Antisubmarine Pioneer"], 人民海军 [*People's Navy*], 16 December 2008, p.1.

109) The Russian series of AMD bottom mines, in production since the late 1950s, is designed to be delivered by air and is believed to have been exported to, and copied by, China. See Watts, "Russian Federation Underwater Weapons," and Rob Hewson, "Type 500 and 1000 Mines, Underwater Weapons," *Jane's Air-Launched Weapons*, 14 April 2005, both available at www.janes.com. Gidropribor's MDM-2 bottom influence mine and PMR-2 rising influence mine are both designed to be delivered by aircraft. See www.gidropribor.ru/eng/products.php4.

110) Lin Changsheng, "Hidden Dragon in the Deep," p.32.

111) "32. How to Conduct Barrier Blockade Combat?"

112) "182. What Force Groups Are Usually Assembled in a Naval Blockade Campaign?" in "XI. Naval Blockade Campaign," in *Campaign Theory Study* Guide, ed., Bi Xinglin.

grasps the utility of aerial MIW and is considering how specifically to employ it in combat.

VII. Non-Traditional Uses of Air Power

The PLA air force remains constrained geographically by lack of overseas bases and of significant aerial refueling capabilities. Moreover, the nature of air power does not lend itself to non-traditional missions, aside perhaps for air lift to support humanitarian assistance and disaster relief operations. For now, China's use of air power to support non-traditional security operations is being led by the PLAN, which has assumed the vanguard for these types of missions and is already using a limited amount of rotary wing air power to support its operations.

The dramatic rise of piracy in the waters off of Somalia in 2008, combined with United Nations Security Council resolutions designed to empower other nations to fight that piracy, presented the Chinese with an historic opportunity to deploy a naval force to the Gulf of Aden to protect merchant vessels from pirates. For the first time in its modern history, China has deployed naval forces operationally (as opposed to representationally) beyond its immediate maritime periphery. Since 26 December 2008, on the first of what have been five task force deployments thus far, China sent two of its most advanced destroyers. These were equipped with the PLAN's most advanced helicopters, the Russian Ka-28 *Helix*. In testimony to both China's utter lack of experience and determination to perform on a new world stage, the helicopters were piloted by some of the PLA's finest — two Senior Colonels with several thousand hours of flight experience. These helicopters assumed a front-line role in what have been extremely cautious rules of engagement. If the PLAN detects a "suspicious vessel," it will deploy a helicopter for surveillance and reconnaissance; and deterrence measures if necessary. Building on earlier land-based training, during transit to the Gulf of Aden, special forces aboard the warships carry out anti-piracy training with ship-borne helicopters, from which they rappel onto the deck to simulate landing on hijacked or pirate vessels. The helicopters also practice nighttime landing operations at sea, a new area for the PLAN.

While the PLAN has sought to minimize contact with pirates during all three types of operations, it has encountered, and demonstrably deterred them, on several occasions. Of all PLAN platforms, helicopters have made the closest and most numerous encounters. These modest aviation assets have enabled China to safeguard key maritime interests, receive considerable international and domestic approbation for its contributions, and help guarantee it a voice in future regional security affairs.

China's counter-piracy deployments in the Gulf of Aden represent a positive contribution to collective security in the global maritime commons. Here, in a "strategic cooperation zone" far from sensitive maritime areas in Northeast Asia, both the U.S. and ROK navies have the opportunity to interact positively and productively with their Chinese counterparts. South Korean sailors have, for instance, conducted joint at-sea exercises with their Chinese counterparts.[113]

In the future, the PLAN may be expected to expand its portfolio of operations that necessitate air power facilitation. In the non-traditional security realm, these may include noncombatant evacuation operations (NEOs) in addition to humanitarian assistance and disaster relief (HADR) operations. As these operations grow in number, scope, and diversity, deck aviation may come to play a role.

VIII. Deck Aviation Developments

The PLAAF and PLANAF already have a wide variety of bases from which to operate on China's immediate maritime periphery. A new dimension of Chinese air power is emerging, however, in the form of deck aviation. The most comprehensive and far-reaching question concerning PLAN modernization is the extent to which Beijing will choose between a navy focused on large-deck aviation versus one based fundamentally on submarines. This is because the former force structure would likely be needed for the PLAN to move 'beyond Taiwan' to genuine blue water power projection capabilities. According to State

113) PLA Daily online.

Commission of Science, Technology and Industry for National Defense Huang Qiang, "China has the capability of building an aircraft carrier, but it is still unknown when one will be built."[114] While critical datapoints remain unclear, aircraft carriers have already captured the imagination of China's public, and even of some of its strategists. Perhaps because of Beijing's determination to be respected universally as a great power and its growing maritime interests, the PLAN is apparently contemplating various alternatives for developing aircraft carriers. Increasingly numerous and diverse statements and writings on this subject offer critical insights into Beijing's emerging maritime strategy.

The U.S. Office of Naval Intelligence estimates that China's former Ukrainian Kuznetsov class aircraft carrier *Varyag* will become operational as a training platform by 2012, and "the PRC will likely have an operational, domestically produced carrier sometime after 2015."[115] According to Scott Bray, Senior Intelligence Officer-China, ONI, "ONI bases its assessments of the timeline for operationalization of KUZNETSOV CV Hull 2 (commonly referred to as the former Russian carrier VARYAG) on a number of factors, including observations of renovations ongoing at Dalian. Reporting from Chinese open sources indicates that the J-15, which is based on the Russian Su-33, is being developed for China's aircraft carrier program. Chinese interest in purchasing the Su-33 appears to have waned in light of indigenous development of J-15. While China has yet to officially announce the existence of an aircraft carrier program, numerous Chinese military officials have made public comments on the program. China likely intends to use aircraft carriers to bring the air component of maritime power to the South China Sea and other regional areas to protect Chinese sea lanes, shipping, and enforcing maritime claims. Additionally, an aircraft carrier would likely be used in regional humanitarian assistance and disaster relief missions."[116]

Ultimately the aircraft carrier itself is essentially a platform for

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114) Li Xinran, "China Capable Of Building Aircraft Carrier," *Shanghai Daily,* January 2007 (http://www.shanghaidaily.com/article/?id=302268&type=National).

115) *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics* (Suitland, Md.: Office of Naval Intelligence, July 2009), p.19.

116) Quotation obtained from ONI Public Affairs Office.

air operations — the system of systems that allows for the projection of air power from the sea. The acquisition of a PLAN carrier vessel would thus be merely one benchmark, and a relatively simple one at that, along a complex continuum that might someday lead to a truly operational PLAN aircraft carrier. The subsequent steps would involve hardware, software and training. Quantum leaps forward are required not only in sea-based aviation and mid-air refueling but also in PLAN doctrine and ASW as well as in PLANAF service culture if PLAN aerial power-projection capabilities are to be improved dramatically. Without major improvements in ASW, for instance, any PLAN carrier would be an easy target for competently manned diesel-electric or nuclear-powered attack submarines. China does not appear to have made significant progress in correcting its weakness in anti-submarine warfare (ASW), however. Although its newer large surface combatants certainly can carry helicopters, and might carry ASW helicopters, none appear to have modern hull-mounted or towed sonars. There is also little evidence that China is devoting much effort to developing planes equivalent to the U.S. P-3 maritime patrol aircraft. Thus PLAN ASW capabilities, while perhaps slowly improving, cannot yet be counted on to provide a reasonable degree of security in open waters. In a crisis scenario, many air support tasks would be performed by the PLAAF. This means that unlike a U.S. carrier strike group, a Chinese CSG would not need to be wholly self-supporting. This would also negate much of its operational utility, however, when operating within range of land-based air.

The PLAN must also determine what mix of surface vessels and submarines would be necessary to support a carrier. Here the evolution of the PLAN's order of battle may offer insights. Beijing might be unlikely to commit itself to a militarily useful carrier until it could constitute the strike group without compromising its ability to execute other missions. PLAN CVs would be highly vulnerable, for instance, to the submarines of the U.S. and other regional competitors; China's time and expense deploying a carrier will be wasted if it cannot be protected.

To date, Beijing has made significantly greater progress in analyzing and targeting enemy carriers than in building its own. For instance, Taiwan scenarios and how to target U.S. surface combatants, especially aircraft carriers, are reportedly often discussed in PLA internal meetings.[117]

Indeed, ONI's Scott Bray assesses, "Much of China's military modernization effort of the past five years, and particularly the modernization of the Chinese Navy, has been designed to improve China's anti-carrier capability. China envisions an attack on a carrier strike group as incorporating submarine-launched ASCM strikes and ASBM attacks."[118] Chinese recognition of the increasing vulnerability of carriers, particularly less-sophisticated versions such as China might develop, may thus retard Beijing's indigenous carrier development.

A PLAN carrier would have little role in a near-term Taiwan scenario, moreover, as land-based PLAAF and PLANAF aircraft could cover all required air operations across the narrow Taiwan Strait. Unless China were able to produce and incorporate a range of carriers in a cohesive and effective concept of operations, it is difficult to envision them as the centerpiece of PLAN doctrine in future decades. A senior Chinese official has further emphasized to the author that "China will not try to compete with the U.S. in the open sea. Even twenty PRC carriers cannot compete with U.S. nuclear carriers."[119]

Developing the necessary forces, training, and experience for long-range combat capabilities would be extremely expensive and time-consuming, however. Building an aircraft carrier is one thing; mastering the complex system of systems that enable air power projection costs years and precious lives. For these reasons, it seems likely that for the foreseeable future, Chinese deck aviation capabilities will be used primarily for naval diplomacy, low-intensity non-traditional security operations and NEOs.

For the foreseeable future, therefore, a Chinese carrier would most likely serve at least one of two major roles. The first is as a discrete capability to support secondary missions in which the most basic motivation is prestige, an attractive commodity for a great power still seeking to right the wrongs of its devastating national weakness since 1840.

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117) Author's interview with Chinese official, Beijing, June 2006.

118) Scott Bray, "Seapower Questions on the Chinese Submarine Force," February 2007.

119) Author's interview, Beijing, June 2006.

This unique role for aircraft carriers was demonstrated by the 2004 tsunami, after which the PLAN found itself completely upstaged by the U.S. Navy, the Indian navy and, most painfully, the JMSDF.[120] China's second carrier role would be as a complement to its submarine-centered fleet. Supporting carrier missions might include collective maritime security (e.g., SLOC protection and counter-piracy). This collective-security force structure is obviously a secondary PLAN mission, and would be oriented toward friends and rivals in the South China Sea and the Indian Ocean. Deployment of an aircraft carrier would also enable modest force projection to assert Chinese claims in the South China Sea.

IX. Potential Emerging Missions

How else might China's leaders employ air power to achieve security objectives? A large number of Chinese citizens are entering conflict-prone areas of the developing world, both as employees of large corporations and as individual entrepreneurs in pursuit of profit. There they face physical security problems including crime, terrorism, and fallout from internal conflicts. China's nascent but growing power projection capability raises the pressure for Beijing to intervene when PRC citizens are threatened. Given China's acute sensitivity concerning sovereignty issues, aside from the its use of air power to support non-traditional maritime missions, the most likely use of Chinese air power is to facilitate a noncombatant evacuation operation (NEO).

Chartering commercial aircraft, as Beijing has done several times in the past decade to evacuate citizens from nations convulsed by ethnic unrest, is likely to be the lowest risk (and thus preferred) evacuation option. China's nationally-flagged airline, Air China, has more than 60 inter-continental range aircraft that might be pressed into service during an evacuation. So long as an area has suitable airfields, China already possesses indigenous air assets that could evacuate Chinese expatriates and assets from a conflict zone. No aerial refueling would be needed

120) Author's interviews, Beijing, December 2005.

— only landing rights at secure airfields as well as overflight clearance.

If the situation on the ground were too dangerous for a chartered commercial aircraft to safely land and embark passengers, the PLAAF could use its 14 *Ilyushin* IL-76MD transport aircraft, which could evacuate at least 120 people apiece. An IL-76MD operating from China's western-most airbase at Kashi could fly to Khartoum or Nairobi and then onward to and from any destination in Africa with 100 passengers without any need for aerial refueling. The IL-76MD could also carry up to 45 tons of vehicles and materiel if physical assets needed to be evacuated.

X. The Future of Chinese Air Power

China has entered the second decade of the twenty-first century as a global economic and political power with growing regional military capabilities. Ongoing territorial disputes on its immediate maritime periphery, and to some extent on its border with India, as well as ethnic unrest in its western provinces and poverty in its vast interior continue to necessitate prioritization in military development, and the focusing of high-end military capabilities in areas close to home. Yet as the world's second largest economy, with its manufacturing industries consuming tremendous resource imports and 40% of its oil arriving by sea, China's interests increasingly extend beyond its shores, to resource rich areas of the developing world and the trade- and energy-rich sea lanes of the Indian Ocean. China's vigorous soft power diplomacy and status as a Permanent Five member of the UN Security Council can only safeguard these interests to a certain degree. Meanwhile, China's is the first developing nation to have developed comprehensive aerospace capabilities. The aviation component, which has so long lagged, is finally reaching internationally-capable levels as manifested in the J-10 fighter and the ARJ-21 commercial jetliner. China's nationalistic, increasingly educated citizenry will not allow their leaders to accept foreign indignities now that Beijing has the means to defend its interests. How Beijing will decide to develop and employ its military capabilities to safeguard its growing interests will critically influence the course of events in the twenty-first century.

A key uncertainty is how far China's military will operate beyond its shores. To support power projection overseas, both for national prestige and for limited missions beyond Taiwan, China must extend the range of its air power. This is likely to involve further emphasis on aerial refueling, acquisition of some modest access rights to overseas military facilities, and development of some form of deck aviation capability. Amid this dynamism, one thing is certain: for the first time in the history of the People's Republic, Beijing's leaders will be able to plan ahead, shape events, and choose from a wide variety of capable air assets to support their statecraft. How, when, and where they decide to do so will significantly shape the security environment in Northeast Asia and beyond.

XI. Implications for the Republic of Korea Air Force (ROKAF, 大韓民國 空軍)

The ROKAF and PLAAF share historical similarities, but their recent trajectories and purposes as instruments of national power have since diverged substantially. Like the PLAAF, the ROKAF had developed gradually during the 1940s, but expanded greatly during the Korean War, in part through acquisition of foreign aircraft and instructors (both from the U.S., as opposed to the USSR, as was the case with the PLAAF). Unlike the PLAAF, whose capabilities declined precipitously in the 1960s and have only begun to recover, the ROKAF continued to develop steadily and substantially in subsequent decades to address ongoing high-intensity threats from North Korea. This clearly Korean effort and achievement, complete with indigenously produced aircraft, was assisted by continuing aircraft purchases and production arrangements and other cooperation with the U.S. Air Force under the aegis of the ROK-U.S. alliance. Unlike the PLAAF, the ROKAF has contributed to international allied missions, supporting coalition forces in Operation Desert Storm in 1990-91 and Somalia stability operations in 1993. In a testament to the caliber of South Korea's indigenous aircraft production capability, Korean Aerospace Industries has sold 19 KT-1B trainers to Indonesia in 2003, and has further export plans.

North Korea remains by far South Korea's primary security threat, and thus North Korea's air force and army remain the ROKAF's primary targets. While most North Korean Air Force aircraft are old Soviet models, its order of battle is twice as big as that of the ROKAF, and it may be prepared to engage in high attrition operations. Perhaps most worrisome, North Korea has long focused on developing artillery and missiles. These projectiles' relatively simple design and low cost enables it to produce significant numbers, while the laws of physics make it far easier to attack aircraft and runways with them than to defend against them. In the future, this could pose a major challenge to the ability of ROKAF aircraft to operate near North Korean airspace in the unfortunate event of conflict.

With its triple-digit SAMS and the world's foremost sub-strategic missile force, China has far more ability than North Korea to disable ROKAF aircraft and the airfields that they operate from. One need only consider the rapidly shifting military balance across the Taiwan Strait to see the PLA's progress in this area. Fortunately, the prospect of hostilities erupting between Seoul and Beijing is extremely low, and the chances of the ROKAF and the PLAAF facing each other in combat as they did during the Korean War over half a century ago is even lower. The ROK and PRC enjoy good relations, and seek to build on their strong and growing economic ties. Still, with regard to strategic issues, there remain certain limits and barriers to cooperation. While Beijing decries military alliances, including the very positive ROK-US alliance that has served as a cornerstone of peninsular and regional stability, it maintains in some form (but rarely discusses) its six-decade alliance with Pyongyang. While the ROK clearly enhances regional stability and economic growth as a responsible and vibrant capitalist democracy, and North Korea continues to play a decidedly harmful and destabilizing role in both these areas, China remains unwilling to acknowledge Seoul's good behavior or punish Pyongyang's bad behavior. No recent issue has so underscored this inequity as the North Korean navy's unconscionable 26 March 2010 sinking of ROKS *Cheonan*. China's unwillingness to condemn this war-like act makes it clear that it will tolerate virtually any North Korean behavior in the name of protecting the stability of its border with North Korea and its northeast regions with their significant

ethnic Korean populations. There are also indications that Beijing is working to position itself as a power-broker with regard to peninsular issues, such that any future reunification would entail critical concessions to Beijing. Such behavior is particularly unfortunate given China's own painful experience of national division, and suggests strongly that while Beijing professes that all nations are equal, in reality it expects deference from South Korea given its relatively smaller size and national power.

For all these reasons, a strong and reliable ROKAF will continue to be important to safeguard ROK security interests in the years ahead. First and foremost, it will have to defend the ROK from North Korean attack, bullying, and brinksmanship. More broadly, however, it will play a critical role in making it clear to China and any other nations that the ROK is to be taken seriously and its interests respected. For all the challenges that the ROK-U.S. alliance has faced over the years (most recently, the U.S. should make it a priority to sign a bilateral free trade agreement, which would benefit both sides significantly), it endures because it is based on mutual interests and mutual respect. The U.S. values and admires the ROK, covets none of its territory, has no opposition whatsoever to its national reunification, takes seriously threats to its security, and is willing — decisively and unapologetically — to help defend against them. Only by maintaining a strong ROKAF and other military services will the ROK be able to demand the similar respect for its interests that it deserves from other countries, such as China.

That Korea has endured such terrible injustices and geopolitical threats is one of the tragedies of history. That it has surmounted nearly insuperable odds to become a leading democracy and economy with technology that is the envy of the world is one of history's miracles, and a testimony to the strength of Korean culture, national spirit, and hard work. It is by no means fair that Korea has had to work so hard to safeguard these great achievements without the advantages that many other nations have enjoyed, but it has been by such exceptional efforts that it has survived and thrived as a nation, and will continue to do so in years to come. It is to be hoped that the ROK-U.S. alliance can continue to productively support South Korea's important and supremely justified efforts to provide a secure climate for its national development.

연세대 공군력 연구총서 ⑩

한반도 안보환경 변화와 항공우주력의 진화

김기정 · 문정인 · 최종건 편

오름

Air-Power's Progress and Security Environment in the Korean Peninsular

본 연구서의 발행은 13번째 회의를 정리하는 단순한 연구총서 이상이다. 본 연구서는 대한민국 공군이 한반도 안보환경 변화에 맞추어 진화하고 있음을 확인하고, 이를 통해 대한민국의 대북 억지력을 강화하는 초석임을 재확인할 수 있는 종합보고서라고 할 수 있다. 또한 '공군과 타군과의 합동성 강화, 대국민 이미지 강화, 무기획득의 효율성 강화'라는 세밀한 주제가 2011년 한반도 안보지형을 이해하는 데 많은 도움을 줄 것이라고 생각된다.

_서문 중에서

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차 례

서 문

본 연구서는 2010년 7월 2일 연세대학교 동서문제연구원(원장 김기정)이 개최했던 제13회 항공우주력 국제학술회의에서 발표된 논문들을 선별적으로 수록한 것이다. 항공우주력 학술회의는 공군본부의 후원으로 1998년 연세대학교 국제학연구소 산하에 설립된 공군력 연구프로그램에서 시작하여 현재는 연세대학교 동서문제연구원 산하 항공우주력 프로그램이 주관하고 있으며 2010년 제13회를 맞이하게 되었다. 현재 연세대학교 항공우주력 학술회의는 한국에서 가장 오래되고 유일한 공군력 학술회의이며, 학-군(學-軍) 협력의 이상형을 제시하고 있다고 해도 과언이 아닐 것이다. 본 회의는 현재의 안보환경과 미래 안보환경에 능동적으로 대비하고자 항공력의 비전 제시를 목적으로 하고 있으며, 실질적으로 국내외의 안보전문가와 석학들이 참여하여 상호간의 인적 네트워크를 창조하는 데 많은 기여를 하였다.

2010년은 6·25전쟁 발발 60주년이 되는 해이다. 그리고 이 전쟁 이후, 휴전은 57년간 지속되고 있다. 휴전상태가 매우 길어지고 있어, 전쟁을 잠시 멈춘 현실이 정서적으로 어색하기도 하다. 그러나 이 기나긴 휴전이 확전으

로 전이될 수도 있다는 위기의식은 일상을 파고들어, 평화의 중요성을 다시금 상기하도록 만든 해가 2010년이었다. 천안함은 폭침되었고, 연평도에는 북의 포격으로 인해 검은 연기가 피어났다. 군인은 물론 민간인이 사상된 한 해, 남북 간의 안정이 불안한 휴전으로 전이된 한 해, 안보 위기가 다시금 우리의 억지태세를 점검하게 한 해가 바로 2010년이었던 것이다. 해군의 피해는 참으로 거대하였다. 초계함이 침몰하였고, 해병대 기지가 초토화되었다. 육군은 경계를 강화하였다. 이러한 안보 위기가 발생할 때, 우리 영공에는 공군의 F-15와 F-16이 마치 대한민국 안보의 최후의 보루처럼 비행하였다. 휴전은 본질적으로 불안정하다. 전쟁이 부재한 이 휴전은 불안정하게 유지될 수 있다는 본질을 보여준 해가 2010년이었다.

이러한 측면에서 본다면, 본 연구서의 발행은 13번째 회의를 정리하는 단순한 연구총서 이상이다. 본 연구서는 대한민국 공군이 한반도 안보환경 변화에 맞추어 진화하고 있음을 확인하고, 이를 통해 대한민국의 대북 억지력을 강화하는 초석임을 재확인할 수 있는 종합보고서라고 할 수 있다. 또한 '공군과 타군과의 합동성 강화, 대국민 이미지 강화, 무기획득의 효율성 강화'라는 세밀한 주제가 2011년 한반도 안보지형을 이해하는 데 많은 도움을 줄 것이라고 생각된다.

본 연구서는 총 4부로 엮여 있다. 제1부는 전쟁수행방식의 변화와 공군의 역할이라는 주제하에, 인도 공군의 아버지라고 할 수 있는 Jasjit Singh의 "Trends in Conventional Conflicts and Air Power", 단국대 조한승 교수의 "21세기 전쟁양상의 변화와 항공우주력의 역할", 미국 해군대학 Andrew S. Erickson 교수의 "China's Increasing Air Power: Implications for the Republic

of Korea Air Force", 총 3편이 수록되어 있다. 각 장은 사실상 21세기 전장 환경의 변화가 지상전에서 항공전으로, 재래식에서 전자전으로, 상비군체제에서 비상비군체제로 변화함을 주목하고 있다. 특히 Singh의 논문은 우리에게 시사하는 바가 크다. 인도의 경우 지상군의 비중이 국방력에서 차지하는 비율이 높았음에도 불구하고, 점진적으로 항공력 중심체계로 변화하고 있다고 주장한다. 즉, 국방비의 효율적인 운영, 인명피해의 최소화, 군의 첨단화를 주도하는 공군의 모습이 인도국방체계에서 등장하고 있다는 점은 중요한 포인트라고 할 수 있다. 특히, 인도 주변국들이 핵 보유 국가들이고, 이에 대한 효과적 억지력을 제공하는 주체가 바로 공군이라는 점은 대한민국 안보의 미래에 과연 공군이 어떠한 역할을 수행해야 하는지를 보여준다고 할 수 있다.

조한승 교수의 논문은 21세기 전쟁변화의 양상을 역사적으로 회고한 글이라고 할 수 있으며, 전쟁사는 물론, 현대전의 변화추세를 학습하는 데 중요한 지침서라고 할 수 있다. 특히, 하이브리드 전쟁이라고 하는 미래전에서 항공우주력의 역할은 매우 중요하며, 이 중요성을 감안할 때, 타군과의 합동군사능력이 전쟁 억지력과 방어력 배양에 필수라고 논의하고 있다. 더욱이 항공우주력은 장거리 대응능력과 대응의 신속성을 가능하게 할 뿐만 아니라, 전략, 작전, 전술적 상황인식에 효과적이라는 논의는 현재 한반도 안보상황을 고려할 때, 공군에 시사하는 바가 크다고 할 수 있다.

Erickson 교수는 중국의 부상을 중국의 항공력 강화라는 측면에서 조명한다. 중국의 항공력을 항공기 자산, 무기 자산 그리고 교리체계를 중심으로 세밀하게 분석하였고, 이는 중국의 항공무기체계를 연구하는 연구자에게 많

은 도움이 될 것이다. 본 논문에서는 부상하는 중국 항공력의 잠재적 위협에 대처하기 위한 공군의 역할을 강조하는 바, 다시 한번 공군의 역할이 단순히 대북억지력뿐만 아니라, 동북아 안보의 중요한 역할을 수행해야 하는 미래상을 제시하고 있다.

2010년 공군력 학술회의에서 최초로 시도된 패널 "국민과 함께 하는 공군력 강화"에서는 언론홍보 학자를 초청하여 과연 공군의 대국민 이미지가 어떠한지 실증 진단하였다. 미국 오클라호마대학의 박남기 교수는 "국민의 눈에 비친 공군 이미지"라는 글에서 미국의 공군 이미지를 비교 분석함으로써 현재 한국 공군의 이미지 제고를 위해 어떠한 사항들이 고려될 수 있는지를 논의한다. 한국 공군의 이미지는 대체로 긍정적이며 독립적인 이미지가 강한 것으로 파악되고, 이는 한국의 언론 보도에 있어서도 대체로 긍정적인 이미지가 국민에게 투사되고 있는 것으로 나타난다. 즉, 타군과는 달리 첨단 기술의 사용, 그리고 미래 전투력의 핵심이라는 이미지와 함께 영화나 방송을 통해 깔끔한 이미지가 전달되고 있음을 의미하며, 이는 공군에게 매우 고무적인 사실로 인식된다. 광운대 정일권 교수는 "항공우주국가로서 한국의 이미지와 공군"이라는 글을 통해 한국 공군의 PR전략을 집중분석한다. 박남기 교수와는 달리 정 교수의 글은 공군의 PR방식이 국민에게 직접적으로 다가가지 못하고 있음을 비판적으로 주장한다. 정 교수의 글은 매우 경험적인 데이터를 바탕으로 공군의 PR방식을 비판하고 있으며, 이는 공군의 대국민 관계설정을 위해 반드시 참고해야 할 필독서라 할 만하다.

본 연구서의 3부는 "항공우주력 발전을 위한 공군 경영 효율성"이라는 주제로 무기 획득 과정의 합리성과 효율성을 위한 제언에 집중한다. 미국

조지워싱턴대학의 객원교수이자 미국 국방부 컨설턴트인 Zachary Mears 박사의 "Acquiring Air Forces: Lessons Learned from Foreign Cases"는 항공자산의 획득을 위해 어떠한 기준으로 현재의 항공력과 안보환경을 진단해야 하는지 논의한다. 이에 대한 두 기준점으로 위협기준(Threat Based)과 능력기준(Capability Based)을 제시한다. 또한 본 장에서 호주와 미국의 항공력 획득과정을 비교 분석함으로써 실증적 분석의 질을 한층 강화하였다. 저자가 주장하듯, 본 장은 한국공군의 무기획득에 있어서 참고자료로 활용할 수 있을 것이다. 세종연구소 정철호 박사의 "미래지향적 공군전력 운용 및 건설의 효율성 강화 방안"은 현재 한국 공군에 직면한 문제들을 점검하고 이에 대한 처방적 방안을 제시한다. 특히 공군 조종사의 유출 문제를 거론한 것은 흥미롭다.

본 연구서는 4부에서 "천안함 사건을 통해 본 합동성 진단"이라는 좌담을 지면 중계하였다. 천안함 폭침 사건으로 인해 불거진 합동성의 문제를 단순히 공군의 시각이 아닌 해군과 군사안보 전문가들의 종합적 시각으로 진단하였다. 문정인 교수의 사회로 진행된 좌담회는 박상묵 전(前) 공군교육사령관, 윤연 전(前) 해군작전사령관, 김종대 D&D Focus 발행편집인, 최현수 국민일보 군사전문기자의 뜨거운 토론과 논쟁으로 진행되었다. 대한민국 국방의 합동성 강화가 왜 필요하고 무엇이 보완되어야 하는지에 대한 전문적 토론은 매우 신선하였다. 더욱이 천안함의 폭침 이후 대한민국의 안보강화를 위해 과연 군을 어떻게 운용해야 하는지에 대한 시각을 확인한 점은 의미가 깊다고 할 수 있다.

휴전이 불안정할수록, 군사력은 강화된다. 강화된 군사력은 다시금 불안

정한 휴전에 가변성을 강화시킨다. 나의 방어적 의도는 상대방에게 공세적으로 인식되고, 이 공세적 인식은 다시금 군사력 강화로 이어진다. 이에 국가는 상대방의 도발을 방지하기 위해 억지력을 강화한다. 한반도의 분단은 대한민국과 북한 간의 상호 강화된 억지력에 의해 유지되고 있다. 이 대북 억지력의 정점이 대한민국의 항공력이다. 연평도 포격사건에서도 극명히 나타났듯이, 북한의 포 진지를 효과적으로 파괴할 수 있는 우리의 전력자산은 공군의 최신예 전투기 F-15이다. 한반도 안정의 초석은 도발 불용에 기초한다. 이를 바탕으로 우리 정부의 대북정책 자율성이 최대한 확보될 수 있다. 대북정책의 자율성을 효과적으로 운영하기 위해서는 대한민국의 항공력이 가장 효과적이다. 먼저, 남한과 북한의 인명피해를 최소화할 수 있다. 우리 공군이 보유한 JDAM과 Slam-ER 공대지미사일은 북한의 포 진지를 정밀타격할 수 있는 무기체계일 뿐만 아니라, 유사시 적의 주요 지휘부를 타격할 수 있어서 대한민국의 억지력 강화에 크게 공헌하고 있다. 따라서 정밀유도무기체계는 한국군은 물론 북한의 민간인 피해를 최소화할 수 있다. 공군은 진화하였으며, 변화된 한반도 안보환경은 다시 한번 공군의 도약을 명령하고 있는 것이다. 국민의 안전한 일상을 지켜야 하는 것이 안보라면, 이 안보의 초석은 비단 하드웨어의 강화뿐만 아니라 합동성과 같은 소프트웨어의 강화도 분명 동시에 진행되어야 한다. 이것이 본 연구서가 지향하는 점이라고 할 수 있다.

본서가 발간되기까지, 그리고 항공우주력 학술회의가 성공적으로 개최되기까지 많은 분들의 공헌이 있었다. 연세대학교 항공우주력 국제학술회의를 위해 물심양면으로 지원해 주신 대한민국 공군 본부와 이계훈 참모총장, 공

군 전투발전단의 박병구 단장, 그리고 세부적으로 협조사항과 행사준비를 직접 맡아준 전투발전단의 안재봉 대령, 김완룡 중령, 그리고 조성진 소령에게도 감사드린다. 특히 이제는 민간인 신분으로 새로운 삶을 개척하시는 이계훈 총장님의 무운을 빌면서 특별한 감사의 말씀을 드린다. 또한 안재봉 대령은 공군의 개혁을 세밀히 주도해 나갈 브레인으로서 안 대령의 넓은 인품만큼 파이팅하시길 기원한다. 국제 회의는 교수 몇 명의 협동과정으로만 가능한 것이 아니다. 연세대학교 정치학과 대학원이 훌륭한 이유는 미래의 학자가 될 우수한 잠재력의 대학원생들이 있기 때문이다. 정진웅 박사과정생은 사실상의 총무간사를 맡아 실무를 책임졌다. 우리 대학원의 공군 위탁장교인 최을렬 소령, 김봉수 소령, 김상준 소령, 송용호 소령의 공헌도 회의 성공에 중요한 요소였음을 밝혀둔다. 또한 미국 현역 공군 장교로, 현재 우리 대학원 석사과정에 재학 중인 Chris Heber 소령 역시 이 회의에 적지 않은 공헌을 했다. 마지막으로 박상준 석사를 비롯한 많은 대학원생들의 자원봉사 역시 회의의 원만한 진행에 큰 도움이 되었음을 밝힌다. 본서의 출판은 오름출판사 부성옥 대표의 흔쾌한 승낙에 의해 가능하였다. 감사의 말씀을 드린다.

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