SECTION 2: CHINA'S MILITARY MODERNIZATION

Introduction

This section examines China's evolving security perceptions; select inputs to China's military modernization; and current and future capabilities of China's naval, air, missile, and space forces. It concludes with a discussion of the implications of China's military modernization for the United States. The statements and assessments presented here are based on Commission hearings, briefs by U.S. and foreign government officials, consultations with nongovernmental experts on China's military,* the Commission's fact-finding trip to Asia, and open-source research and analysis.

China's Evolving Security Perceptions

In the early 1980s, the People's Liberation Army (PLA) began to transition from a large infantry-based peasant army designed to fight protracted wars to a smaller, well-trained, and technology-enabled force. For the next 15 years, China's military modernization was gradual, incremental, and focused primarily on overcoming the PLA's obsolescence, reflecting Beijing's view that a major war was unlikely and that China's economic development was the Chinese Communist Party's (CCP) most pressing strategic goal.

However, Taiwan's steady march toward democracy in the 1990s raised fears in Beijing that Taiwan's increasingly progressive government would produce a president who would pursue de jure independence from mainland China. This provided an impetus for the PLA to strengthen its capabilities for Taiwan conflict scenarios. Furthermore, the success of U.S. long-range, precision strikes and network-centric warfare during multiple U.S. and North Atlantic Treaty Organization (NATO) military operations in the 1990s and the U.S. deployment of two aircraft carrier battle groups during the Taiwan Strait Crisis in 1995–1996 demonstrated to Beijing that the United States might be willing to intervene in a Taiwan conflict involving China and could do so effectively. This led Beijing to accelerate its military modernization in the late 1990s and to focus on developing capabilities to counter U.S. naval and air intervention in a Taiwan contingency.[1]

By the mid-2000s, the growth of China's export-driven economy and Beijing's recognition of the immense value and vulnerability of

* Commission staff interviewed or consulted the following nongovernmental experts during the drafting of this section; however, these experts do not necessarily agree with or endorse the Commission's assessments and statements contained herein: Ken Allen, Richard Bejtlich, Richard Bitzinger, Dennis Blasko, J. Michael Cole, Gabe Collins, Mark Cozad, Tai Ming Cheung, Ian Easton, Jeffrey Engstrom, Andrew Erickson, Richard Fisher, M. Taylor Fravel, Scott Harold, Terrence Kelly, Adam Liff, Jonathan McDowell, Joe McReynolds, Kevin Pollpeter, Michael Raska, Mark Rosen, Mark Stokes, Lloyd Thrall, and Peter Wilson.

sea lanes and resources in China's maritime periphery combined to incentivize China to develop the ability to protect regional and strategic sea lanes and preserve freedom of movement on the high seas. Faced with this emerging requirement, as well as the desire of CCP leaders to legitimize their regime by successfully asserting China's nationalistic ambitions, China hastened the development of maritime capabilities necessary to assert control over China's claims in the East China Sea and South China Sea and to protect China's access to marine resources.

In 2004, Beijing issued a directive to the PLA to prepare for non-traditional missions beyond China's immediate periphery, including humanitarian assistance/disaster relief, counterterrorism, and international peacekeeping operations. In Beijing's view, these missions are essential to China's development because they enhance China's diplomatic and political leverage in global affairs; bolster China's image as a great nation for domestic and international audiences; and protect China's expanding foreign economic assets and interests, which the CCP views as a cornerstone of the regime's legitimacy and a requirement for preserving the political system.[2] Linking China's economic and strategic interests abroad created a requirement for the PLA to be able to project power outside of Asia on a limited basis. As the PLA's operational capabilities have improved, its naval, air, and ground forces have begun to operate beyond China's immediate periphery to fulfill these new missions and demonstrate to the world its increasing ability to project military power throughout the Asia Pacific region and beyond.

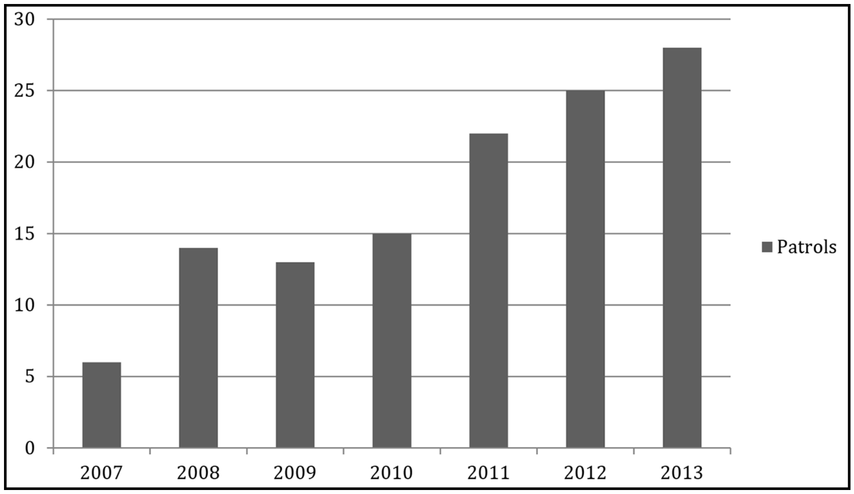
- The number of what official Chinese sources refer to as PLA Navy "combat readiness patrols," or "blue-water training" deployments, increased from six in 2007 to 28 in 2013, according to Commission analysis of U.S. government information and Commission discussions with U.S. and foreign government officials (see Figure 1).[3] The PLA Navy now maintains a near-constant presence throughout the first and second island chains (see Figure 2).* This activity currently is concentrated in the Philippine Sea, an area Beijing judges would be crucial to interdicting U.S. forces in a conflict,[4] but is expanding gradually into the southern reaches of the South China Sea and the Indian Ocean. According to a senior U.S. Navy official, "the amount of time [PLA Navy surface task groups] train in the Philippine Sea now rivals that of the United States."[5]
- Since 2009, the PLA Navy has conducted counterpiracy operations in the Gulf of Aden to protect Chinese commercial shipping interests. Not including naval diplomacy, the initial Gulf of Aden mission represented China's first operational deployment of naval forces outside of China's regional waters. More recently, from January to June 2014, two successive PLA Navy

* PLA strategists and academics argue the United States relies primarily on the "first island chain" and the "second island chain" to encircle strategically China and prevent China from "settling" its objectives vis-à-vis Taiwan, the East China Sea, and the South China Sea. The first island chain extends from Western Japan through the Ryukyus and Taiwan to the Philippines, and the second island chain stretches from the Kuriles through Eastern Japan and the Bonin Islands to Saipan and Guam in the Marianas. Although Western observers usually describe the "island chains" concept as a Chinese one, Chinese analysts claim the concept was developed by the United States following World War II to "surround" and "contain" the newly established People's Republic of China.

ships joined ships from Russia and Europe for 20 joint escorts of chemical weapons used in Syria's civil war from Syria into international waters for neutralization.[6] The PLA Navy's activities in the Gulf of Aden and the Mediterranean Sea demonstrate its ability to conduct small-scale long-distance naval operations for extended durations despite China's lack of overseas military bases. For more on these PLA Navy operations, see Chapter 2, Section 1, "Year in Review: Security and Foreign Affairs."

- In 2010, China deployed fighter aircraft to Turkey for a joint China-Turkey air exercise that reportedly involved mock dogfights and other air-based maneuvers.[7] During the Shanghai Cooperation Organization's Peace Mission exercise later in 2010, PLA Air Force bombers, escorted by fighter aircraft, carried out China's first simulated long-range air strike from air bases in western China. Following mid-air refueling, the aircraft rehearsed bombing ground targets in Kazakhstan.[8] China's activities during these exercises demonstrated for the first time the PLA Air Force's ability to conduct long-range air strikes and air-ground operations.
- In 2011, the PLA Air Force and Navy deployed four cargo aircraft and one surface combatant, respectively, to support and protect the evacuation of 35,000 Chinese nationals from Libya in China's first overseas noncombatant evacuation operation. China's Ministries of Commerce, Foreign Affairs, and Public Security; the Civil Aviation Administration of China; Chinese companies operating in Libya; and Chinese shipping companies also participated in the evacuation and coordinated closely with the PLA. This operation enabled the PLA to demonstrate a commitment to the protection of Chinese citizens overseas and highlighted China's ability to rapidly mobilize civilian assets for military operations.[9]
- In 2013, the PLA contributed nearly 400 troops to the United Nations (UN) Multidimensional Integrated Stabilization Mission in Mali. This was Beijing's first deployment of infantry to support a peacekeeping operation since China began participating in UN missions in 1990. China previously had limited the PLA's participation in peacekeeping operations to noncombat troops—mainly military observers; staff officers; and engineering, medical, and transportation personnel.[10] Additionally, China began to deploy 700 troops to the UN Mission in South Sudan in September 2014, marking Beijing's first contribution of an infantry battalion to a UN peacekeeping force.[11]
- In early 2014, a PLA Navy surface task group carried out a sophisticated training exercise spanning the South China Sea, eastern Indian Ocean, and Philippine Sea. The deployment marks the first time the PLA Navy has conducted a surface combat readiness patrol in the Indian Ocean.[12] Furthermore, from late 2013 to early 2014, China conducted its first submarine combat readiness patrol to the Indian Ocean.[13] For more on these PLA Navy deployments to the Indian Ocean, see Chapter 2, Section 1, "Security and Foreign Affairs Year in Review."

Figure 1: PLA Navy Surface and Submarine Combat Readiness Deployments, 2007–2013



Source: This figure reflects Commission estimates and judgments based on Commission analysis of U.S. government information and Commission discussions with U.S. and foreign government officials.

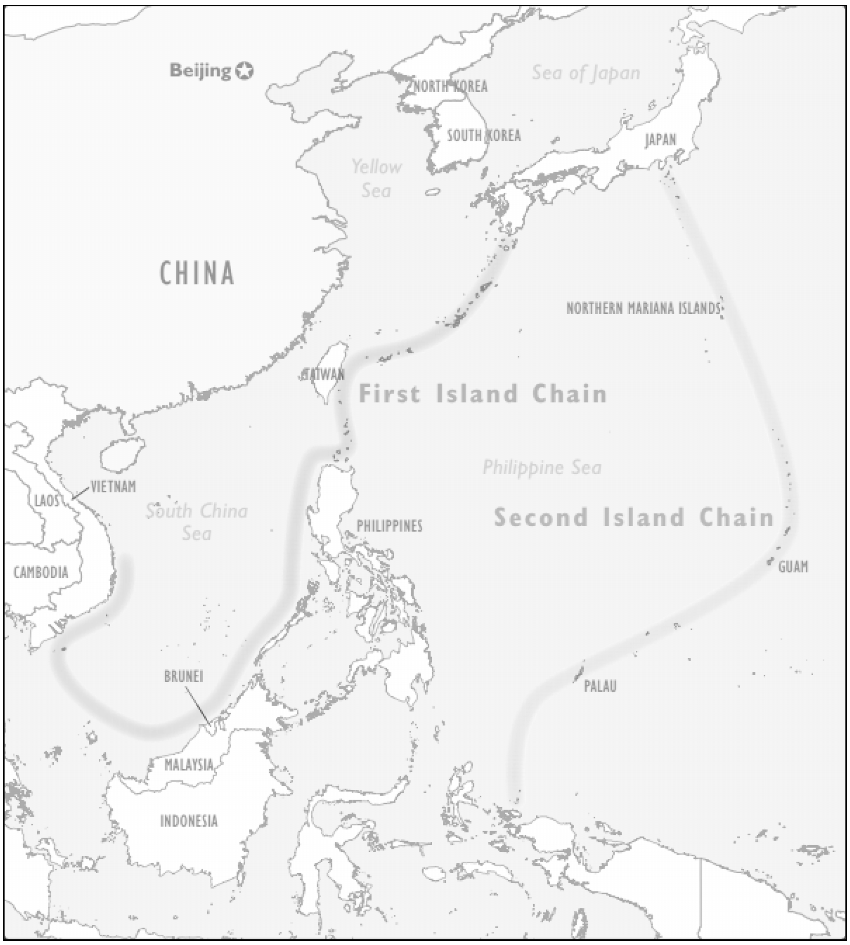
The CCP's 18th Party Congress work report, China's 2012 defense white paper, and official Chinese media indicate continuity in Beijing's assessments of the nature of future warfare and its immediate and long-term threat perceptions. This suggests the PLA's strategy and modernization priorities will remain focused on building offensive and defensive capabilities for long-duration, high-intensity regional conflicts, including those involving U.S. intervention.[14]

At the same time, President, CCP Chairman, and Central Military Commission (CMC)* Chairman Xi Jinping's speeches to the military and official PLA statements and documents indicate the PLA probably will increase its efforts to address longstanding, pervasive institutional and structural problems that could limit the PLA's actual ability to sustain combat operations, despite its impressive capability gains. CMC Chairman Xi has repeatedly called for the PLA to develop a strong, professional force that is "fully capable of fighting" and can "win every war" by increasing "combat realism" in training.[15] Moreover, CMC Chairman Xi reportedly told a committee of CCP leaders in March 2014: "There cannot be modernization of national defense and the military without modernization of the military's forms of organization. There has to be thoroughgoing reform of leadership and command systems, force structure and policy institutions." According to David Finkelstein, vice president and director of China Studies of CNA China Studies, "Military reform is part of the larger program that Xi is putting in place to put his imprimatur on the Chinese party-state. . . . 'This

*The CMC—China's highest military decision-making body—ensures continued CCP control of the PLA, sets military policy and strategy, interprets CCP guidance for the military, and oversees the daily operations of the massive PLA bureaucracy. The CCP chairman since 1989 typically has served as CMC chairman.

time, we're serious' should be the subtext of this new tranche of reform. It will be five years before you see the fruits of it. But 10 years from now, you might see a very different PLA." [16]

Figure 2: China's First and Second Island Chains



Source: U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2012, 2012*, p. 40.

Furthermore, China's offensive missile force—the Second Artillery—may play an increasingly important role in China's military strategy and modernization priorities. Chinese state media reported that CMC Chairman Xi met with the Second Artillery in one of his first public meetings with the PLA since taking office in 2012. During the meeting, he reportedly called on the Second Artillery to "build a powerful and technological missile force" and said the missile force "is the core strength of China's strategic deterrence, the strategic support for the country's status as a major power, and an important cornerstone safeguarding national security." [17] Chairman Xi's promotion of Second Artillery Commander

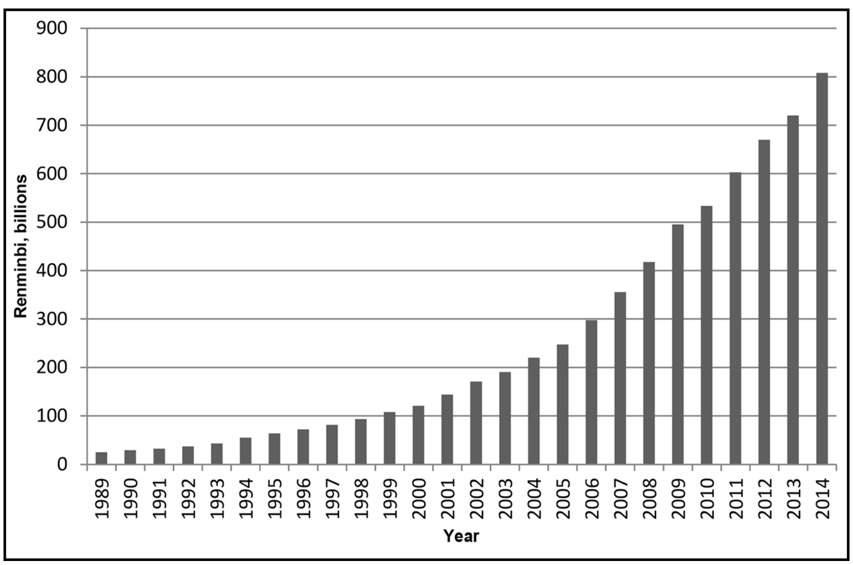
Wei Fenghe to full general shortly after Xi assumed office also may indicate the growing importance of China's missile force. This was the first PLA promotion over which Xi presided as the military's new leader.[18]

Select Inputs to China's Military Modernization

Military Spending

China's rapid economic growth has enabled it to provide consistent and sizeable increases to the PLA's budget to support its military modernization and gradually expanding missions. China's announced official projected defense budget increased from 720 billion RMB (approximately $119.5 billion) in 2013 to 808 billion renminbi (RMB) (approximately $131.6 billion) in 2014, a 12.2 percent increase. With the exception of 2010, China's official defense budget has increased in nominal terms by double-digits every year since 1989 (see Figure 3).[19]

Figure 3: China's Announced Defense Spending, 1989–2014



Note: These numbers represent China's announced official defense budgets, not actual aggregate defense spending. They do not account for inflation or appreciation in the value of China's currency.

Source: This figure reflects Commission judgments based on several sources. Each provides data for part of the period 1989–2014. The most recent source is used when these sources disagree. For 1989–93, David Shambaugh, *Modernizing China's Military: Progress, Problems, and Prospects* (Berkeley, CA: University of California Press, 2002), p. 189; for 1994–2001, Dennis J. Blasko et al., *Defense-Related Spending in China: A Preliminary Analysis and Comparison with American Equivalents* (The United States-China Policy Foundation, 2007), p. 19. *http://www.uscpf.org/v2/pdf/defensereport.pdf*; for 2002–12, Andrew Erickson and Adam Liff, "Demystifying China's Defense Spending: Less Mysterious in the Aggregate," China Quarterly (December 2013): 805–830; for 2013, Jeremy Page, "China Raises Defense Spending 12.2% for 2014," *Wall Street Journal*, March 5, 2014. *http://online.wsj.com/articles/SB10001424052702304732804579421021045941010*; and for 2014, Andrew Erickson and Adam Liff, "The Budget This Time: Taking the Measure of China's Defense Spending," Asan Forum 2:2 (March–April 2014). *http://www.theasanforum.org/the-budget-this-time-taking-the-measure-of-chinas-defense-spending/*.

China's actual aggregate defense spending * is higher than the officially announced budget due to Beijing's omission of major defense-related expenditures—such as purchases of advanced weapons, research and development programs, and local government support to the PLA—from its official figures. The Department of Defense (DoD) estimates China's actual defense spending in 2013 exceeded $145 billion, approximately 21 percent higher than China's announced defense budget of $119.5 billion;[20] the Stockholm International Peace Research Institute estimates China's actual defense spending in 2013 was $188 billion, approximately 57 percent higher than China's announced defense budget.[21]

The definition of defense spending is intrinsically subjective and no major power includes all defense-related spending in its official defense budget. However, relative to the United States and other advanced industrial democracies at a comparable level of military development, China is exceptional in the extent and type of defense spending excluded and, most importantly, the fact that the relevant data generally are not publicly available elsewhere. Therefore, outside calculations of China's actual defense spending—at least those relying on open-source data—involve a significant amount of guesswork. Efforts to assess China's actual defense spending and to compare budgets over time also are hampered by changing official RMB–U.S. dollar (USD) exchange rates since 2005, a lack of consensus about appropriate RMB evaluation, the PLA's poor financial management practices, and the difficulty determining how China's purchasing power parity affects the cost of China's foreign military purchases and domestic goods and services.[22]

The PLA focuses on advancing and defending its interests in the Asia Pacific while developing the capacity to project power elsewhere. Moreover, China's defense spending is increasing at a far greater rate than that of the United States as well as U.S. treaty allies and established and emerging U.S. security associates in the region.†

Andrew Erickson, associate professor at the U.S. Naval War College, testified to the Commission that China's defense spending levels provide the PLA with "sufficient funding to develop formidable military capabilities for use on its immediate periphery and in its general region." Dr. Erickson also explained China's focus on developing regional capabilities has allowed the PLA to "rapidly exploit its geographical proximity and the vulnerabilities of its potential adversaries' military technologies and force structures, potentially placing them on the costly end of a capabilities competition." He testified this acquisition strategy has provided China with "asymmetric capabilities that are disproportionately efficient in asserting its interests, even though its overall defense spending still remains a distant second to America's."

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* There is no international consensus on which items should or should not be included in a country's "official" defense budget. Every major power—including the United States and major allies—spends money on the military that is not captured in the country's official "defense budget." For a discussion of several different definitions of total defense-related spending, see Dennis Blasko et al., *Defense-Related Spending in China: A Preliminary Analysis and Comparison with American Equivalents* (United States-China Policy Foundation, 2007). *http://www.uscpf.org/v2/pdf/defensereport.pdf*.

† U.S. treaty allies in the Asia Pacific are Australia, Japan, the Philippines, South Korea, and Thailand. "Established and emerging U.S. security associates" refers to Indonesia, Malaysia, New Zealand, Singapore, Taiwan, Vietnam, and India.

In a paper published by the Center for a New American Security, Captain Henry Hendrix (U.S. Navy) illustrates the efficacy and efficiency of China's asymmetric approach by comparing the cost of China's DF–21D antiship ballistic missile with the cost of the platform it is designed to strike, the U.S. aircraft carrier. Assuming China's DF–21D costs $11 million per missile, the high-end of an estimate made by two Chinese analysts, and future U.S. aircraft carriers cost $13.5 billion each, Captain Hendrix explains:

> *China could build 1,227 DF–21Ds for every carrier the United States builds going forward. U.S. defenses would have to destroy every missile fired, a tough problem given the magazines of U.S. cruisers and destroyers, while China would need only one of its weapons to survive to [achieve] a mission kill. Although U.S. Navy and Air Force leaders have coordinated their efforts to develop the means to operate in an anti-access/area denial environment by disrupting opposing operations, the risk of a carrier suffering a mission kill that takes it off the battle line without actually sinking it remains high.*[23]

China's defense spending increases appear sustainable. Even high-end foreign estimates put Beijing's actual aggregate defense spending at a moderate 2–3 percent of China's gross domestic product (GDP). Furthermore, increases to the official defense budget often have been exceeded by growing central government expenditures in other areas,[24] probably insulating Chinese leaders from potential criticism that they are spending too much on the military.

In a 2013 article in the *China Quarterly* journal, Dr. Erickson and Adam Liff, a postdoctoral fellow at Princeton University's Woodrow Wilson School and an assistant professor at Indiana University, explain the practical consequences of China's defense spending going forward:

> *The more sophisticated and technology-intensive [the PLA's] systems become, the less benefit the PLA can derive from acquiring and indigenizing foreign technologies, and the less cost-advantage China will have in producing and maintaining them. . . . Developing the capabilities necessary to wage high- or even medium-intensity warfare beyond China's immediate vicinity would require significant additional increases in the defense budget and heavy investment in new platforms, weapons and related systems; as well as training, operations and maintenance; not to mention some form of support infrastructure abroad. If China decides to develop significant power projection capabilities, its investments are likely to be increasingly inefficient and provide significantly less "bang" for a significantly larger "buck."*[25]

Defense Industry

In the late 1990s, China's leaders began to take concrete steps to strengthen the country's defense industry. Although the PLA has not fully overcome its dependence on foreign suppliers, China since then has increased the size and capacity of several defense sectors in support of the PLA's equipment modernization plans. According to Tai Ming Cheung, director of the University of California's Institute on Global Conflict and Cooperation, "there are so many projects underway [in 2014] that the Chinese defense industry appears to be on steroids." [26]

Ballistic and Cruise Missiles: China is able to rapidly develop and produce a diverse array of advanced ballistic and cruise missiles. China maintains the largest and most lethal short-range ballistic missile force in the world; fielded the world's first antiship ballistic missile in 2010; deployed its military's first long-range, air-launched land-attack cruise missile in 2012; and will widely deploy its military's first indigenous advanced, long-range submarine-launched antiship cruise missile in the next few years, if it has not already.* Furthermore, the PLA is developing hypersonic glide vehicles as a core component of its next-generation precision strike capability. Hypersonic glide vehicles could render existing U.S. missile defense systems less effective and potentially obsolete (see the text box, "China's Hypersonic Missile Program," later in this section).

Naval Shipbuilding: China has demonstrated it is capable of manufacturing a wide range of naval combatants, including patrol boats, frigates, destroyers, large amphibious ships, and conventional and nuclear submarines and is developing its first indigenous aircraft carrier. Jesse Karotkin, senior intelligence officer for China at the Office of Naval Intelligence (ONI), testified to the Commission that "during 2013 alone, over fifty naval ships were laid down, launched, or commissioned, with a similar number expected in 2014." China's shipbuilders already have surpassed their counterparts in Western Europe, Japan, and South Korea in terms of the number and types of ships they can produce; China's shipbuilders could reach the technical proficiency† of Russian shipbuilders by 2020 and approach the technical proficiency of U.S. shipbuilders by 2030.[27]

Naval Technology: China is developing its own marine gas turbines and already has produced them domestically for its YUYI-class hovercraft. China likely will develop the ability to mass produce marine gas turbines for larger combatant ships in the next decade. Gas turbines will give PLA Navy ships better acceleration and combat maneuverability than steam turbines that power them today due to their high power-to-weight ratio, speed, fuel efficiency, and compact size. Gas turbines also will allow the PLA Navy to achieve higher readiness rates, because they do not require the start-up time of steam turbines.[28]

Unmanned Aerial Vehicles: China is one of the world's leading unmanned aerial vehicles (UAV) producers, with dozens of models currently in production. According to a 2012 report by the Defense Science Board:

> *[China's] move into unmanned systems is alarming. The country has a great deal of technology, seemingly unlimited*

* The PLA Navy already possesses an advanced, long-range submarine-launched antiship cruise missiles, but it was acquired from Russia.

† "Technical proficiency" refers to the ability to develop, produce, and integrate advanced mechanical, electrical, cargo, habitability, and weapon systems into ships.

> *resources and clearly is leveraging all available information on Western unmanned systems development. China might easily match or outpace U.S. spending on unmanned systems, rapidly close the technology gaps and become a formidable global competitor in unmanned systems.*[29]

China thus far has focused on using UAVs for intelligence, surveillance, and reconnaissance (ISR) but has fielded units capable of delivering lethal weapons (such as missiles) and conducting electronic warfare.[30] Furthermore, China's UAV industry recently made advancements in unmanned combat aerial vehicle (UCAV) development. In November 2013, China conducted the inaugural test flight of its first stealth UCAV, the *Lijin*. According to a Chinese aerospace expert quoted in the state-owned *China Daily*, "the [*Lijin*] can be used for reconnaissance and an air-to-ground strike. . . . The size and technological capability of the *Lijin* [also] make it a suitable choice for the [PLA Navy] if it is to select an unmanned combat platform for its aircraft carrier."[31] In addition to the *Lijin,* China in 2013 revealed it is developing two other UAVs that are designed to carry weapons.[32]

China's Hypersonic Missile Program

In January 2014, China tested its first hypersonic missile vehicle, reportedly designated the WU–14. The test was acknowledged by China's Ministry of National Defense and later confirmed by DoD. After the WU–14 is deployed, the missile could enable China to conduct kinetic strikes anywhere in the world within minutes to hours.[33] According to Mark Stokes, executive director of the Project 2049 Institute, Chinese technical literature suggests that research into boost-glide weapons has been underway for some time and that China may seek to field a "boosted hypersonic glide missile capable of intercontinental strike" by 2020 and a "hypersonic scramjet-propelled cruise vehicle for global operations" before 2025.[34]

China tested the WU–14 again in August, according to two media reports citing unnamed sources.[35] The test has not been acknowledged by China or confirmed by DoD. Although the test reportedly was unsuccessful,[36] Lora Saalman, an associate professor at the Asia-Pacific Center for Security Studies, explains, "The decision to conduct a second WU–14 test only a few months after its first test shows China's commitment to fast-tracking this program. . . . When compared with the yearly gaps between its [antisatellite] and [ballistic missile] tests in 2007, 2010, 2013, and 2014, the WU–14 accelerates China's developmental timeline exponentially."[37]

China's Hypersonic Missile Program—*Continued*

The United States and Russia are the only other countries with developmental hypersonic weapons programs. Hypersonic vehicles create two challenges for existing missile defense systems, which are designed to counter slower, less maneuverable weapon systems. Hypersonic weapons travel at speeds of Mach 5 to Mach 10 (3,840 to 7,680 miles per hour). Furthermore, because hypersonic vehicles launched from ballistic missiles can travel at lower altitudes, they can evade quick detection.[38] Lee Fuell, technical director for force modernization and employment at the National Air and Space Intelligence Center (NASIC), testified to the Commission:

> *The Chinese have talked about a recent successful test of a hypersonic glide vehicle, which is basically a ballistic missile launch system that gets the target or gets the payload fast and high, pitches over, dives to hypersonic speed, and then basically just glides to the target. At this point, NASIC thinks that it is associated with [China's] nuclear deterrent forces. Of great concern would be if [China] was to apply the same technology and capability with a conventional warhead or even just without a warhead because of the kinetic energy that it has in combination with their theater ballistic missiles, you know, in a theater role.*
>
> *The hypersonic vehicles of any kind, whether they are glide vehicles or cruise missiles, are extremely difficult to defend against because just the time is so compressed between initial detection, being able to get a track, being able to get a fire control solution, and then just being able to have a weapon that can intercept them in some way just because of the speed at which they're moving. If that is combined with more traditional ballistic missile attacks forcing a target to defend against very high aspect warheads coming in this way at the same time they have to defend against low altitude, very high speed targets coming in this way, it makes the defense problem orders of magnitude worse for the defender.*[39]

China's progress modernizing its defense industry is due in large part to China's substantial and sustained investment in defense research and development (R&D). China's large-scale, state-sponsored theft of intellectual property and proprietary information also has allowed China to fill knowledge gaps in its domestic defense and commercial R&D. This process has enabled China to save time and money on defense R&D. China probably allocates at least 5 percent and potentially up to 10 percent of its overall defense spending to R&D, making it second only to the United States in overall defense R&D spending.[40]

Furthermore, according to Battelle's *2014 Global R&D Funding Forecast*:

> *[China] has increased its overall R&D investments by 12 percent to 20 percent annually for each of the past 20 years;*

> *while at the same time, U.S. R&D spending increased at less than half those rates. As a result, China's investment is now about 61 percent that of the United States, and continuing to close. At the current rates, China's commitment is expected to surpass that of the United States by about 2022, when both countries are likely to reach about $600 billion in R&D.*[41]

Although this spending is not explicitly intended for use by the PLA, China since the late 1990s has promoted "civil-military integration" to facilitate the transfer of commercial technologies for military use. As part of this effort, China has encouraged civilian enterprises to participate in military R&D and production, sponsored research into dual-use science and technology, and developed common military and civilian technical standards.

The most important coordinating body for China's military R&D is the Central Special Committee, formally known as the National Defense Industry Special Committee. Established in the early 1960s and led through the decades by some of China's top political leaders, the Central Special Committee brings together Chinese civilian and military leaders and top technical experts to direct and coordinate high-priority strategic R&D programs for China's military modernization, such as China's nuclear weapons, nuclear submarines, ballistic missiles, and space weapons. The composition and role of the Committee under President and CMC Chairman Xi is unknown, but it likely is led by Premier Li Keqiang.[42]

To manage China's investment in R&D, Beijing has promulgated a number of formal R&D plans, research funding programs, and policies that have ambitious goals and concrete timelines. China's R&D initiatives cut across the government, military, and private spheres by coordinating state-funded R&D efforts across them and placing a heavy emphasis on funding basic and foundational research with impacts on multiple fields.

- In its *National Medium- to Long-Term Plan for the Development of Science and Technology (2006–2020)*, approved in 2006, Beijing calls for the transformation of Chinese economy into a science and technology (S&T) powerhouse by 2020 and a global leader by 2050. This "grand blueprint of S&T development" is designed to bring about the "great renaissance of the Chinese nation."[43]
- *Document 37*, issued in 2010 by the State Council and CMC, directs the PLA to improve its defense industry by (1) strengthening political guidance and coordination; (2) encouraging the opening up and sharing of military-local resources, particularly for S&T; (3) promoting the mutual transfer of dual-use technology; (4) accelerating the development of national key laboratories that facilitate civilian-military integration; (5) bolstering joint research of dual-use technologies; (6) expanding the scope and intensity of civilian R&D work that civilian research institutions and enterprises conduct in military-use technologies; and (7) developing civil-military integration S&T parks, and civil-military dual-use technology innovation bases.[44]

Comparing R&D in China and the United States, James Lewis, senior fellow and director of the Strategic Technologies Program at the Center for Strategic and International Studies, testified to the Commission:

> *China has engaged in a sustained investment in technology for thirty years while U.S. investments in science have too often come in fits and starts and been driven by fads. China's policy to maintain and increase economic growth has many flaws, but at least they have one, and the contrast is beginning to tell. A centrally-directed economy subject to heavy political interference can be remarkably inefficient in making investment decisions and in production, but China has compensated for this with heavy and sustained government spending to build capacity and by drawing upon an immense and underutilized talent pool.*

Furthermore, Beijing reportedly is drafting a plan to incorporate military research institutes into listed state-owned enterprises, providing them access to capital markets. Currently, these military research institutes are funded entirely by the Chinese government and do not seek profits.[45] With expanded sources of funding, China's defense industry may improve both its ability to meet PLA requirements and to compete in the global arms market.

Foreign Acquisitions

China turns to foreign countries, mainly Russia, to purchase weapon systems and technologies that it cannot produce indigenously.* Although Moscow's concern over China's record of disregarding intellectual property rights by copying Russian weapon designs † has contributed to a decline in arms sales to China since the mid-2000s, the two sides reportedly are negotiating several sales of major weapon systems, including those designed specifically to counter the United States (for more information on potential Russian arm sales to China, see "China's Maritime Forces" and "China's Air Forces" later in this section).

China also continues to purchase weapon systems and technology from European Union (EU) countries, despite the limited arms embargo those countries imposed on China after its military massacred civilians in the 1989 Tiananmen Square crackdown. Unlike the United States, which enacted strict legislation prohibiting weapon sales to China, the EU embargo is nonbinding, and each member is permitted to interpret it in the context of their respective national laws and regulations.[46] According to Oliver Brauner, a researcher at the Stockholm International Peace Research Institute (SIPRI):

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* Based on the numbers of contracts signed for licensed production and direct export, Russia from 2000–2013 significantly outstripped all other arms suppliers to China. During this same period, China imported smaller numbers of arms from France, Ukraine, Germany, the United Kingdom, Belarus, Israel, and Switzerland. Stockholm International Peace Research Institute, "The SIPRI Arms Transfers Database." *http://www.sipri.org/databases/armstransfers*.

† For example, after absorbing and mastering the technology and knowledge transfers that Russia provided for the Su-27 fighter aircraft, China reverse engineered the Su-27 to create the J–11. The J–11 features improvements over the Su-27, such as a reduced radar cross-section and a better fire-control radar, and has a Chinese-developed engine.

> *The EU has so far failed to develop a strategic approach toward the potential security implications of transfers of European militarily sensitive technologies that goes beyond the existing arms embargo and currently lacks effective mechanisms to control the flow of such technologies to China. ... This is mainly because the EU-China relationship continues to be dominated by the economic interests of individual member states, both in trade and increasingly in investments. Furthermore, due to a lack of direct security interests in the Asia-Pacific, Europeans do not generally see China as a security threat or a strategic competitor.*[47]

EU arms makers received licenses to export 3 billion euros (about $3.8 billion) of military equipment from 2001–2011.* The most recent EU report on arms sales by member nations claims member countries approved licenses to export 173 million euros (about $220 million) of military equipment in 2012. France accounted for more than 80 percent of these licenses by value, according to the EU report.[48] Perhaps more importantly, EU countries are exporting dual-use technology that in many cases can be sold without licenses. For example, most of China's indigenous diesel-electric submarines and several of its surface combatants are equipped with engines designed and manufactured by German and French firms.[49]

With the emergence of a more modern and able domestic defense industrial base, China is gradually shifting its focus from purchasing complete foreign systems to procuring foreign military and dual-use subsystems and components via open sources, trade, and traditional and nontraditional espionage. Among China's most effective methods used to acquire sensitive U.S. technology are cyber espionage; witting and unwitting collection by Chinese students, scholars, and scientists; joint ventures; and foreign cooperation. These methods are discussed in this section.

Cyber Espionage: Since at least the mid-2000s, the Chinese government has conducted large-scale cyber espionage against the United States. China has compromised a range of U.S. networks, including those of DoD, defense contractors, and private enterprises. A 2012 Defense Science Board report identified dozens of critical system designs compromised by Chinese cyber actors, including the Patriot Advanced Capability-3 air defense system, the F–35 and the F/A–18 fighter aircraft, the P–8A reconnaissance aircraft, the Global Hawk UAV, the Black Hawk helicopter, the Aegis Ballistic Missile Defense System, and the Littoral Combat Ship. The report also revealed Chinese cyber actors have obtained information on various DoD technologies, including directed energy, the UAV video system, tactical data links, satellite communications, electronic warfare systems, and the electromagnetic aircraft launch system.[50] However, the actors seeking information on these weapon systems and technologies are not just stealing the designs themselves, but they also are targeting internal communications, program schedules, meeting minutes, and human resource records, among other documents.[51]

* The approval of a license to export does not necessarily translate into an actual export.

Dr. Lewis testified to the Commission that cyber espionage "has been and continues to be a godsend to China's economic and technological modernization." He explained:

> *Technological espionage has carried over into cyberspace, as the Chinese discovered that the Internet gave them unparalleled access to poorly secured western networks. Cyber espionage has given China access to defense-industrial databases, [which are] the record of previous weapons programs and an invaluable resource. These databases provide the historic experience of building weapons. They show design changes, modifications, how production problems were overcome, and testing results.*

U.S. private cyber security firms such as FireEye have reported that China's levels of cyber espionage activity have not substantially decreased in 2014,[52] despite a concerted U.S. effort since 2013 to expose and stigmatize Chinese economic espionage.

China's material incentives for continuing this activity are immense and unlikely to be altered by small-scale U.S. actions. According to Joe McReynolds, a research associate at Defense Group Inc.'s Center for Intelligence Research and Analysis:

> *Western analysts of the PLA often frame discussions of China's expanding Computer Network Operations capabilities as a question of whether the Chinese will one day become a 'status quo' power in cyberspace, finding agreement with the United States on shared 'rules of the road' that do not privilege either party. Implicit in this thinking is the notion that cyberspace has a natural equilibrium, which the Chinese have temporarily disrupted through aggressive use of Computer Network Operations against military and commercial targets but will one day have a material interest in protecting. However, the emergence of China as a truly status quo power in cyberspace is unlikely. China accrues vast benefits from penetrating foreign networks, and China's strategic thinkers see the status quo in cyberspace as leaving China intolerably vulnerable due to the United States' asymmetric control of the Internet's core infrastructure.*[53]

In February 2014, Admiral Locklear (U.S. Navy), commander of U.S. Pacific Command, explained, "the sooner we come to the realization that if we expect the Chinese to behave . . . well as a nation in cyberspace just because we ask them to, it is not realistic. I think we have to design into our own capabilities and our own systems things that protect our capabilities."[54]

Using Students, Scholars, and Scientists for Espionage: Chinese students attending U.S. universities have the potential to collect information, whether wittingly or unwittingly, on sensitive U.S. technology on behalf of the Chinese government and military. A 2011 study by the Federal Bureau of Investigation provides an example of how China may have attempted to obtain restricted information or products by targeting U.S. universities:

> *Despite university warnings on the restrictions on his research, University of Tennessee professor Reece Roth em-*

ployed a Chinese and an Iranian student to assist in plasma research while working on a classified U.S. Air Force project that stipulated no foreign nationals could work on the project. Roth also traveled to China with his laptop computer containing export-restricted information and had a sensitive research paper emailed to him there through a Chinese professor's email account. Roth claimed the research was "fundamental" and not sensitive, but a jury concluded otherwise. . . . In September 2008, Roth was found guilty on 18 counts of conspiracy, fraud, and violating the Arms Export Control Act; he was later sentenced to four years in prison.

A country or company does not have to orchestrate the actual theft of the research in order to capitalize on it. It is unknown how the Chinese used the information they obtained from Roth, but because they invited him to visit China and he had a sensitive report emailed to him while there, it should be assumed they were interested in his research and planned to utilize it.[55]

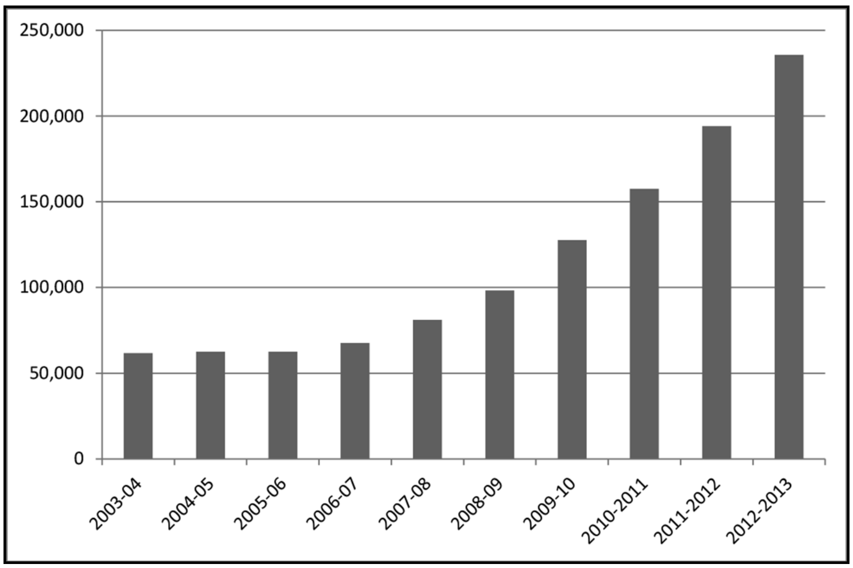
The Defense Security Service's annual report in 2013 also suggests China uses students and academics to acquire sensitive U.S. technology from cleared defense contractors:

The Defense Security Service assesses [with high confidence] that many East Asia and the Pacific students and academics in the United States probably pose a counterintelligence and technology transfer threat to cleared industry. While available information does not point to a direct connection between most, if any, academics and home-country intelligence services, such individuals and their sponsoring institutions likely view placement in U.S. facilities as supporting current R&D goals, some of which have military applications. Such placement opportunities are abundant in the United States, and East Asia and the Pacific students will almost certainly continue to seek them.[56]

It has become difficult to discern Chinese traditional and nontraditional collectors from legitimate students as the number of Chinese students in the United States grows.[57] The number of students from China attending U.S. universities more than doubled from 2008–2009 to 2012–2013, from approximately 100,000 to 235,000 (see Figure 4). In 2012–2013, about 40 percent of these students were undergraduate students and 44 percent were graduate students; for all academic levels, the top fields of study were business/management (29 percent), engineering (19.2 percent), and math/computer science (11.2 percent).[58] According to a 2014 report by a Chinese organization subordinate to the Ministry of Education, the majority of these students return to China after conducting their studies abroad.[59] They bring with them advanced scientific knowledge and the tacit knowledge of research strategies and techniques not found in scientific journals.

Furthermore, many PLA universities have established partnerships with Chinese civilian universities. For example, in January 2013, seven PLA universities and seven Chinese civilian universities signed a "strategic partnership" to "cultivate personnel and explore new modes of military-civilian joint education," according to Chinese state-owned press.[60] In addition to training the next generation of China's defense scientists and engineers, these partnerships concentrate civilian S&T research on emerging military technologies and could provide PLA scientists and engineers with opportunities to interact with U.S. entities and networks to gather information on sensitive U.S. technology.

Figure 4: Students from China Attending U.S. Universities: Total Enrollment, 2003–2004 to 2012–2013 Academic Years



Source: Institute of International Education, *Open Doors: Report on International Educational Exchange*, November 2013. *http://www.iie.org/~/media/Files/Corporate/Open-Doors/Fact-Sheets-2013/Country/China-Open-Doors-Fact-Sheet-2013.ashx*.

Joint Ventures: Chinese companies that acquire advanced technologies through joint ventures with foreign companies are legally required—under Chinese state security laws—to share the technology with the PLA and Chinese intelligence services if requested. The *Law of the People's Republic of China for Protection of State Secrets*, adopted in 1988, defined state secrets as all "matters that have a vital bearing on state security and national interests." The law and its implementation guidelines were so broad and vague that they encompassed essentially all conceivable information. A new version of the law, passed in 2010, offers slightly refined but still remarkably unclear parameters for what constitutes a state secret.[61]

Furthermore, Chinese joint-venture partners often exploit the agreement by demanding more technology than their foreign partners originally intended. The physical access to proprietary information and technologies provided by a joint venture also enables Chinese partners to more easily steal technology via traditional theft from their foreign partners.[62]

One instance of this occurred in China's developing rail industry. Japanese Kawasaki Heavy Industries, which had entered into a joint venture with China South Locomotive & Rolling Stock Corporation Ltd. (CSR), accused CSR of copying and selling its bullet train technology on both the domestic and global markets.[63] In another case, China-based cyber actors compromised a company shortly after it entered into a joint venture with a Chinese entity. The cyber actors targeted internal communications belonging to the company's executive leadership, who were involved in talks with their Chinese counterparts over a deal involving a specific project. FireEye assesses that the cyber actors then gave this information to the Chinese entity to provide it with an advantage in the negotiations, which, if successful, would provide the Chinese organization with exclusive access to the company's technologies and proprietary data. However, the cyber actors also targeted and stole information pertaining to several of the company's technologies and critical systems, which they likely gave to Chinese companies for use in developing an economic advantage in the industry.[64]

Foreign Cooperation: Chinese state-owned companies are pursuing foreign cooperation to improve their commercial design and manufacturing capabilities. For example, in the late 2000s, a Chinese company signed a deal with a U.S. company for final assembly and testing of the CF34–10A engine in China.[65] The engine will be used to power China's first indigenous passenger jet aircraft. No open-source information exists on the extent to which current Chinese military programs are exploiting technologies and know-how gained through foreign cooperation on civilian projects, but such activity would be consistent with China's past behavior. China almost certainly views the benefit to military development from such transfers as outweighing the risk of censure for violating end-user agreements on technology transfer deals.

PLA Navy Modernization

In the late 1980s, China began a modernization program to transform the PLA Navy from a coastal force into a technologically advanced navy capable of projecting power throughout the Asia Pacific. China's acquisition of platforms, weapons, and systems has emphasized qualitative improvements, not quantitative growth, and centered on improving its ability to strike opposing ships at sea and operate at greater distances from the Chinese mainland. From 2000 to June 2014, China's aggregate number of submarines and surface ships increased slightly from 284 to 290, while its overall capabilities improved significantly as it rapidly replaced legacy platforms with modern ones equipped with advanced, long-range weapon systems and sensors. China's modern ships also tend to be larger than legacy platforms, allowing them to handle rougher seas, hold more fuel and supplies for long deployments, mount more weapons, and carry larger crews to support a broader set of missions.

As of June 2014, the PLA Navy had 5 nuclear attack submarines (SSNs); 4 nuclear ballistic missile submarines (SSBNs); 39 diesel attack submarines (SS); 12 diesel air-independent attack submarines (SSP); 1 aircraft carrier; 24 destroyers (DD) and guided-missile destroyers (DDG); 63 frigates (FF), light frigates, and guided-missile frigates (FFG); about 85 missile-equipped patrol craft; and 57 medium and large amphibious ships.[66]

Mr. Karotkin, ONI's senior China analyst, explained to the Commission the inherent difficulties of using Chinese and U.S. naval orders-of-battle for comparing Chinese and U.S. naval capabilities:

> *. . . key differences in the types of PLA Navy ships (in comparison to the U.S. Navy) make it extremely difficult to apply a common basis for comparing the order-of-battle. A comprehensive tally of ships that includes hundreds of small patrol craft, mine warfare craft, and coastal auxiliaries provides a deceptively inflated picture of China's actual combat capability. Conversely, a metric based on ship displacement returns the opposite effect, given the fact that many of China's modern ships . . . are small by U.S. standards, and equipped primarily for regional missions.*

Defining "Modern" Submarines and Surface Ships

In reference to China's submarine force, the term "modern" is used in this report to describe a second-generation submarine that is capable of employing antiship cruise missiles or submarine-launched intercontinental ballistic missiles. The following PLA Navy submarine classes are considered modern: SHANG SSN, YUAN SSP, SONG SS, KILO 636 SS, and JIN SSBN.[67]

In reference to China's surface force, the term "modern" is used in this Report to describe a surface ship that possesses a multi-mission capability, is armed with more than a short-range air defense capability, and has the ability to embark a helicopter. The following PLA Navy surface ship classes are considered modern: LUHU DD, LUHAI DD, LUZHOU DDG, LUYANG I/II/III DDG, Sovremenny I/II DDG, JIANGWEI I/II FF, JIANGKAI I FF, and JIANGKAI II FFG.[68]

The PLA Navy also has a large number of submarines and surface combatants that are not considered modern as well as amphibious warfare, mine warfare, and auxiliary ships with various roles. Including all types and sizes, the PLA Navy currently operates more than 720 ships.[69]

Table 1: PLA Navy Orders-of-Battle, 2000–2020

Type	*2000*	*2005*	*2010*	*2014*	*2020*
Diesel Attack Submarines	60	51	54	51	59–64
Nuclear Attack Submarines	5	6	6	5	6–9
Nuclear Ballistic Missile Submarines	1	2	3	4	4–5

Table 1: PLA Navy Orders-of-Battle, 2000–2020—*Continued*

Type	***2000***	***2005***	***2010***	***2014***	***2020***
Aircraft Carriers	0	0	0	1	1–2
Destroyers	21	21	25	24	30–34
Frigates	37	43	49	63	83–97
Amphibious Ships	60	43	55	57	50–55
Coastal Patrol (Missile)	100	51	85	85	85
TOTAL	**284**	**217**	**277**	**290**	**318–351**

Note: "Frigates" refers to frigates, light frigates, and guided-missile frigates. The rapid construction of the JIANGDAO-class light frigate accounts for a large share of the anticipated sharp increase of total frigates in the PLA Navy from 2014 to 2020. Some sources classify China's JIANGDAO ship as a "corvette" rather than a light frigate.

Source: This chart reflects Commission estimates and judgments based on unclassified briefs by U.S. and foreign government officials, discussions with nongovernmental experts on China's military, consecutive versions of DoD's annual *Report to Congress on Military and Security Developments Involving the People's Republic of China*, and consecutive versions of the International Institute for Strategic Studies' *The Military Balance*.

Modern Submarines

Over the last 14 years, the PLA Navy has increased its inventory of modern nuclear and conventional submarines from one in 2000 to nearly 40 in 2014. China has at least seven classes of modern submarines in use, in production, or under development: SHANG SSN, YUAN SSP, SONG SS, KILO 636 SS, JIN SSBN, Type-096 SSBN, and Type-095 guided-missile, nuclear powered submarine (SSGN).

- The PLA Navy's SHANG SSN, YUAN SSP, and SONG SS are designed for antisurface warfare and ISR in the approaches to China's maritime periphery and likely will escort future nuclear deterrent patrols and aircraft carrier task groups. Initially equipped with the subsonic, medium-range YJ–82 antiship cruise missiles (20 nm),* the PLA Navy likely will install the advanced, long-range CH–SS–N–13 antiship cruise missile (120+ nm) on these three classes in the near term, if it has not already.[70] The upgraded SHANG SSN, YUAN SSP, and SONG SS will complement the PLA Navy's KILO 636 SS, which is equipped with the supersonic, long-range SS–N–27 antiship cruise missile (120 nm).
- By the end of 2014, the PLA Navy's JIN SSBN probably will conduct its first patrol while armed with the JL–2 submarine-launched ballistic missile (see "China's Offensive Missile Force" later in this section for more information). China also is developing its next-generation SSBN and submarine-launched ballistic missile, called the Type 096 SSBN and the JL–3, respectively. The new SSBN likely will feature improved stealth over its predecessor, the JIN, which is a very noisy submarine and could be vulnerable to U.S. and Japanese antisub-

* Throughout this section, the maximum range of cruise and ballistic missiles is indicated in parenthesis following the first reference of the missile.

marine capabilities. Additionally, the new submarine-launched ballistic missile probably will have a longer range and be more lethal than the JL–2.[71]

- China is pursuing a new class of nuclear attack submarines, the Type 095 SSGN. Although details of the program are unavailable in open sources, Mr. Karotkin testified to the Commission that the Type 095 may "provide a generational improvement in many areas such as quieting and weapon capacity" and carry the PLA Navy's first submarine-launched land-attack cruise missile.

Furthermore, China is pursuing joint-design and production of four to six Russian advanced diesel-electric attack submarines containing Russia's latest submarine sonar, propulsion, and quieting technology.[72] The deal would improve the PLA Navy's capabilities and assist China's development of quiet submarines, thus complicating future U.S. efforts to track and counter PLA Navy submarines.

China's expanding inventory of modern submarines has significantly enhanced China's ability to strike foreign surface ships, including those of the U.S. Navy, near major seas lines of communication in the Asia Pacific. According to William Murray, associate research professor at the U.S. Naval War College:

> *Beijing's ongoing investment in increasingly modern (and therefore progressively quiet) antiship-cruise-missile-firing diesel submarines reflects a determination to overwhelm and destroy surface ships operating within at least a hundred miles of shallow waters of [China's] near seas, including Taiwan. This distance is greatly extended and reinforced by the DF–21D [antiship ballistic missile] and by [antiship cruise missiles] launched from surface warships and . . . aircraft. PLA reliance on large numbers of antiship cruise missiles as a means of deterring and defeating opposing surface naval forces represents a significant challenge for a potential adversary, and it suggests specifically that the U.S. Navy's post-Cold War ability to conduct high-volume, uncontested, maritime strike operations from surface ships in the western Pacific has ended, at least temporarily.*[73]

Aircraft Carriers

China commissioned its first aircraft carrier, the *Liaoning*, in 2012 after approximately six years of renovation work on the Soviet-designed, Ukrainian-built hull and one year of sea trials, and is developing a carrier-based fighter aircraft, the J–15. At least six J–15 prototypes are being tested. China conducted the first test flight of the J–15 in 2009; the first takeoff from a land-based simulated ski jump in 2010; and the first take-offs and landings on the *Liaoning* in 2012. The J–15 had begun performing full-stops and take-offs with maximum weapon loads by September 2013.[74]

Although the *Liaoning* is an important symbol for the Chinese government, Chinese citizens, and regional observers of China's ever-increasing military power, the *Liaoning*'s military value currently is limited to humanitarian assistance/disaster relief, helicopter support to ground forces, antisubmarine warfare, airborne early warning, search and rescue, and presence operations. However, after China's first carrier-based aviation unit becomes operational, which is expected by 2016, the *Liaoning* could contribute significantly to the PLA's combat capabilities in the South China Sea, where the nation's airpower today is limited by the short ranges of China's fighter fleet (for more information on China's air combat range limitations, see "China's Air Forces" later in this section). In the South China Sea, China's aircraft carrier probably could quickly overwhelm potential adversaries such as the less capable naval and air forces of the Philippines and Vietnam. The *Liaoning* and its embarked aircraft likely would not represent much of an offensive strike threat against U.S. carrier strike groups operating in the South China Sea, though together they could conduct air defense and antisubmarine warfare in support of China's broader antiaccess/area denial operations against the United States.[75]

The *Liaoning* and its embarked aircraft also could provide China with a potent expeditionary force. During the carrier's first-ever long-distance training deployment in early 2014, it reportedly exercised with at least 12 other ships, including submarines and amphibious ships, suggesting China is experimenting with multiple types of future carrier formations, including those resembling U.S. combined expeditionary groups.[76]

China probably intends to follow the *Liaoning* with at least two and potentially as many as four indigenously-produced hulls[77] that will be larger than the *Liaoning*'s 60,000 tons and feature design and engine improvements. Construction of China's first indigenous carrier has yet to be observed; however, modern ship construction methods allow sections of a ship to be constructed inside buildings long before a full ship is laid down in the dock, making it difficult to corroborate China's progress in this area. If the first of these indigenous carriers began construction in 2013, as U.S. analysts widely reported, it could reach initial operational capability by 2020.[78] Regarding China's aircraft carrier construction, Admiral Jonathan Greenert (U.S. Navy), the U.S. Chief of Naval Operations, in July 2014 said China is "moving on a pace that is extraordinary."[79]

Modern Surface Combatants

Over the last 14 years, the PLA Navy more than tripled its inventory of modern destroyers and frigates, from less than 15 in 2000 to about 50 in 2014. China also continues to regularly upgrade legacy platforms with new weapon systems as they become available.

- The PLA Navy surface force has significantly enhanced its antisurface warfare capabilities since 2000 with the fielding of advanced long-range antiship cruise missiles and over-the-horizon targeting systems aboard the PLA Navy's newest destroyers and frigates. These antiship cruise missiles include the Russian SS–N–22 (130 nm) and the Chinese YJ–62 (150 nm), YJ–83 (95 nm), and YJ–8A (65 nm). China's newest destroyer, the LUYANG III, which is expected to enter the force by the end of 2014, will be fitted with a new vertically-launched, long-range antiship cruise missile.[80]

- Although naval air defense has historically been a weak area for the PLA Navy, its newest destroyers and frigates feature medium- or long-range surface-to-air missiles that enable PLA Navy ships to operate beyond land-based air defenses while still maintaining air defense coverage. These surface-to-air missiles include the Russian SA–N–20 (80 nm) and SA–N–7 (20 nm) and the Chinese HHQ–9 (55 nm) and HHQ–16 (40 nm). The new LUYANG III DDG will carry an extended-range variant of the HHQ–9 surface-to-air missile.[81]
- The PLA Navy does not have the ability to strike land targets with cruise missiles but likely will field its first sea-based land-attack cruise missile in the next five to ten years on the LUYANG III DDG and Type 095 SSGN. A future sea-based land-attack cruise missile, when combined with greater frequency of long-range combat readiness patrols, will complement the PLA's arsenal of other cruise and ballistic missiles, enhancing Beijing's flexibility for attacking land targets throughout the Asia Pacific, including U.S. facilities in Guam.[82]
- China appears to be developing a new cruiser, potentially called the Type 055, which reportedly would displace approximately 10,000 tons and carry large numbers of antiship cruise missiles, surface-to-air missiles, and land-attack cruise missiles as well as potentially laser and rail-gun weapons.[83]

The PLA Navy's expanding and modernizing fleet of combat ships has improved Beijing's ability to project power in the Taiwan Strait, the East China Sea, the South China Sea, and the Philippine Sea as well as to fulfill the PLA Navy's growing missions beyond the Asia Pacific, such as expeditionary warfare, defense of distant maritime trade routes, humanitarian assistance/disaster relief, and counterpiracy. Dr. Erickson explained the trajectory of the PLA Navy and its implications for the United States and the region:

> *While one of the world's largest, China's slightly-expanding surface fleet has grown far faster in quality. Chinese naval platforms display a growing multi-mission emphasis. Whereas previously antisurface warfare focus eclipsed competing priorities, now increasing emphasis is devoted to the over-the-horizon targeting necessary to support antisurface warfare, as well as to antiair warfare. China's latest destroyers and frigates, which its large, increasingly advanced shipbuilding industry is building steadily, boast significant area air defense capabilities. With a developing aircraft carrier program, the possibility of land-attack cruise missiles being deployed in surface vessel vertical launch systems in the near future, and deployment of larger amphibious vessels including YUZHAO-class landing platform docks and Zubr air-cushioned landing craft, the PLA Navy may be starting to develop a force capable of*

conducting strike operations ashore. As China's consolidating coast guard forces increasingly patrol disputed areas in the Yellow Sea, East China Sea, and South China Sea to advance China's claims there, PLA Navy ships are free to range further afield to bolster China's antiaccess/area denial envelope in the Western Pacific and expand its presence and influence in the Indian Ocean and beyond.[84]

As the PLA Navy has strengthened its long-range capability, it also has bolstered its shorter-range forces with the introduction of 60 HOUBEI-class guided-missile patrol boats (PTGs) from the mid- to late-2000s and the ongoing deliveries of JIANGDAO-class light frigates, which began in 2012.[85]

The HOUBEI PTG, equipped with eight long-range antiship cruise missiles and able to attain high speeds, has significant offensive potential against U.S. and allied forces operating within 200 nm of China's coast. John Patch, a U.S. intelligence analyst, explains the significant operational and tactical ramifications of the HOUBEI PTG for the U.S. Navy:

The HOUBEI PTG's size and partial stealth mean that the [U.S. Navy] may never locate with long-range sensors the firing platform . . . making prosecution by the [U.S. Navy's] surface-launched Harpoon [antiship cruise missile] difficult at best. . . . Air-launched Harpoons or aerial cueing may be solutions, but operating friendly aircraft or unmanned aerial systems within range of China's growing fourth-generation naval air defense raises the risks to these platforms. . . . Recent U.S. government assessments of the Littoral Combat Ship suggest that it too will not be up to the task of HOUBEI hunter-killer missions in high-threat waters.[86]

The JIANGDAO light frigate is armed with several naval guns, torpedoes, and four long-range antiship cruise missiles and is able to support helicopter operations. In contrast to the HOUBEI PTG, the JIANGDAO light frigate appears to be designed primarily for patrol, surveillance, and sovereignty protection in the East China Sea and the South China Sea rather than rapid offensive strike missions. China to date has built 14 JIANGDAO light frigates and is expected to field 15–25 more units. The integration of the JIANGDAO light frigate into the force will free the PLA Navy's larger, more capable surface combatants to focus on operations farther from the Chinese mainland.[87]

Replenishment Ships

The demands of the PLA Navy's expanding missions in distant seas—such as its Gulf of Aden counterpiracy deployments since 2009 and its search for missing Malaysia Airlines Flight 370 in 2014—have strained the capacity of the PLA Navy's logistics fleet, placing its small fleet of replenishment oilers on near-constant deployment status. To help improve the PLA Navy's ability to sustain high-tempo operations at longer ranges, China introduced two new oilers in 2013, bringing its total inventory of oilers to seven, and launched another in June 2014. There are indications China plans to build two additional oilers in the next one to two years and potentially more units later in the decade. Oilers are very easy for China to build; they can be completed (keel to commissioning) in 12 to 18 months.[88]

Amphibious Ships

Beginning in approximately 2006, the PLA Navy's amphibious acquisition shifted from small tank landing ships designed for a full-scale invasion of Taiwan toward larger multipurpose amphibious ships designed to provide the PLA Navy with greater flexibility in balancing its growing commitments to diverse missions. From 2007–2012, the PLA Navy commissioned three YUZHAO-class amphibious transport docks (LPD). China likely will build additional YUZHAO LPDs and may introduce a new landing helicopter assault ship, called the Type-081, in the next five years.[89]

The YUZHAO LPD can carry up to four YUYI hovercraft,* 20 amphibious armored vehicles, and 800 combat troops and at least four helicopters. Given the ship's size, range, and ability to support over-the-horizon operations using helicopters and hovercraft, it is well-suited for amphibious assaults against the islands and reefs in the South China Sea and Taiwan-controlled islands in the Taiwan Strait, as well search and rescue, humanitarian assistance/disaster relief, and counterpiracy. Furthermore, the YUZHAO's LPD's recent deployment to the Indian Ocean and amphibious assault training suggest the PLA Navy is developing operational concepts and proficiencies for expeditionary missions, such as amphibious raids, direct action operations, airfield and port seizures, and personnel and materiel seizure/recovery.

The PLA continues to increase the size, sophistication, and frequency of its amphibious training. China's amphibious force consists of the 1st Amphibious Mechanized Infantry Division and an amphibious armored brigade in the Nanjing Military Region, the 124th Amphibious Mechanized Infantry Division in the Guangzhou Military Region, and the 1st and 164th marine brigades in the South Sea Fleet.[90]

Maritime Law Enforcement Ships

China employs its maritime law enforcement ships to monitor, protest, and in some cases harass foreign vessels engaging in activities that it believes violate its maritime rights. Beijing almost certainly views this approach as less provocative than deploying its navy because it allows China to present the confrontation as a domestic law enforcement issue rather than a foreign defense issue requiring the military's intervention. Nevertheless, the PLA Navy still plays a role by backing up maritime law enforcement patrols from a distance; visibly training and transiting through disputed waters; and resupplying Chinese-controlled land features in the South China Sea.[91]

Prior to 2013, China had six chief Maritime Law Enforcement agencies, all with separate and sometimes overlapping missions.

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* The YUYI LCUA—similar in size to the U.S.-designed landing craft air cushion—can carry approximately 60 tons and has space for one main battle tank. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 10, 2014; IHS Aerospace, Defense, and Security, "Analysis: China's Expanding Amphibious Capabilities," October 2013.

China in June 2013 officially consolidated four of these six agencies into the new China Coast Guard* in an effort to address long-standing shortcomings in its coordination of maritime policy and to centralize control of China's maritime law enforcement operations.[92] The consolidation has allowed the China Coast Guard to more flexibly deploy patrol ships in response to perceived challenges to China's sovereignty and more easily patrol China's maritime claims.

Together, China's maritime law enforcement agencies operate over 100 ocean-going ships and over 1,000 patrol craft and smaller boats.[93] Some of these ships have light mounted-weapons but most are unarmed. However, all of them likely have a gun locker for personnel weapons. In some instances, newly constructed ships for the China Coast Guard have provisions for future fit of guns (for example, empty gun collars). According to Mr. Karotkin, future weapons, if installed, would be similar to other coast guards worldwide, including the U.S. and Japanese Coast Guards.

China's maritime law enforcement force, like the PLA Navy, is in the midst of a major modernization program and will expand significantly between now and 2020. Most of these units will be larger and more capable than previous ones, and some will have the ability to embark helicopters.[94]

U.S. Force Posture in Asia

In August 2014, U.S. Pacific Command (PACOM) reported it has approximately 360,000 personnel, including 140,000 assigned to the Navy; 86,000 assigned to the Marine Corps; 29,000 assigned to the Air Force; 60,000 assigned to the Army; 38,000 DoD civilians; and 1,200 Special Operations personnel. PACOM's order-of-battle includes 200 ships, 50 of which are forward-stationed or forward-deployed in the Asia Pacific while the remaining 150 are stationed in the Eastern Pacific (from the West Coast of North America to the International Date Line); 1,500 aircraft (including those from the U.S. Navy, U.S. Marine Corps, and U.S. Air Force); and two Marine Expeditionary Forces.[95]

The declared U.S. rebalance to Asia policy calls for increasing the forward presence of the U.S. Navy from about a 50/50 distribution between the Pacific and the Atlantic to a 60/40 distribution by 2020 and using these assets in new ways to enhance U.S. posture and partnerships. Under its submission to the President's Budget for Fiscal Year 2015, the U.S. Navy would increase its forward presence in the Asia Pacific from about 50 ships on average today to about 67 on average in 2020. The 2020 total includes an additional attack submarine in Guam, where three are stationed today. The U.S. Navy also plans to operate MQ–4C TRITON high endurance UAVs from Guam by 2018.[96]

* China's former six chief maritime law enforcement agencies were China Maritime Surveillance, Fisheries Law Enforcement Command, China Coast Guard, Maritime Customs Service, Maritime Safety Administration, and China Rescue and Salvage. China consolidated the assets of all but the Maritime Safety Administration and China Rescue and Salvage into the new China Coast Guard.

U.S. Force Posture in Asia—*Continued*

However, budget uncertainty could impact PACOM's planned upgrades to its force posture, presence, and readiness. In March 2014, PACOM Commander Admiral Locklear explained:

> *Budget uncertainty has hampered our readiness and complicated our ability to execute long-term plans and to efficiently use our resources. These uncertainties impact our people, as well as our equipment and infrastructure by reducing training and delaying needed investments. They ultimately reduce our readiness, our ability to respond to crisis and contingency as well as degrade our ability to reliably interact with our allies and partners in the region.*
>
> *. . . Due to continued budget uncertainty, we were forced to make difficult short-term choices and scale back or cancel valuable training exercises, negatively impacting both the multinational training needed to strengthen our alliances and build partner capacities as well as some unilateral training necessary to maintain our high-end warfighting capabilities. These budgetary uncertainties are also driving force management uncertainty. Current global force management resourcing, and the continuing demand to source deployed and ready forces from PACOM [area of responsibility] to other regions of the world, creates periods in PACOM where we lack adequate intelligence and reconnaissance capabilities as well as key response forces, ultimately degrading our deterrence posture and our ability to respond.*[97]

China's Air Forces

In the early 1990s, Beijing began a comprehensive modernization program to upgrade the PLA Air Force from a short-range, defensively-oriented force with limited capabilities into a modern, multirole force capable of projecting precision airpower beyond China's borders, conducting air and missile defense, and providing early warning and dynamic situational awareness. This program has focused on weapon system acquisition and integration, infrastructure upgrades, tactics development, and more recently, training improvements.

Combat Aircraft

The PLA Air Force has approximately 2,200 operational combat aircraft. This total includes air defense and multi-role fighters, ground attack aircraft, fighter-bombers, and bombers (see Table 2). Of these combat aircraft, 330–500 operate from permanent bases in the eastern half of China, allowing them to conduct operations in and around Taiwan without aerial refueling. Moreover, China—using its robust military, civilian, and reserve airfield network—could forward deploy hundreds of additional combat aircraft on short notice in a conflict scenario.[98]

Defining "Modern" Combat Aircraft

The definition of "modern" combat aircraft changes frequently as new technologies are proven and fielded. Combat aircraft can be characterized by their radar signatures, sensors, avionics, weapons, propulsion, controls, materials, and flight performance capabilities. Features and capabilities can be introduced piece-meal as an interim upgrade to an existing airframe, or via the rollout of an all new system.

In reference to China's combat aircraft, the term "modern" is used in this report to describe the following aircraft, all of which feature advanced avionics and weapon systems: J–10, J–11, JH–7, Su-27, and Su-30. If and when they are acquired by China, the J–15, J–20, J–31, and Su-35 will be added to this list.

Table 2: China's Combat Aircraft, 2000–2014

	2000	**2005**	**2010**	**2014**
Total (Approximate)	3,000	1,900	1,617	2,193
Modern (Approximate)	65	154	381	593
Percent Modern (Approximate)	2	8	24	27

Note and Source: Estimates of China's inventory of total combat aircraft, including modern and legacy aircraft in the PLA Air Force and PLA Navy, vary across sources. This chart uses data from consecutive versions of the International Institute for Strategic Studies' *The Military Balance*, which is the most demonstrably reliable and comprehensive source available.

Air Defense and Multi-role Fighters, Ground-Attack Aircraft, and Fighter-bombers: The PLA Air Force has approximately 2,100 air defense and multi-role fighters, ground attack aircraft, and fighter-bombers, including about 600 that are considered modern.

Complementing China's new modern combat aircraft are a diverse array of beyond-visual-range air-to-air missiles; all of China's fighters in 2000, with the potential exception of a few modified Su-27s, were limited to within-visual-range missiles. China over the last 15 years also has acquired a number of sophisticated short- and medium-range air-to-air missiles; precision-guided munitions including all-weather, satellite-guided bombs, antiradiation missiles, and laser-guided bombs; and long-range, advanced air-launched land-attack cruise missiles and antiship cruise missiles. Moreover, China has installed advanced electronic warfare systems on some its aircraft, improving their survivability and lethality and allowing them to jam or interfere with an adversary's communications.[99]

Comparing U.S. and Chinese trends in fighter modernization from 1995 to the present, David Shlapak, a senior policy analyst at the RAND Corporation, explains:

> *Now visualize a . . . meeting . . . in 1995. The U.S. pilot would most likely have been flying an F–15, F–16, or F/A–18—a sophisticated "fourth generation" fighter featuring*

cutting-edge radar and avionics, as well as advanced "fire and forget" air-to-air missiles. The PLA Air Force pilot, on the other hand, most likely would . . . be flying a J–6, armed with a Chinese copy of a Soviet copy of a first-generation, short-range U.S. air-to-air missile. The U.S. pilot would have enjoyed an overwhelming qualitative advantage in aircraft, electronics, and weapons. Advance 20 years to the present day. The United States would most likely be represented by the same F–15 equipped with somewhat updated versions of the same sensors, avionics, and missiles. The PLA Air Force, meanwhile, could meet it with a J–10 or J–11, both modern fighters comparable in performance to the fourth-generation U.S. jets. The Chinese pilot would likewise have at its disposal weapons and other equipment that reflect rough parity with those found on the typical U.S. fighter.[100]

With the J–10, J–11, Su-27, and Su-30, China likely would be able to sustain air combat operations along the Taiwan Strait and over the Senkaku Islands, even in the face of U.S. intervention. During a conflict with Japan or Taiwan, China's quantitative advantages over those countries, combined with the proximity of China's air bases to the prospective war zones, would allow for a short logistics chain, high sortie rates, and extensive aircraft availability and help to facilitate integrated air defense and command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR). Furthermore, the upgraded JH–7 attack aircraft, introduced in the mid-2000s, provides China with potent air intercept and maritime strike capabilities. During a conflict, this platform would allow China to protect its territorial airspace and coastal airspace as well as attack foreign surface forces operating throughout much of the first island chain.

Nevertheless, most of China's fighter and attack aircraft lack the combat range to conduct air operations in the Philippine Sea and the southern reaches of the South China Sea. Until the PLA Navy's first carrier-based aviation wing becomes operational, China must use air refueling tankers to enable air operations at these distances from China. However, China's current fleet of air refueling aircraft, which consists of only about 12 1950s-era H–6U tankers, is too small to support sustained, large-scale, long-distance air combat.[101] Furthermore, the H–6U tanker has a limited capacity to hold transferable fuel, China has inadequate support infrastructure on the ground, and most of China's fighters do not have the equipment necessary to refuel in the air.[102]

To augment its H–6U tankers, China purchased as many as 10 IL–78 tankers from Russia in the mid-2000s. Production issues have prevented Russia from delivering any of the IL–78 tankers to date. Some indications, however, suggest deliveries could begin by the end of 2014. Furthermore, China reportedly acquired a small number of tankers from Ukraine in 2013–2014[103] and may build a large number of new tankers using the Y–20 transport aircraft's airframe when it becomes available (for more information on the Y–20, see "Strategic Airlift" later in this section).[104]

Over the next five years, China is expected to continue to develop and modernize its fleet of fighter and attack aircraft with variants of its existing platforms. China also is on track to introduce two fifth-generation fighters, the J–20 and the smaller J–31. China's fifth-generation fighters probably will have low visibility, high maneuverability, and large internal weapons bays and feature advanced sensors, radars, and datalinks. The J–20 and J–31 are expected to reach initial operational capability between 2017–2019.

- China continues to produce variants of the J–10 and J–11 fighters. Future aircraft may feature the more powerful Chinese WS–10A turbofan engine, new radars, new cruise missiles, and design modifications. Among the J–11 variants in production, the J–16 is the most notable because it could have significantly improved range, payload capacity, and maneuverability compared to China's current inventory. China likely will initially use the J–16 to augment the JH–7 and Su-30 in the PLA Air Force and PLA Navy. Depending on its performance and the status of other aircraft programs, the J–16 may eventually replace these fighters.[105]

- The PLA Air Force conducted the first test flight of the J–20 in January 2011 and continues to build and test prototypes of the aircraft. The third and fourth prototypes, which flew in March and July 2014, respectively, feature a number of important design modifications, suggesting China continues to improve its stealth technology.[106] The J–20 fighters will be more advanced than any other fighter currently deployed by Asia Pacific countries, adding to China's military leverage against Taiwan, Japan, and South China Sea counterclaimants. Furthermore, according to Mr. Shlapak, the J–20 "will confront the U.S. military with, in effect, the dilemma that the U.S. Air Force has for 20 years been imposing on adversaries—how to defend against low-observable aircraft." [107]

- China conducted the first flight test of the J–31 in October 2012 and may have as many as three prototypes in production.* The J–31's intended use remains unknown to foreign observers. A PLA Navy official in 2013 claimed the aircraft is designed for export to China's friends and allies that are unable to purchase the F–35; however, another PLA Navy official in 2013 said the J–31 will serve as the basis for China's next-generation carrier-based aircraft.[108] China also could field the smaller stealth fighter to complement the J–20.

Furthermore, China appears to be in the final stages of purchasing Russian Su-35 fighter aircraft. The Su-35 is a versatile, highly capable aircraft that would offer significantly improved range and fuel capacity over China's current fighters. The aircraft thus would strengthen China's ability to conduct air superiority missions in the Taiwan Strait, East China Sea, and South China

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*The J–31 appears to share similarities to Lockheed Martin's F–35 and F–22 fighters. Credible reporting indicates Chinese cyber operators stole data on the design, performance, and other characteristics of the F–35 from the Western defense firms. Trefor Moss, "China's Stealth Attack on the F–35," *Diplomat*, September 27, 2012. *http://thediplomat.com/2012/09/the-fake-35-chinas-new-stealth-fighter/*; Australian, "Security Experts Admit China Stole Fighter Jet Plans," March 12, 2012. *http://www.theaustralian.com.au/news/world/security-experts-admit-china-stole-secret-fighter-jet-plans/story-fnb64oi6-1226296400154?nk=d041d43ecbce5fdb831ea5201b29dee9#*.

Sea as well as provide China with the opportunity to reverse engineer the fighter's component parts, including its advanced radar and engines, for integration into China's current and future indigenous fighters.[109]

Bombers: China operates approximately 100 bombers, more than any other country in the world except for the United States and Russia. The current inventory is comprised of multiple variants of the H–6 bomber. China gained the newest and most capable version, the H–6K, in 2013. The H–6K has improved survivability over China's existing bomber fleet and can carry China's new long-range land-attack cruise missile, the CJ–20. The H–6K/CJ–20 weapon system provides the PLA Air Force with the ability to strike Guam, which previously had been out of its range.[110] Although the CJ–20 land-attack cruise missile appears to be designed primarily for conventional strikes, the U.S. Air Force Global Strike Command claims it can carry a nuclear warhead.[111]

China's current bomber fleet gives it the ability to hold at risk targets on Taiwan, Japan, Vietnam, and the Philippines, as well as U.S. forces in Japan, South Korea, and Guam. However, China's paucity of air refueling tankers and their limited capacity to offload fuel (discussed previously in this section) could require China's bombers to conduct long-range strike missions without fighter escorts, potentially decreasing their effectiveness in some regional strike missions. Moreover, China's bombers, all of which are derived from a 1950s-era Soviet air-frame, probably require frequent maintenance and have low engine life expectancies. China is developing a new long-range stealth bomber that could address these issues and strengthen the PLA Air Force's ability to project power regionally.[112] According to Richard Fisher, senior fellow at the International Assessment and Strategy Center, "Many Chinese sources note [Xian Aircraft Corporation's] new bomber will be a 'flying wing' design similar to the U.S. Northrop-Grumman B–2 Spirit bomber. Xian's design effort has benefited from espionage, especially from the disclosures made by former Northrop engineer Noshir Gawadia." [113] Furthermore, China and Russia are discussing the joint development of an advanced bomber, according to a Russian official quoted in Taiwan media.[114]

Strategic Airlift

In January 2013, China conducted the first test flight of its indigenously-built jet cargo aircraft, designated the Y–20. China previously was unable to build heavy transports so has relied on 10–15 Russian IL–76 aircraft for strategic airlift since the 1990s.

Aircraft specifications provided by official Chinese media indicate the Y–20 can carry 66 tons, about twice the cargo load of the PLA's only operational jet cargo aircraft, the IL–76, and three times the cargo load of the U.S. C–130. Such a cargo capacity would allow the Y–20 to deploy China's heaviest armored vehicle, the Type 99A2 main battle tank, or about 90 paratroopers. Although the Y–20 currently is powered by Russian D–30KP–2 engines, China ultimately plans to replace these with a Chinese engine, potentially the WS–20, which could feature better fuel efficiency and thrust-to-weight ratio.[115] If and when the Y–20 is mated with a Chinese engine, the airframe could become the basis for a new generation of support planes for the PLA for missions such as air refueling, airborne early warning, command and control, and electronic warfare.[116]

China probably will operationally deploy its first Y–20 transports within the next two years. A report by China's National Defense University published in 2014 recommends that the PLA build 400 Y–20s.[117] Such a large fleet of Y–20s would significantly improve the PLA Air Force's ability to mount and sustain large-scale air operations. In particular, the Y–20 will enhance the PLA's ability to rapidly move cargo, troops, and heavy equipment to Taiwan during an invasion; to China's far western territories for a conflict against India or internal stability operations; and to offshore locations, such as Hainan Island. The Y–20 also will provide PLA commanders with increased flexibility during international peacekeeping and humanitarian assistance operations.[118]

C4ISR Aircraft

China is developing and fielding a variety of dedicated C4ISR aircraft to provide high-fidelity and time-sensitive tracking for China's air and maritime forces. Lacking airborne early warning and control (AEW&C) aircraft in 2000, the PLA Air Force today deploys 12 of them, split between two models: the KJ–2000 and the KJ–200. The KJ–2000, which China uses primarily for long-range C4ISR operations, "employs radar technology two generations ahead of that used by the U.S. Air Force's E–3C [aircraft]," according to Dr. Carlo Kopp, an Australia-based military analyst and editor of *Air Power Australia*.[119] China's smaller KJ–200 complements the KJ–2000 by performing shorter-range C4ISR operations. Dr. Kopp assesses the KJ–200's technology is "two generations ahead of the mechanically steered technology used by the United States."[120] China likely will continue to steadily field additional KJ–2000 and the KJ–200, potentially doubling its force of AEW&C aircraft over the next five years.

In addition to its two dedicated AEW&C platforms, China over the past decade has fielded more than a dozen specialized C4ISR aircraft, most of which are based on the Y–8. Notably, China recently began to develop a Y–8 variant for antisubmarine warfare.[121] China's current inventory of only a few large, fixed-wing antisubmarine warfare aircraft—the cornerstone of open-ocean antisubmarine warfare for other leading world navies, including the United States and Japan—prevents China from fully realizing the potential of its growing inventory of modern surface combatants and could limit the PLA Navy's ability to conduct antiaccess/area denial operations.

The PLA also is steadily incorporating UAVs into its air forces to supplement manned C4ISR aircraft. Strategic reconnaissance UAVs—such as the BZK–005, deployed in 2010—are designed for long-duration C4ISR at extended distances from the Chinese mainland, allowing them to provide over-the-horizon targeting for the PLA's long-range antiship cruise missiles and antiship ballistic missiles. In particular, they could be useful for detecting, locating, and tracking high-value fixed and mobile targets—such as U.S. and

Japanese naval ships—throughout the East China Sea, northern portions of the South China Sea, and the Philippine Sea. UAVs like the BZK–005 probably will become some of China's most valuable ISR assets in managing maritime disputes and asserting maritime claims. The BZK–005 reportedly conducted its first ISR mission over the East China Sea in September 2013.[122] According to Mr. Fisher, "Given their low cost, about $1 million for a UAV the size of the BZK–005, China could soon inundate Japan's ADIZ with UAVs that might overwhelm [Japan's air forces]." [123]

China also is developing smaller, tactical reconnaissance UAVs designed to provide ISR on fixed and mobile targets on Taiwan and in the Taiwan Strait and to test operational concepts for UAV use. Depending on their basing and range, some of these UAVs also could conduct ISR in portions of the East China Sea and South China Sea.[124]

Land-Based Air Defense

Previously comprised mostly of variants of the 1950s-era SA–2 surface-to-air system, the PLA Air Force's air defense capabilities have significantly improved since 2000. China now has one of the most robust air defense forces in the world.[125]

China in the mid-2000s fielded several new types of indigenous surface-to-air missiles to augment the advanced, long-range surface-to-air missiles it purchased from Russia in the mid-1990s. China's surface-to-air missile systems—which are concentrated along the Taiwan Strait and China's southeastern coast—include the Chinese HQ–9 (124 miles) and the Russian SA–10 (56+ miles), SA–20A (93 miles), and SA–20B (124 miles). China has at least eight and potentially up to 16 SA–20B battalions. The SA–20B is the most advanced surface-to-air missile system sold by Russia.[126] Complementing the purchase and development of these new systems are improvements in China's national air defense network, which since 2007 has spanned the entire country. Together, these improvements enable the PLA Air Force to extend air defense coverage over the Taiwan Strait and northeastern Taiwan and provide overlapping, integrated air defenses for important Chinese military, industrial, and population centers.[127]

In 2014, Russia approved in principle the sale of its next-generation surface-to-air missile system, the S–400, to China, according to Russian media reports. Such a sale has been under negotiation since at least 2012.[128] The S–400 would more than double the range of China's air defenses from approximately 125 to 250 miles—enough to cover all of Taiwan, the Senkaku Islands, and parts of the South China Sea [129]—and feature an improved ballistic missile defense capability over China's existing surface-to-air missile systems.[130] As China pursues the S–400, it also is developing its next-generation indigenous surface-to-air missile, the HQ–19, which likely will have features and range similar to the S–400.[131]

China's Offensive Missile Force

Since the mid-1990s, China's offensive missile force—the Second Artillery—has added significant conventional strike capabilities; previously, the force had been comprised of only nuclear ballistic missiles. During this period, the Second Artillery has developed and fielded a robust and modern short-range ballistic missile force. The force also has introduced conventional medium-range ballistic missiles, intermediate-range ballistic missiles, antiship ballistic missiles, and ground-launched land-attack cruise missiles designed to counter key aspects of U.S. military power. Meanwhile, China has gradually modernized and expanded its nuclear strike capability by deploying its first road-mobile intercontinental ballistic missiles and its first credible sea-based nuclear deterrent capability.[132]

According to DoD, the Second Artillery has at least 1,330 and potentially more than 1,895 ballistic and cruise missiles, which includes 1,000–1,200 short-range ballistic missiles, 75–100 medium-range ballistic missiles, 5–20 intermediate-range ballistic missiles, 50–75 intercontinental ballistic missiles, and 200–500 ground-launched land-attack cruise missiles.[133] A more precise estimate of the number of missiles in the Second Artillery's inventory is hindered by DoD's omission of detailed missile orders-of-battle in its annual report to Congress on China. According to Hans Kristensen, director of the Nuclear Information Project at the Federation of American Scientists, "Up until 2010, the annual DoD reports included a table overview of the composition of the Chinese missile force. But the overview gradually became less specific until it was completely removed from the reports in 2013. The policy undercuts the Administration's position that China should be more transparent about its military modernization by indirectly assisting Chinese government secrecy."[134]

Conventional Strike

Short-Range Ballistic Missiles (less than 621 miles): In 2002, China had 350 short-range ballistic missiles. After a rapid expansion, China today has the world's largest short-range ballistic missile force, with 1,000–1,200 missiles. The force also has become more lethal as China has gradually replaced older missiles lacking a true precision-strike capability with new short-range ballistic missiles and variants of existing short-range ballistic missiles that feature longer ranges and improved accuracies and payloads.[135]

China's short-range ballistic missile force consists mainly of multiple variants of the DF–11 and DF–15. All of these missiles are solid-propelled and road-mobile; most variants have a maximum range of more than 373 miles, allowing them to strike targets throughout Taiwan.[136] Moreover, the Second Artillery in 2010–2011 fielded a new short-range ballistic missile, the DF–16. The DF–16 reportedly has a higher reentry velocity than the DF–11 and DF–15 and an extended range of 621 miles. In addition to increasing China's ability to penetrate Taiwan's missile defenses, the DF–16 for the first time allows the Second Artillery to target large sections of the East China Sea with short-range ballistic missiles.[137]

China also is developing several new road-mobile short-range ballistic missiles: the CSS–9, the CSS–14, the CSS–X–15, and the

CSS–X–16.* These missiles have maximum ranges of between 93–174 miles [138] and presumably feature greater accuracy and precision than previous models. According to Mr. Fisher, "China's development of new classes of short-range ballistic missiles is prompted by the requirement to strengthen its ability to coerce or attack Taiwan, but also by commercial pressures to offer better short-range ballistic missiles to capture export markets. Short-range ballistic missiles are produced at two, possibly three Chinese factories, and it is Chinese government policy to promote vigorous competition between them and to support export efforts." [139]

During a conflict with Taiwan, China likely would use its short-range ballistic missiles to strike critical military infrastructure and command and control nodes as well as key political and economic centers. Chinese military doctrine suggests the Second Artillery would fire large salvos from multiple axes to confuse, overwhelm, and exhaust Taiwan's ballistic missile defenses. The Second Artillery has been conducting increasingly larger missile exercises; to date, its live-fire exercises have included salvoes of at least ten missiles.[140] Mr. Murray testified to the Commission that China's expanding and modernizing missile force could rapidly defeat Taiwan's defenses, despite Taipei's significant investments in ballistic missile defenses.

Theater-Range Ballistic Missiles (621 miles to 3,418 miles): † In 2008, the PLA fielded its first conventional theater-range ballistic missile, the DF–21C medium-range ballistic missile. With a range of more than 1,087 miles, the DF–21C gives China the ability to target U.S. forces in Japan and South Korea. China also may have deployed a second conventional medium-range ballistic missile in 2010–2011: a DF–16 variant with a maximum range of 746 miles.[141]

China plans to deploy a new conventional intermediate-range ballistic missile that can strike land targets out to at least 1,864 miles and potentially as far as 3,418 miles.[142] This missile, which probably will be operationally deployed in the next five years, could allow China to threaten U.S. forces in Guam, Northern Australia, and Alaska, and U.S. bases in the Middle East and the Indian Ocean, depending on its ultimate range. Moreover, according to Ian Easton, research fellow at the Project 2049 Institute, "If the PLA's conventional intermediate-range ballistic missile program is successful, it is possible that China could develop the means to threaten Hawaii and the West Coast of the United States with a conventional intermediate-range ballistic missile by sometime in the early-to-mid 2020s." [143]

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* These are the NATO designators provided by the U.S. National Air and Space Intelligence Center; the Chinese designators for these short-range ballistic missiles are unknown to foreign observers at this time.

† Theater-range ballistic missiles are comprised of medium-range ballistic missiles (621–1,864 miles) and intermediate-range ballistic missiles (1,864–3,418 miles).

Table 3: China's Conventional Ballistic Missiles

Chinese Designator and Missile Type	NATO Designator	Deployment Mode	Approximate Maximum Range (Miles)
DF-11 SRBM	CSS-7 Mod 1	Road Mobile	186
DF-11A SRBM	CSS-7 Mod 2	Road Mobile	373
DF-15 SRBM	CSS-6 Mod 1	Road Mobile	373
DF-15A SRBM	CSS-6 Mod 2	Road Mobile	528+
DF-15B SRBM	CSS-6 Mod 3	Road Mobile	450+
DF-16 SRBM	CSS-11 Mod 1	Road Mobile	621
DF-16 MRBM	Unknown	Road Mobile	746
DF-21C MRBM	CSS-5 Mod 3	Road Mobile	1,087+
DF-21D ASBM	CSS-5 Mod 5	Road Mobile	932+

Sources: Commission judgments and estimates based on analysis by nongovernmental experts on China's military, consecutive versions of the annual U.S. DoD *Report to Congress on Military and Security Developments Involving the People's Republic of China,* a 2013 report by the U.S. National Air and Space Intelligence Center, and U.S. and Asian media reporting.

Antiship Ballistic Missiles: In 2010, China deployed the world's first antiship ballistic missile, the DF–21D. The DF–21D has a maximum range of more than 932 miles and is armed with a maneuverable warhead, providing China with the ability to threaten U.S. Navy aircraft carriers operating east of Taiwan from secure sites on the Chinese mainland. China may be developing an even longer-range antiship ballistic missile capable of striking ships operating in maritime areas as far as Guam.[144] The Second Artillery appears to have already formed two antiship ballistic missile brigades—not testing or training units—in Qingyuan City (southeastern China)[145] and Laiwu City (northeastern China).[146] The antiship ballistic missile brigade in Qingyuan reportedly conducted one of its first major field training exercise in spring 2011.[147]

Ground-Launched Land-Attack Cruise Missiles: In 2007–2008, the Second Artillery introduced its first ground-launched land-attack cruise missile, the CJ–10. China's large inventory of CJ–10s—200–500 missiles deployed on 40–55 road-mobile launchers[148]—suggests the missile plays a central role in China's regional strike strategy. The CJ–10 reportedly features a stealthy design and has a maximum range over 932 miles, giving the PLA the ability to hold at risk U.S. forces in Japan and South Korea.[149] Although it appears to be primarily intended for conventional missions, a 2013 NASIC report suggests the missile also could carry a nuclear warhead.[150] Mr. Fuell explained the potential utility of China's emerging land-attack cruise missile capabilities to the Commission:

> *Combining long stand-off distances with high accuracy makes cruise missiles an excellent tool to reach targets difficult to engage with many other classes of weapons. Because there is an overlap in the kinds of targets China is likely to engage with either ballistic missiles or cruise mis-*

siles, land-attack cruise missiles provide key operational and planning flexibility. These weapons are likely to reduce the burden on ballistic missile forces, as well as creating somewhat safer strike opportunities for Chinese aircrew, allowing them to engage from much longer distances and/or from advantageous locations of their own choosing. This in turn will complicate their adversary's air and missile defense problem. Combining cruise missiles with ballistic missile attacks on the same target further complicates the defensive problem. Fundamentally, land-attack cruise missiles are yet another component of China's complex arsenal, and could be used as a flexible tool for engaging a range of targets.

Nuclear Strike

China's official pronouncements about its nuclear policies and strategies are short, rare, and vague. For example, China's 2012 Defense White Paper only says that "if China comes under a nuclear threat, the nuclear missile force will act upon the orders of the Central Military Commission, go into a higher level of readiness, and get ready for a nuclear counterattack to deter the enemy from using nuclear weapons against China."[151] Previous defense white papers and other official Chinese statements convey that "China consistently upholds the policy of no first use of nuclear weapons, adheres to a self-defensive nuclear strategy, and will never enter into a nuclear arms race with any other country." However, China's so-called "no first use" policy is subject to interpretation, and some doctrinal evidence suggests exceptions to the policy exist. For example, according to a Second Artillery doctrinal publication, "under our predetermined nuclear guidelines, in general cases China would retaliate only after being hit first."[152] The text does not explain under which circumstances China would conduct a first strike. Other PLA writings suggest China might deem an enemy first strike to have occurred when Beijing believes an enemy nuclear attack is imminent or judges an enemy is threatening the destruction of China's nuclear deterrent capability with conventional weapons.[153] For planning purposes, Chinese strategists consider the United States as the principal threat.[154]

High-confidence assessments of the numbers of Chinese nuclear-capable ballistic missiles and nuclear warheads are not possible due to China's lack of transparency about its nuclear program. China's official statements about its nuclear forces and nuclear capabilities are short, rare, and vague in order to maintain "strategic ambiguity."

DoD has not released detailed information on China's nuclear program, only noting in 2013 that "China's nuclear arsenal currently consists of approximately 50–75 intercontinental ballistic missiles,"[155] and that "the number of Chinese intercontinental ballistic missile nuclear warheads capable of reaching the United States could expand to well over 100 within the next 15 years."[156] DoD also has not provided an unclassified estimate of China's nuclear warhead stockpile since 2006, when the Defense Intelligence Agency said China had more than 100 nuclear warheads.[157] Estimates of China's nuclear forces by nongovernmental experts and foreign governments tend to be higher. Dr. Kristensen and Robert Norris, senior fellow for nuclear policy at the Federation of American Scientists, assess "China has approximately 250 [nuclear] warheads in its stockpile for delivery by nearly 150 land-based ballistic missiles, aircraft, and an emerging ballistic submarine fleet,"[158] while Taiwan's Ministry of National Defense asserts China has "over 200 nuclear warheads."[159] Some analysts assess China may be obscuring a much larger nuclear effort and have much larger stockpiles.*

Despite the uncertainty surrounding China's stockpiles of nuclear missiles and nuclear warheads, it is clear China's nuclear forces over the next three to five years will expand considerably and become more lethal and survivable with the fielding of additional road-mobile nuclear missiles; as many as five JIN SSBNs, each of which can carry 12 JL–2 submarine-launched ballistic missiles; and intercontinental ballistic missiles armed with multiple independently targetable reentry vehicles (MIRVs) (for an overview of China's nuclear ballistic missiles, deployment modes, and maximum ranges, see Table 4). At the same time, China likely will continue to improve its silo-based nuclear force; harden its nuclear storage facilities, launch sites, and transportation networks; and expand its already extensive network of underground facilities.[160]

Table 4: China's Nuclear Ballistic Missiles

Chinese Designator and Missile Type	NATO Designator	Deployment Mode	Approximate Maximum Range (Miles)
DF–3A IRBM	CSS–2	Transportable	1,864
DF–4 ICBM	CSS–3	Transportable	3,418+
DF–5A ICBM	CSS–4 Mod 2	Silo	8,078+
DF–5B ICBM	CSS–4 Mod 3	Silo	8,078+
DF–21 MRBM	CSS–5 Mod 1	Road Mobile	1,087+
DF–21A MRBM	CSS–5 Mod 2	Road Mobile	1,087+
DF–31 ICBM	CSS–10 Mod 1	Road Mobile	4,474+
DF–31A ICBM	CSS–10 Mod 2	Road Mobile	6,959+
JL–1 SLBM	CSS–NX–3	SSBN	1,056
JL–2 SLBM	CSS–NX–14	SSBN	4,598+

Note: China likely is in the process of phasing out the DF–3A IRBM.

Source: Commission judgments and estimates based on analysis by nongovernmental experts on China's military, consecutive versions of the annual U.S. DoD *Report to Congress on Military and Security Developments Involving the People's Republic of China*, a 2013 report by the U.S. National Air and Space Intelligence Center, and U.S. and Asian media reporting.

* For example, Georgetown University professor Phillip Karber has suggested China may have 3,000 or more nuclear weapons. This assertion apparently follows from extrapolations of historical Western reports and analysis of the elaborate underground tunnel complexes China uses for nuclear weapons storage and transportation. These methods have received criticism from other arms control experts and scholars, who place greater emphasis on suspected nuclear materials stockpiles and delivery systems.

Road-Mobile Nuclear-Capable Ballistic Missiles: China deployed the DF–31 intercontinental ballistic missiles in 2006 and the more advanced DF–31A intercontinental ballistic missiles in 2007. China apparently has ceased production of the DF–31 but continues to field additional DF–31As.[161] Unlike the rest of the Second Artillery's intercontinental ballistic missile force, the DF–31 and DF–31A are road mobile, allowing for faster launch times and making them much more difficult for an adversary to locate and attack. Furthermore, the new missiles use solid fuel instead of liquid fuel, increasing portability and service life while reducing maintenance costs. The DF–31A has a maximum range of at least 6,959 miles, allowing it to target most of the continental United States.[162]

Sea-Based Nuclear Deterrent: China has commissioned three JIN SSBNs since 2007 and likely will introduce two additional units by 2020.[163] The JIN SSBN's intended weapon, the JL–2 submarine-launched ballistic missile, appears to have reached initial operational capability [164] after approximately ten years of R&D, giving China its first credible sea-based nuclear deterrent.* The JL–2's range of approximately 4,598 miles gives China the ability to conduct nuclear strikes against Alaska if launched from waters near China; against Alaska and Hawaii if launched from waters south of Japan; against Alaska, Hawaii, and the western portion of the continental United States if launched from waters west of Hawaii; and against all 50 U.S. states if launched from waters east of Hawaii.[165]

A November 2013 article in a Chinese newspaper sponsored by the CCP hails the arrival of China's JIN SSBN and JL–2 submarine-launched ballistic missile and illustrates a notional employment scenario against the United States:

> *After a nuclear missile strikes a city, the radioactive dust produced by 20 warheads will be spread by the wind, forming a contaminated area for thousands of kilometers. The survival probability for people outdoors in a [746 to 870 mile] radius is basically zero. Based on the actual level of China's one million tons TNT equivalent small nuclear warhead technology, the 12 JL–2 nuclear missiles carried by one JIN nuclear submarine could cause the destruction of five million to 12 million people, forming a very clear deterrent effect. There is not a dense population in the United States' midwest region, so to increase the destructive effect, the main soft targets for nuclear destruction in the United States will be the main cities on the west coast, such as Seattle, Los Angeles, San Francisco, and San Diego.*[166]

The same article includes a graphic depicting the potential destructive effect of a Chinese intercontinental ballistic missile attack on Los Angeles (see Figure 5). The graphic evokes then Lieutenant General Xiong Guangkai's assertion to Chas Freeman, a former

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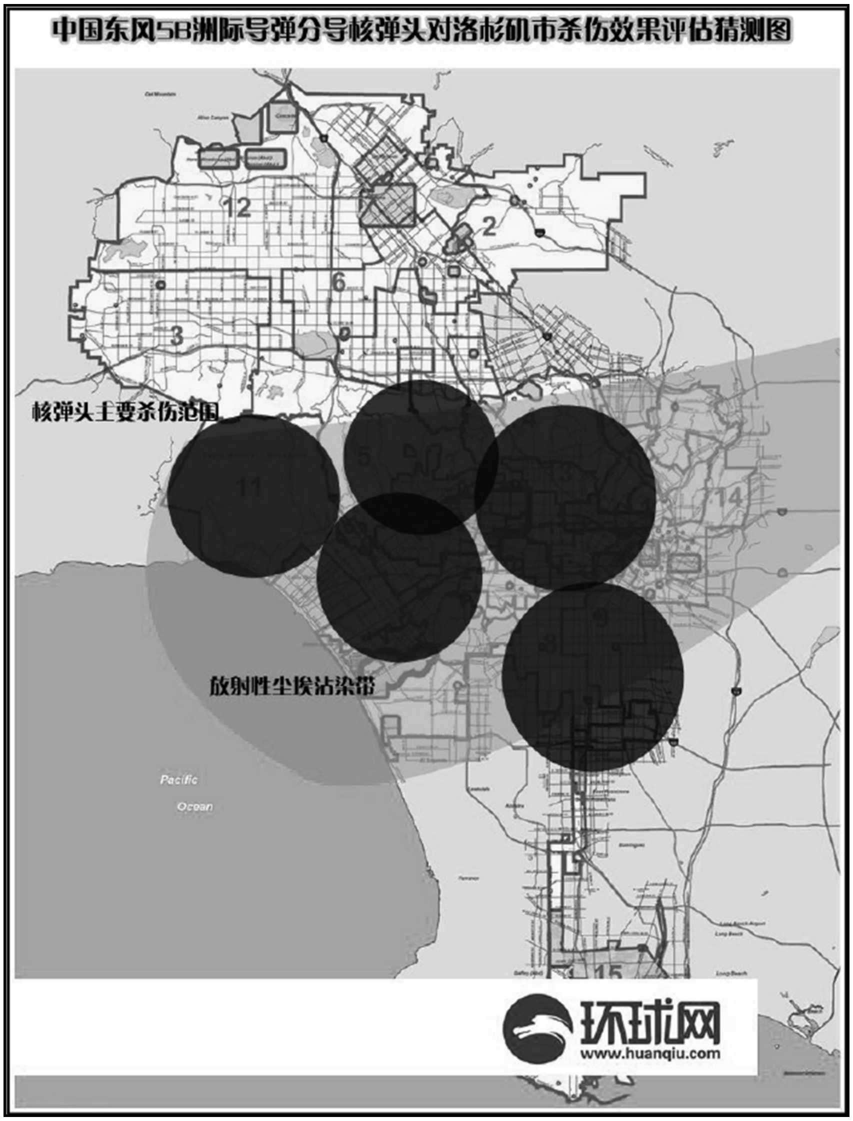
*The PLA Navy has operated one SSBN/SLBM weapon system with the XIA-class SSBN and the JL–1 SLBM since the late 1980s; however, the U.S. Department of Defense does not consider it to be a credible threat. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 6; U.S. Office of Naval Intelligence, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics*, 2009, p. 23.

U.S. assistant secretary of defense, that "Americans care more about Los Angeles than they do about Taiwan" during the Taiwan Strait Crisis in 1995–1996. Lieutenant General Xiong, who at the time was a deputy chief in the PLA office that is responsible for intelligence and international matters, was suggesting China could use its intercontinental ballistic missile force to target the United States for intervening on behalf of Taiwan in a cross-Strait conflict.[167]

MIRVs: In December 2013, China reportedly conducted the second flight test of a new road-mobile intercontinental ballistic missile, the DF–41. The DF–41, which could be deployed as early as 2015, may carry up to 10 MIRVs and have a maximum range as far as 7,456 miles, allowing it to target the entire continental United States.[168] In addition, some sources claim China has modified the DF–5 and the DF–31A to be able to carry MIRVs.[169] Moreover, China in late September reportedly conducted the first flight test of a new DF-31 variant, the DF-31B, which may be able to carry MIRVs.[170] China could use MIRVs to deliver nuclear warheads on major U.S. cities and military facilities as a means of overwhelming U.S. ballistic missile defenses. Mr. Fuell testified to the Commission:

> *Mobile missiles carrying MIRVs are intended to ensure the viability of China's strategic deterrence. MIRVs provide operational flexibility that a single warhead does not. Specifically, they enable more efficient targeting, allowing more targets to be hit with fewer missiles, more missiles to be employed per target, or a larger reserve of weapons held against contingency. China is likely to employ a blend of these three as MIRVs become available, simultaneously increasing their ability to engage desired targets while holding a greater number of weapons in reserve.*

Figure 5: Chinese Media Depiction of the Potential Destructive Effect of a MIRV-Capable Intercontinental Ballistic Missile on Los Angeles



Source: Pei Shen, "China Has Undersea Strategic Nuclear Deterrent against United States for the First Time," *Global Times*, October 13, 2013. Open Source Center translation. ID: CHR2013100762536387.

China's Space and Counterspace Programs

Expanding Space-Based C4ISR Capabilities

The PLA in the mid-1990s began an extensive C4ISR modernization program to improve its ability to command and control its forces; monitor global events and track regional military activities;

and increase the range at which it can place U.S. ships, aircraft, and bases at risk with conventional missile systems. Mr. Karotkin explained to the Commission the "formidable challenge" for China of building and disseminating a picture of all air and maritime activities in the Asia Pacific:

China must build a maritime and air picture covering nearly 875,000 square nautical miles (sqnm). The Philippine Sea, which could become a key interdiction area in a regional conflict, expands the battlespace by another 1.5 million sqnm. In this vast space, many navies and coast guards converge along with tens of thousands of fishing boats, cargo ships, oil tankers, and other commercial vessels.

China's initial efforts focused on developing a robust and secure network of fiber optic cables, mobile radios, datalinks, and microwave systems. However, China in the mid-2000s shifted the emphasis of its C4ISR modernization program to expanding and enhancing its space-based infrastructure. China now has approximately 100 active satellites in orbit,* compared to about 10 in 2000 and 35 in 2008.† Although these satellites conduct a wide array of missions, many serve C4ISR functions for the PLA, and those satellites that are capable of contributing to a military mission likely do so.[171]

Maritime ISR: China is fielding increasingly sophisticated space-based electro-optical, synthetic aperture radar, and electronic reconnaissance satellites. Combining these varying capabilities is crucial, as satellite instruments face tradeoffs in achieving high resolution in spatial, spectral, radiometric, and temporal categories.

China's current maritime ISR satellite coverage likely is concentrated in the first island chain to support PLA operations in potential conflicts against Taiwan, Japan, or South China Sea counterclaimants but almost certainly will expand to the Philippine Sea and Indian Ocean in the next five to ten years as China fields additional ISR and data relay satellites. Mr. Stokes explained the implications of this development to the Commission:

As its persistent sensor and command and control architecture increases in sophistication and range, the PLA's ability to hold at risk an expanding number of targets throughout the western Pacific Ocean, South China Sea, and elsewhere around its periphery is expected to grow. A survivable space-based sensor architecture, able to transmit reconnaissance data to ground sites in China in near-real time, fa-

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* This number excludes Chinese satellites that are in orbit but assessed to no longer be active. Including those that are both active and inactive, China has 146 satellites in orbit. Jonathan McDowell, "China Satellite Update: 2014," *Jonathan's Space Report*, June 2014. *http://planet4589.org/space/papers/china2014.pdf*; Jonathan McDowell (Astrophysicist, Harvard-Smithsonian Center for Astrophysics), e-mail interview with Commission staff, June 15, 2014.

† For comparison, the United States has between 500 to 550 active satellites in orbit and Russia has approximately 130 active satellites in orbit. Jonathan McDowell, "China Satellite Update: 2014," *Jonathan's Space Report*, June 2014. *http://planet4589.org/space/papers/china2014.pdf*; Jonathan McDowell (Astrophysicist, Harvard-Smithsonian Center for Astrophysics), e-mail interview with Commission staff, June 15, 2014; and Union of Concerned Scientists, "UCS Satellite Database." *http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html*.

cilitates the PLA's ability to project firepower at greater distances and with growing lethality and speed.

China's most important space-based ISR asset is the Yaogan series of advanced electro-optical, synthetic aperture radar, and electronic reconnaissance satellites. Although purportedly civilian in mission, the technical and orbital characteristics of the Yaogan series suggest it is intended to provide overlapping, near-persistent, medium-resolution ISR of military targets,[172] such as U.S. carrier strike groups, as far as China's second island chain.[173] China to date has launched at least 26 Yaogan satellites, including some that form a constellation similar to the U.S. Navy's state-of-the-art electronic intelligence satellite system, the Naval Ocean Surveillance System.[174] China's Shijian series and Gaofen series of satellites also probably play vital roles in the PLA's ISR infrastructure. The Gaofen series, which was launched in 2013 and ultimately is expected to consist of five to seven satellites, features China's first high-resolution satellites.[175]

Regional Satellite Navigation: In December 2012, China's Beidou regional satellite navigation system became fully operational. Using 16 satellites and a network of ground stations, Beidou provides subscribers, including the PLA, with 24-hour regional precision, navigation, and timing services as well as a short messaging service for messages up to 120 characters. The system thus gives China's military an operational alternative to foreign navigation systems, such as Global Positioning System (GPS), for the first time. According to official Chinese press, the PLA already is using Beidou extensively during exercises to track its forces and communicate. Additionally, the availability of Beidou would allow China to attack an adversary's access to GPS or other foreign systems without disrupting the PLA's own capabilities. Beijing plans to expand Beidou to provide global coverage by 2020.[176]

Data Relay: In July 2012, China launched a Tianlian data relay satellite into orbit, completing China's first global data relay satellite constellation.[177] As China fields more relay-capable ISR satellites, the Tianlian constellation will enhance the accuracy and timeliness of the PLA's ISR by reducing the time the PLA must wait before receiving intelligence data.[178] Without a data relay system, Chinese satellites must wait until they orbit into view of China before sending ISR information, potentially causing a time lag and thus reducing the PLA's ability to collect time-sensitive intelligence on mobile targets.

Space-Launch Capabilities

China continues to expand and improve its ability to launch civil, military, and commercial satellites, despite enduring technological deficiencies in China's industrial base. China conducted 52 known space launches from 2011–2013, only three less than the United States during this period (see Table 5).[179] China likely will expand its space-based C4ISR architecture with the launch of approximately 35–50 additional satellites through 2015.[180] This growth will be facilitated by planned improvements to China's ground-based space infrastructure and launch vehicles.

Table 5: Chinese versus U.S. Space Launches, 2011–2013

	2011	*2012*	*2013*
Chinese Launches (Satellites Deployed)	19 (18)	19 (25)	14 (17)
U.S. Launches (Satellites Deployed)	19 (38)	16 (31)	20 (82)

Source: Jonathan McDowell, "China Satellite Update: 2014," *Jonathan's Space Report*, June 2014. *http://planet4589.org/space/papers/china2014.pdf*; Jonathan McDowell (Astrophysicist, Harvard-Smithsonian Center for Astrophysics), e-mail interview with Commission staff, June 15, 2014.

Ground-Based Infrastructure: Space operations require a substantial terrestrial footprint, including launch, telemetry, control, and tracking. China has three dedicated launch sites (Jiuquan, Xichang, and Taiyuan) and plans to open a new space launch facility in Hainan Island, in the southernmost province of China, by the end of 2014.[181] This site likely was chosen for its proximity to seaports, the open ocean, and the equator. China also continues to build telemetry, control, and tracking facilities across the nation. Furthermore, because domestic tracking stations are unable to track satellites and manned space vessels around the world, China operates at least three space-tracking naval ships in the Pacific and Indian Oceans (under PLA control) and has established at least five overseas tracking stations in Namibia, Pakistan, Chile, Kenya, and most recently, Australia.[182]

Launch Vehicles: China's next-generation LM–5 space launch vehicle may conduct its first flight as early as 2015 if China's space industry is able to overcome challenges to building the vehicle. Once operational, the rocket will more than double the size of payloads China can send into geosynchronous orbit,[183] allowing it to launch more advanced C4ISR satellites, modules of China's planned space station, and potentially reusable orbital vehicles.

Furthermore, in September 2013, China launched a satellite using a new solid-fueled orbital launch vehicle called the "Kuaizhou." China also is developing a second solid-fueled launch vehicle, the LM–11, which China is expected to test launch by as early as the end of 2014. Solid-fueled rockets lack the payload capacity of liquid-fueled rockets but are cheaper, simpler to operate, transportable, and can be released with less preparation. Although Chinese media have highlighted the use of these launch vehicles in "natural disaster monitoring," China likely is developing the Kuaizhou and LM–11 to put microsatellites * into orbit on short notice. Such a capability would allow the PLA to rapidly replace or augment its satellites in the event of any disruption in coverage during a conflict.[184]

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* In 2000, China began to launch microsatellites. Although their small size often limits their capabilities, microsatellites are significantly cheaper and easier to develop than larger satellites that serve similar functions. Microsatellites also have lower observable signatures than larger satellites, making them harder for an adversary to track in space. Mark Stokes and Dean Cheng, *China's Evolving Space Capabilities: Implications for U.S. Interests* (Project 2049 Institute, April 26, 2012), pp. 37–39. *http://project2049.net/documents/uscc_china-space-program-report_april-2012.pdf*.

Pursuing a Multifaceted Counterspace Program

The PLA is pursuing a broad counterspace program to challenge U.S. information superiority in a conflict and disrupt or destroy U.S. satellites if necessary. Beijing also likely calculates its growing space warfare capabilities will enhance its strategic deterrent as well as allow China to coerce the United States and other countries into not interfering with China militarily.[185]

- In July 2013, China launched a LM–4C rocket carrying three satellites, one of which is equipped with a robotic arm for grabbing or capturing items in space.[186] Once in orbit, one of the satellites fired onboard thrusters to adjust its speed and trajectory, and then it passed near two other Chinese satellites in static orbit.[187] Although publicly available information is insufficient to definitely assess the nature of this event, the movement of the satellite and the potential involvement of a satellite equipped with a robotic arm suggest China may have been testing a new space-based counterspace weapon designed to attack satellites in orbit. Co-orbital antisatellite (ASAT) systems can employ multiple attack methods, such as grabbing, damaging, or colliding with another satellite, or jamming or disrupting a target satellite's communication, guidance, or electrical systems.[188]

- In May 2013, China fired a rocket into nearly geosynchronous Earth orbit, marking the highest known suborbital launch since the U.S. Gravity Probe A in 1976 and China's highest known suborbital launch to date. Beijing claims the launch was part of a high-altitude scientific experiment; however, available data suggest China was testing the launch vehicle component of a new high-altitude ASAT capability. If true, such a test would signal China's intent to develop an ASAT capability to target satellites in an altitude range that includes GPS and many U.S. military and intelligence satellites.[189]

- In 2011, China's unpiloted Shenzhou 8 spacecraft and Tiangong-1 orbiting space lab completed the country's first- and second-ever dockings in orbit. China followed with its first- and second-ever piloted dockings in 2012 and a more advanced piloted docking in 2013.[190] These dockings are significant achievements that will facilitate proximity operations critical for future manned space missions and contribute to the development of ASAT and other military technologies.

- In 2010 and 2013, China carried out its first and second land-based missile intercept tests.[191] These tests have not been definitively tied to China's ASAT program but probably were designed to help China assess the performance of homing technologies that it could use to target satellites in low Earth orbit.[192] In July 2014, official U.S. and Chinese sources confirmed China conducted its third land-based missile intercept test. In a statement to *Space News,* a U.S. Department of State spokesperson said, "We call on China to refrain from destabilizing actions—such as the continued development and testing of destructive anti-satellite systems—that threaten the long term security and sustainability of the outer space environment, on which all nations depend."[193]

- In January 2007, China destroyed an aging Chinese weather satellite with an ASAT kinetic kill vehicle, demonstrating China's ability to put at risk satellites in low Earth orbit, such as remote sensing satellites. The impact produced vast amounts of orbital debris, generating worldwide criticism and threatening NASA and international space activities in low Earth orbit.[194]
- China likely has developed ground-based satellite communications jammers, which the PLA could potentially employ to degrade or deny U.S. access to some satellite communications and GPS within line of sight of China.[195]
- Chinese military doctrine and the integration of cyber operations, electronic warfare, and counterspace reflected in certain Chinese military organizations and research programs suggest the PLA would attempt to conduct computer network attacks against ground-based facilities that interact with U.S. satellite systems.[196]

In January 2014, Ashley Tellis, senior associate at the Carnegie Endowment for International Peace, assessed the implications of China's counterspace program for the House Armed Services Subcommittee on Strategic Forces and the Subcommittee on Seapower and Projection Forces:

> *The immensity of the burdens associated with securing this information dominance in an era when all U.S. ISR, communications, and other combat support systems will be under persistent attack—even if they are not physically destroyed—cannot be underestimated. Even if Beijing eschews kinetic attacks on U.S. space systems and their ground segments in the early phases of a Chinese counterspace campaign, U.S. military forces will have to apply enormous effort toward: defeating Chinese deception and denial operations; mitigating the Chinese jamming of all critical U.S. space systems to include the Global Positioning System constellation and its terrestrial receivers, space-based synthetic aperture radars, major satellite communication systems, and the links that ensure the effectiveness of the electro-optical and infrared surveillance systems; protecting all satellites from laser dazzling and damage; and, warding off cyber attacks on the space control networks and eventually against the space systems themselves. Thus, even if kinetic attacks against satellites and their ground segments by direct-ascent, co-orbital, nuclear and missile weapons, and special forces are excluded from consideration, the challenges confronting the U.S. military in regard to sustaining the information dominance it has traditionally enjoyed—in the face of current and prospective Chinese counterspace capabilities—will be enormous. Furthermore, given that kinetic counterspace attacks cannot be ruled out at any point in the event of a conflict, the U.S. military will have to simply prepare for all eventualities, irrespective of what Chi-*

nese space warfare theorists contend is either plausible or desirable.

The United States is eminently capable of dealing with the threats posed by Chinese counterspace investments through both defensive and offensive counterspace responses of its own, but these will necessarily require significant financial resources if they are to be successfully brought to fruition. . . . Suffice it to say that because protecting U.S. information dominance is vital not only to securing success in war but also to procuring that victory at the lowest cost in terms of lives and effort expended, both the administration and the Congress should not stint in funding all the mitigation efforts required to defeat China's counterspace initiatives—the term "defeat" in this context understood as enabling the U.S. military to successfully complete its missions despite opposition.[197]

Later in 2014, General William Shelton (U.S. Air Force), Commander, U.S. Air Force Space Command testified to the Senate Armed Services Subcommittee on Strategic Forces that due to China's investment in counterspace technologies, among other factors, the United States is at a "strategic crossroad in space." He explained:

In space, our sustained mission success integrating these [satellite] capabilities into our military operations has encouraged potential adversaries to further develop counterspace technologies and attempt to exploit our systems and information. . . . We are so dependent on space these days. We plug into it like a utility. It is always there. Nobody worries about it. . . . You do not even know sometimes that you are touching space. So [to lose U.S. space capabilities] it would be almost a reversion back to . . . industrial-based warfare.[198]

Implications for the United States

China's rapid military modernization is altering the military balance of power in the Asia Pacific in ways that could engender destabilizing security competition between other major nearby countries, such as Japan and India, and exacerbate regional hotspots such as Taiwan, the Korean Peninsula, the East China Sea, and the South China Sea.

Moreover, China's growing antiaccess/area denial capabilities increasingly will challenge the ability of the United States to deter regional conflicts, defend longtime regional allies and partners, and maintain open and secure access to the air and maritime commons in the Asia Pacific. While the United States currently has the world's most capable navy, its surface firepower is concentrated in aircraft carrier task forces. China is pursuing a missile-centric strategy with the purpose of holding U.S. aircraft carriers at high risk if they operate in China's near seas and thereby hinder their access to those waters in the event of a crisis. Given China's growing navy and the U.S. Navy's planned decline in the size of its fleet, the balance of power and presence in the region is shifting in China's direction. By 2020, China could have as many as 351 submarines and missile-equipped surface ships in the Asia Pacific. By comparison, the U.S. Navy, budget permitting, plans to have 67 submarines and surface ships stationed in or forward deployed to region in 2020, a modest increase from 50 in 2014. Furthermore, Frank Kendall, undersecretary of defense for acquisition, technology, and logistics, testified to the House Armed Services Committee in January 2014 that concerning "technological superiority, DoD is being challenged in ways that I have not seen for decades, particularly in the Asia Pacific region. . . . Technological superiority is not assured and we cannot be complacent about our posture." [199] Evan Braden Montgomery, senior fellow at the Center for Strategic and Budgetary Assessments, adds that "because the United States has grown accustomed to opponents that are too weak to seriously threaten its overseas bases, air and naval forces, and information networks, a confrontation with [China] would represent a major departure from the types of conflicts it has fought and prepared for during the unipolar era." [200]

The United States would need to quickly and safely deploy military forces across great distances during a regional conflict.* This "tyranny of distance" would pose significant challenges to U.S. logistics and C4ISR, potentially exacerbating any U.S. capability and technology gaps. China's large-scale cyber campaign against the United States † could further impede U.S. wartime operations in the Asia Pacific. The Senate Armed Services Committee released a report in September 2014 that provides evidence China is conducting a cyber campaign against the networks of key U.S. Transportation Command contractors.[201] The nature of this activity and PLA writings suggest the goal of these peacetime cyber intrusions is to enable the PLA during wartime to disrupt U.S. networks, including satellite networks, that support the mobilization and movement of U.S. forces toward China and that link forward-deployed U.S. forces with rear-area command and logistics units.[202] The Commission in its 2011 Annual Report highlighted this potential vulnerability when it recommended that "relevant Congressional committees investigate the adequacy of security for the Department of Defense's logistics data system, the time-phased force deployment data system, to ensure that the data therin are secure from cyberattack." [203]

Growing Chinese confidence in the PLA's expanding capabilities also increases the risk China's leaders will seek to compensate for declining economic growth and rising social unrest by encouraging and relying on popular nationalism. Promoting a sense of grievance among the Chinese people and creating diversionary tensions in the region would carry real risks of escalation and create the potential for the United States to be drawn into a regional conflict.

Perhaps of even greater concern is the increasing number of opportunities Beijing will have to provoke incidents at sea and in the air that could lead to a crisis or conflict as China's maritime and air forces expand their operations beyond China's immediate pe-

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* For context, Taiwan is about 7,000 miles from San Diego.

† For more information on China's cyber operations against the United States, see "China's Cyber Activities" (Chapter 2, Section 2) in the Commission's 2013 Annual Report, and "China's Cyber Activities" (Chapter 2, Section 2) in the Commission's 2012 Annual Report.

riphery. China already has initiated dangerous encounters at sea on several occasions. In December 2013, a U.S. Navy ship was forced to maneuver to avoid a collision with a PLA Navy ship that had intentionally stopped in front of it. Both ships were operating in international waters. Later in 2014, a China Coast Guard ship rammed a Vietnamese coast guard ship following China's placement of a state-owned deep-sea drilling platform inside Vietnam's exclusive economic zone, and a Chinese fighter flew within 30 feet of a U.S. Navy reconnaissance aircraft in international airspace. DoD characterized the latter incident as a "very, very close, very dangerous" intercept that "posed a risk to the safety and well-being of the [U.S.] air crew and was inconsistent with customary international law." [204]

Regarding crisis management, regional crisis stability mechanisms remain underdeveloped (including U.S.-China mechanisms), and Beijing remains hesitant to invest substantively in mechanisms for incidents at sea and in the air. Although U.S.-China military-to-military ties have increased somewhat during the last two years, Beijing has been reluctant to engage in substantive military diplomacy with the United States.

Based on (1) the changing balance of military power, (2) the continued strength of regional and Chinese nationalism, (3) increasing Chinese assertiveness in the Asia Pacific, and (4) the relatively nascent state of crisis stability mechanisms, the potential for security miscalculation in the region is rising. Regarding conventional deterrence and the regional military balance, U.S. and Chinese analysts likely hold differing beliefs about how a military conflict would conclude and which side would be victorious. As highlighted by RAND's Lloyd Thrall:

> *Great power warfare, particularly in the air and sea domains, remains rare, and its operational underpinnings are both highly technical and highly secretive. It is therefore unsurprising that the history of great power warfare is fraught with strategic and operational surprise. In practice, confidently calculating the balance of power is a difficult and contingent science; we should acknowledge that the perceptions of military capability and national will underpinning conventional deterrence are likely to differ. As suggested by Pearl Harbor, it is possible for either side to confidently reach wrong conclusions.*[205]

Fundamental U.S. interests are at stake in the evolving geopolitical situation in East Asia and the Western Pacific. China's rise as a major military power in the Asia Pacific challenges decades of air and naval dominance by the United States in a region in which Washington has substantial economic and security interests.

Conclusions

- As a result of China's comprehensive and rapid military modernization, the regional balance of power between China, on the one hand, and the United States and its allies and associates on the other, is shifting in China's direction.

- China's accelerated military modernization program has been enabled by China's rapid economic growth; reliable and generous increases to the People's Liberation Army's (PLA's) budget; gradual improvements to China's defense industrial base; and China's acquisition and assimilation of foreign technologies—especially from Russia, Europe, and the United States—through both purchase and theft.
- Since 2000, China has significantly upgraded the quality of its air and maritime forces as well as expanded the types of platforms it operates. Together with the fielding of robust command, control, communications, computers, intelligence, surveillance and reconnaissance capabilities, these improvements have increased China's ability to challenge the United States and its allies and partners for air and maritime superiority in the Asia Pacific. China's power projection capability will grow rapidly between now and 2020 with the addition of up to approximately 60 new submarines and surface ships; China's first carrier-based aviation wing and second aircraft carrier; and 600 new modern combat aircraft, including China's first fifth-generation fighters.
- After over a decade of research, development, and production, many of China's regional strike capabilities have matured. China's ballistic and cruise missiles have the potential to provide the PLA with a decisive military advantage in the event of a regional conflict and are contributing to a growing imbalance in the regional security dynamic. China now is able to threaten U.S. bases and operating areas throughout the Asia Pacific, including those that it previously could not reach with conventional weapons, such as U.S. forces on Guam.
- China's nuclear force will rapidly expand and modernize over the next five years, providing Beijing with a more extensive range of military and foreign policy options and potentially weakening U.S. extended deterrence, particularly with respect to Japan.
- China is becoming one of the world's preeminent space powers after decades of high prioritization and steady investment from Chinese leaders, indigenous research and development, and a significant effort to acquire and assimilate foreign technologies, especially from the United States. Qualitatively, China now produces near-state-of-the-art space systems for certain applications, such as intelligence, surveillance, and reconnaissance satellites to support China's long-range cruise missiles. Quantitatively, China's numerous active programs continue to increase its inventory of satellites and other space assets.
- Based on the number and diversity of China's existing and developmental counterspace capabilities, China likely will be able to hold at risk U.S. national security satellites in every orbital regime in the next five to ten years.
- Fundamental U.S. interests are at stake in the evolving geopolitical situation in East Asia and the Western Pacific. China's rise as a major military power in the Asia Pacific challenges decades of air and naval dominance by the United States in a region

in which Washington has substantial economic and security interests.

ENDNOTES FOR SECTION 2

1. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 41; Andrew Erickson, "China's Modernization of Its Naval and Air Power Capabilities," in Ashley J. Tellis and Travis Tanner, eds., *Strategic Asia 2012–13: China's Military Challenge* (Seattle, WA, and Washington, DC: National Bureau of Asia Research, 2012), pp. 63–67; Michael McDevitt, "The PLA Navy's Antiaccess Role in a Taiwan Contingency," in Phillip Saunders et al., eds., *The Chinese Navy: Expanding Capabilities, Evolving Roles* (Washington, DC: National Defense University Press, 2011), pp. 191–214; and Roger Cliff et al., *Entering the Dragon's Lair: Chinese Antiaccess Strategies and Their Implications for the United States* (Santa Monica, CA: RAND, 2007), pp. 3–12.

2. M. Taylor Fravel, "Economic Growth, Regime Insecurity, and Military Strategy: Explaining the Rise of Noncombat Operations in China," *Asian Security* 7:3 (2011): 177–200; U.S.-China Economic and Security Review Commission, *Hearing on China's Military and Security Activities Abroad*, written testimony of Daniel Hartnett, March 4, 2009; James Mulvenon, "Chairman Hu and the PLA's 'New Historic Missions,'" *China Leadership Monitor* (January 2009). *http://www.hoover.org/publications/china-leadership-monitor/3564*; and Open Source Center, *Analysis: China—Media Highlight Noncombat Missions to Address Nontraditional Threats*, October 16, 2008. ID: FEA20081017785345.

3. Commission estimates and judgments are based on the following sources: U.S. Office of Naval Intelligence analysts, unclassified discussion with Commission staff, Washington, DC, April 2014; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States,* written testimony of Jesse Karotkin, January 30, 2014; Japan Maritime Self Defense Force, *Japan's National Security Faced with Challenges and Problems to Maritime Order in East Asia,* unclassified briefing to the U.S.-China Economic and Security Review Commission, Washington, DC, November 2013; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013,* May 2013, p. 39; U.S. naval intelligence data reproduced in Hans Kristensen, "Chinese Nuclear Developments Described (and Omitted) by DOD Report," *FAS Strategic Security Blog,* May 13, 2013. *http://blogs.fas.org/security/2013/05/china2013/*; U.S. Seventh Fleet, unclassified briefing to the U.S.-China Economic and Security Review Commission, Yokosuka, Japan, July 2013; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2011,* 2011, p. 15.

4. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; James Fanell, "WEST 2014: What about China?" (San Diego, CA, February 11–13, 2014); Lou Qingyun and Zhou Yancheng, "Always Keeping Taut the Bowstring of Fighting War—A Report from the Enhancement of Combat Power by a Certain Submarine Flotilla of the South Sea Fleet," *People's Navy*, December 16, 2013. Open Source Center translation. ID: CHL2014021850956262; and *Modern Ships*, "The Problems That China Needs to Solve to Beat the United States," July 1, 2013. Open Source Center translation. ID: CHR2013090447001392.

5. James Fanell, "WEST 2014: What about China?" (San Diego, CA, February 11–13, 2014).

6. Guo Renjie, "Chinese Navy Wraps Up Escort Mission for Syria's Chemical Weapons," *China Military Online,* June 25, 2014. *http://eng.chinamil.com.cn/news-channels/china-military-news/2014-06/25/content_6010867.htm*; Andrew Erickson and Austin Strange, "China and the Far Seas," *Diplomat,* January 10, 2014. *http://thediplomat.com/2014/01/china-and-the-far-seas/*.

7. Open Source Center, *PRC 2010 Military Training Stresses Joint Operations in Complex Conditions,* February 17, 2011. ID: CPF20110216638001; David Fulghum, "China's Fighters Train in Turkey," *Aviation Week,* October 10, 2014. *http://awin.aviationweek.com/portals/awin/cmsfiles/media/pdf/as_pdf/2010/10/04/asd_10_04_2010.pdf*.

8. Kenneth Allen and Emma Kelly, *Assessing the Growing PLA Air Force Foreign Relations Program* (Jamestown Foundation, August 26, 2012). *http://www.jamestown.org/single/?no_cache=1&tx_ttnews[tt_news]=39304#.U_zFuWOK0pc*; Roger McDermott, China Showcases Expeditionary Military Power in Peace Mission 2010 (Jamestown Foundation, September 28, 2010). *http://www.jamestown.org/single/?tx_ttnews[tt_news]=36955&no_cache=1#.U_zGNWOK0pc.*

9. Michael Chase, *The PLA Prepares for Future Non-Combatant Evacuation Operations* (Jamestown Foundation, February 15, 2013). *http://www.jamestown.org/single/?tx_ttnews[tt_news]=40463%no_cache=1#.VAB62GOK0pc*; U.S.-China Eco-

nomic and Security Review Commission, *2011 Annual Report to Congress*, November 2011, pp. 162–163; and Andrew Erickson and Gabe Collins, *Implications of China's Military Evacuation of Citizens from Libya* (Jamestown Foundation, March 10, 2011). *http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews[tt_news]=37633%cHash=7278cfd21e6fb19afe8a823c5cf88f07#.U_zC9mOK0pc*.

10. Craig Murray, *China to Deploy "Security Force" to UN Peacekeeping Operation in Mali* (U.S.-China Economic and Security Review Commission, July 9, 2013). *http://www.uscc.gov/sites/default/files/Research/Backgrounder_China%20to%20Deploy%20Security%20Force%20to%20UN%20Peacekeeping%20Operation%20in%20Mali_0.pdf*.

11. Nicholas Bariyo, "China Deploys Troops in South Sudan to Defend Oil Fields, Workers," *Wall Street Journal,* September 9, 2014. *http://online.wsj.com/articles/china-deploys-troops-in-south-sudan-to-defend-oil-fields-workers-1410275041*;
Colum Lynch, "UN Peacekeepers to Protect China's Oil Interests in South Sudan," *Foreign Policy*, June 16, 2014. *http://thecable.foreignpolicy.com/posts/2014/06/15/un_peacekeepers_to_protect_chinas_oil_interests_in_south_sudan*.

12. Craig Murray, Caitlin Campbell, and Kimberly Hsu, *China's Navy Extends its Combat Reach to the Indian Ocean* (U.S.-China Economic and Security Review Commission, March 14, 2014). *http://origin.www.uscc.gov/sites/default/files/Research/Staff%20Report_China%27s%20Navy%20Extends%20its%20Combat%20Reach%20to%20the%20Indian%20Ocean.pdf*.

13. Sandeep Unnithan, "Exclusive: Indian Navy Headless as Chinese Nuclear Sub Prowls Indian Ocean," *India Today*, March 21, 2014. *http://indiatoday.intoday.in/story/indian-navy-chinese-nuclear-sub-indian-ocean/1/350498.html*; Senate Arms Services Committee, *Defense Intelligence Agency Annual Threat Assessment*, written statement of Michael Flynn, February 11, 2014. p. 28. *http://www.armed-services.senate.gov/imo/media/doc/Flynn_02-11-14.pdf*.

14. Commission judgments based on the following sources: RAND Corporation analysts, unclassified discussion with Commission staff, Washington, DC, June 8, 2014; David Cohen, *China Examines Military Strategy* (Jamestown Foundation, February 7, 2014). *http://www.jamestown.org/regions/chinaasiapacific/single/?tx_ttnews[pointer]=3%tx_ttnews[tt_news]=41932%tx_ttnews[backPid]=664%cHash=6d22d936c56c37fba96e3732d5eec079#.U5b2lSh5ZhR*; and M. Taylor Fravel and Dennis Blasko, "Xi Jinping and the PLA," *Diplomat*, March 19, 2013. *http://thediplomat.com/2013/03/xi-jinping-and-the-pla/*.

15. U.S.-China Economic and Security Review Commission, *2013 Annual Report to Congress*, November 2013, pp. 209–10.

16. Jane Perlez and Chris Buckley, "China's Leaders, Seeking to Build its Muscle, Pushes Overhaul of the Military," *New York Times*, May 24, 2014. *http://www.nytimes.com/2014/05/25/world/asia/chinas-leader-seeking-to-build-its-muscle-pushes-overhaul-of-the-military.html?_r=0*.

17. Bi Mingxin, ed., "Xi Jinping Calls for Powerful Missile Force," *Xinhua* (English edition), December 5, 2012. *http://news.xinhuanet.com/english/china/2012-12/05/c_132021964.htm*.

18. Michael Chase, *The Second Artillery Force in the Xi Jinping Era* (Jamestown Foundation, March 28, 2013). *http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews%5Btt_news%5D=40662&tx_ttnews%5BbackPid%5D=688&no_cache=1#.VCVspkvtV-I*.

19. Jeremy Page, "China Raises Defense Spending 12.2% for 2014," *Wall Street Journal*, March 5, 2014. *http://online.wsj.com/news/articles/SB10001424052702304732804579421021045941010*; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Andrew Erickson, January 30, 2014; and Adam Liff and Andrew Erickson, "Demystifying China's Defense Spending: Less Mysterious in the Aggregate," *China Quarterly* (December 2013): 4–5.

20. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 43.

21. Sam Perlo-Freeman and Carina Solmirano, *Trends in World Military Expenditure, 2013* (Stockholm International Peace Research Institute, April 2014): p. 2. *http://books.sipri.org/product_info?c_product_id=476#*.

22. Adam Liff (Postdoctoral Fellow, Princeton University's Woodrow Wilson School and Assistant Professor, Indiana University), e-mail interview with Commission staff, May 27, 2014; Andrew Erickson and Adam Liff, "The Budget This Time: Taking the Measure of China's Defense Spending," *Asan Forum* 2:2 (March-April 2014). *http://www.theasanforum.org/the-budget-this-time-taking-the-measure-of-chinas-defense-spending/*; and Adam Liff and Andrew Erickson, "Demystifying China's Defense Spending: Less Mysterious in the Aggregate," *China Quarterly* (December 2013).

23. Henry Hendrix, *At What Cost a Carrier?* (Center for a New American Security, March 2013), p. 10.

24. Adam Liff (Postdoctoral Fellow, Princeton University's Woodrow Wilson School and Assistant Professor, Indiana University), e-mail interview with Commission staff, May 27, 2014; Andrew Erickson and Adam Liff, "The Budget This Time: Taking the Measure of China's Defense Spending," *Asan Forum* 2:2 (March-April 2014). *http://www.theasanforum.org/the-budget-this-time-taking-the-measure-of-chinas-defense-spending/*; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Andrew Erickson, January 30, 2014; and Andrew Erickson and Adam Liff, "China's Military Development, Beyond the Numbers," *Diplomat*, March 12, 2013. *http://thediplomat.com/2013/03/chinas-military-development-beyond-the-numbers/?allpages=yes*.

25. Adam Liff and Andrew Erickson, "Demystifying China's Defense Spending: Less Mysterious in the Aggregate," *China Quarterly* (December 2013): 21.

26. Tai Ming Cheung, *The Current State of Defense Innovation in China and Future Prospects* (University of California Institute on Global Conflict and Cooperation, January 2014), p. 1. *http://igcc.ucsd.edu/assets/001/505243.pdf*.

27. Gabe Collins (Co-Founder, *China SignPost*), e-mail interview with Commission staff, June 26, 2014; Gabe Collins, "China Has Become a Top Global Warship Builder" in Tai Ming Cheung, ed., *The Chinese Defense Economy Takes Off: Sector-by-Sector Assessments and the Role of Military End-Users* (San Diego, CA: University of California Institute on Global Conflict and Cooperation, January 2014), p. 40.

28. Gabe Collins (Co-Founder, *China SignPost*), e-mail interview with Commission staff, June 26, 2014; U.S. Office of Naval Intelligence, unclassified discussion with Commission staff, Washington, DC, April 2014.

29. U.S. Defense Science Board, *Task Force Report: The Role of Autonomy in DoD Systems*, July 2012, p. 71.

30. Kimberly Hsu, *China's Unmanned Aerial Vehicle Industry* (U.S.-China Economic and Security Review Commission, June 13, 2013). *http://origin.www.uscc.gov/sites/default/files/Research/China%27s%20Military%20UAV%20Industry_14%20June%202013.pdf*.

31. Zhao Lei, "China Conducts Test Flight of Stealth Unmanned Drone," *China Daily*, November 22, 2013. *http://usa.chinadaily.com.cn/epaper/2013-11/22/content_17124629.htm*.

32. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 33.

33. Bradley Perrett, Bill Sweetman, and Michael Fabey, *U.S. Navy Sees Chinese HGV as Part of Wider Threat* (Aviation Week and Space Technology, January 27, 2014). *http://aviationweek.com/awin/us-navy-sees-chinese-hgv-part-wider-threat*; Bill Gertz, "Hypersonic Arms Race: China Tests High-Speed Missile to Beat U.S. Defenses," *Washington Times*, January 13, 2014. *http://www.washingtontimes.com/news/2014/jan/13/hypersonic-arms-race-china-tests-high-speed-missil/?page=all*.

34. Mark Stokes, "China's Quest for Joint Aerospace Power: Concepts and Future Aspirations," in Richard P. Hallion et al., eds., *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities* (Washington, DC: National Defense University Press, 2012), pp. 50–51.

35. Minnie Chan, "China's Second Hypersonic Glider Test Fails as PLA Trials Nuclear Weapons Delivery System," *South China Morning Post* (Hong Kong), August 22, 2014. *http://www.scmp.com/news/china/article/1578756/chinas-second-test-nuclear-armed-hypersonic-glider-fails;* Bill Gertz, "China Secretly Conducts Second Flight Test of New Ultra High-Speed Missile," *Washington Times*, August 19, 2014. *http://www.washingtontimes.com/news/2014/aug/20/china-secretly-conducts-second-test-new-hypersonic/*.

36. Minnie Chan, "China's Second Hypersonic Glider Test Fails as PLA Trials Nuclear Weapons Delivery System," *South China Morning Post* (Hong Kong), August 22, 2014. *http://www.scmp.com/news/china/article/1578756/chinas-second-test-nuclear-armed-hypersonic-glider-fails*.

37. Bill Gertz, "China Secretly Conducts Second Flight Test of New Ultra High-Speed Missile," *Washington Times*, August 19, 2014. *http://www.washingtontimes.com/news/2014/aug/20/china-secretly-conducts-second-test-new-hypersonic/*.

38. Zackery Keck, "Will Hypersonic Capabilities Render Missile Defense Obsolete?" *Diplomat*, February 7, 2014. *http://thediplomat.com/2014/02/will-hypersonic-capabilities-render-missile-defense-obsolete/*.

39. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, testimony of Lee Fuell, January 30, 2014.

40. Tai Ming Cheung (Director, University of California Institute on Global Conflict and Cooperation), e-mail interview with Commission staff, June 20, 2014; Tai Ming Cheung, *China's Really Big Military R&D Effort* (Lowy Institute, October 6, 2013). *http://www.lowyinterpreter.org/post/2013/10/08/Chinas-really-big-military-RD-effort.aspx*.

41. Battelle, *2014 Global R&D Funding Forecast*, December 2013, p. 14. *http://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf?sfvrsn=4*.

42. Tai Ming Cheung, ed., *China's Emergence as a Defense Technological Power* (New York, NY: Routledge, 2013), p. 51; Tai Ming Cheung, ed., *New Perspectives On Assessing The Chinese Defense Economy 2011 Industry Overview And Policy Briefs* (University of California Institute on Global Conflict and Cooperation, 2011). *http://igcc.ucsd.edu/assets/001/504358.pdf*; and Evan A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to Information Age* (Stanford, CA: Stanford University Press, 2003): p. 53.

43. James McGregor, *China's Drive for 'Indigenous Innovation'—A Web of Industrial Policies* (U.S. Chamber of Commerce, July 27, 2010). *https://www.uschamber.com/report/china's-drive-indigenous-innovation-web-industrial-policies*.

44. Brian Lafferty, Aaron Shraberg, and Morgan Clemens, "China's Civil-Military Integration" in Tai Ming Cheung, ed., *The Chinese Defense Economy: Sector-by-Sector Assessments and the Role of Military End-Users* (San Diego, CA: University of California Institute on Global Conflict and Cooperation, 2013), p. 60.

45. Henry Sanderson and Steven Yang, "China Said to Plan Capital Market Access for Military," Bloomberg, April 23, 2014. *http://www.bloomberg.com/news/2014-04-22/china-said-to-plan-move-of-military-assets-to-listed-companies.html*.

46. Stockholm International Peace Research Institute, "EU Arms Embargo on China," November 20, 2012. *http://www.sipri.org/databases/embargoes/eu_arms_embargoes/china*; Dallas Boyd, *Advanced Technology Acquisition Strategies of the People's Republic of China* (Science Applications International Corporation, September 2010), p. 21.

47. Oliver Brauner, "Beyond the Arms Embargo: EU Transfers of Defense and Dual-Use Technologies to China," *Journal of East Asia Studies* 13 (2013): 457.

48. Tom Hancock, "EU Firms Help Power China's Military Rise," AFP, May 1, 2014. *https://sg.news.yahoo.com/eu-firms-help-power-chinas-military-rise-051120343.html*; David Lague, "Chinese Military's Secret to Success: European Engineering," Reuters, December 20, 2013. *http://in.reuters.com/article/2013/12/19/breakout-submarines-special-report-pix-g-idINL4N0JJ0FM20131219*.

49. David Lague, "Chinese Military's Secret to Success: European Engineering," Reuters, December 20, 2013. *http://in.reuters.com/article/2013/12/19/breakout-submarines-special-report-pix-g-idINL4N0JJ0FM20131219*.

50. *Washington Post*, "A List of the U.S. Weapon Designs and Technologies Compromised by Hackers," May 27, 2013. *http://www.washingtonpost.com/world/national-security/a-list-of-the-us-weapons-designs-and-technologies-compromised-by-hackers/2013/05/27/a95b2b12-c483-11e2-9fe2-6ee52d0eb7c1_story.html*.

51. FireEye analysts, interview with Commission staff, June 5, 2014.

52. FireEye analysts, interview with Commission staff, June 5, 2014. Mandiant, *M Trends: Beyond the Breach—2014 Threat Report*, February 2014, pp. 15–21.

53. Joe McReynolds (Research Associate, DGI's Center for Intelligence Research and Analysis), e-mail interview with Commission staff, June 22, 2014.

54. Dan Lamothe, "Exclusive: Top Admiral Says China Likely to Keep Stealing Military Secrets," *Foreign Policy*, April 18, 2014. *http://complex.foreignpolicy.com/posts/2014/04/18/exclusive_top_admiral_says_china_likely_to_keep_stealing_military_secrets*.

55. Federal Bureau of Investigation, *Higher Education and National Security: The Targeting of Sensitive, Proprietary, and Classified Information on Campuses of Higher Education,* April 2011. *http://www.fbi.gov/about-us/investigate/counterintelligence/higher-education-and-national-security*.

56. U.S. Defense Security Service, *Targeting U.S. Technology: A Trend Analysis of Cleared Industry Reporting*, 2013, p. 26.

57. Commission judgments based on the following sources: William C. Hannas, James Mulvenon, and Anna Puglisi, *Chinese Industrial Espionage: Technology Acquisition and Military Modernization* (New York, NY: Routledge, 2013), pp. 136–185; Daniel Golden, "American Universities Infected by Foreign Spies Detected by FBI," Bloomberg, April 8, 2012. *http://www.bloomberg.com/news/2012-04-08/american-universities-infected-by-foreign-spies-detected-by-fbi.html*; Office of the National Counterintelligence Executive, *Foreign Spies Stealing U.S. Economic Secrets in Cyberspace: Report to Congress on Foreign Economic Collection and Industrial Espionage, 2009–2011*, October 2011. *http://www.ncix.gov/publications/reports/fecie_all/Foreign_Economic_Collection_2011.pdf*; James McGregor, *China's Drive for 'Indige-*

nous Innovation'—A Web of Industrial Policies (U.S. Chamber of Commerce, July 27, 2010). *https://www.uschamber.com/report/china's-drive-indigenous-innovation-web-industrial-policies*; and George Tenet and Louis Freeh, *Report to Congress on Chinese Espionage Activities against the United States*, December 12, 1999.

58. Institute of International Education, *Open Doors 2013 Data. http://www.iie.org/en/Research-and-Publications/Open-Doors/Data*.

59. Zhang Yue, "Chinese Return from Overseas Hungry for Work," *China Daily*, March 30, 2014. *http://www.chinadaily.com.cn/china/2014-03/30/content_17389967.htm*.

60. Liu Daxin and Fan Jvwei, "Military and Civilian Universities in Wuhan Establish Strategic Partnership," *China Military Online*, January 6, 2013. *http://english.peopledaily.com.cn/90786/8079393.html*.

61. Congressional-Executive Commission on China, *National People's Congress Standing Committee Issues Revised State Secrets Law*, May 20, 2010. *http://www.cecc.gov/publications/commission-analysis/national-peoples-congress-standing-committee-issues-revised-state*.

62. FireEye analysts, interview with Commission staff, June 5, 2014; House Committee on Science, Space, and Technology, *Hearing on Espionage Threats at Federal Laboratories: Balancing Scientific Cooperation with Protecting Critical Informatio*n, written testimony of Michelle Van Cleave, May 16, 2013.

63. Michael Fitzpatrick, "Did China Steal Japan's High-Speed Train?" *Fortune*, April 15, 2013. *http://fortune.com/2013/04/15/did-china-steal-japans-high-speed-train/*.

64. FireEye analysts, interview with Commission staff, June 5, 2014.

65. Shengyang Liming, "GE Aviation Sign Accord," *China Civil Aviation Report*, 2012. *http://www.chinacivilaviation.com/articles/ccar_405.html*.

66. These numbers reflect Commission estimates and judgments based on the following sources: U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, pp. 7–8, 77; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; and U.S. and Asian media reporting.

67. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

68. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

69. Commission estimate based on discussions with nongovernmental experts on China's military, consecutive versions of DoD's annual *Report to Congress on Military and Security Developments Involving the People's Republic of China*, and consecutive versions of the International Institute for Strategic Studies' *The Military Balance*.

70. Commission judgments based on the following sources: William Murray, "Underwater TELs and China's Antisubmarine Warfare: Evolving Strength and Calculated Weakness," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 19; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2010*, 2010, pp. 3, 30.

71. Commission judgments based on the following sources: J. Michael Cole (Editor-in-Chief, *Thinking Taiwan*), e-mail interview with Commission staff, August 15, 2014; Michael Chase, "China's Transition to a More Credible Nuclear Deterrent," *Asia Policy* 16 (July 2013): 91; Tseng Fu-sheng, "Assessing China's Naval Buildup," *Want China Times* (Taiwan), February 9, 2013. *http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20130209000029%cid=1703*; Benjamin Purser and Michael Chase, *Waypoint or Destination? The Jin-Class Submarine and China's Quest for Sea-Based Nuclear Deterrence* (Jamestown Foundation, August 3, 2012). *http://www.jamestown.org/single/?tx_ttnews[tt_news]=39729%tx_ttnews[backPid]=589#.U4dTEyh5ZhQ*; J. Michael Cole, "Analysis: Questions Remain on China's Nuclear Stance," *Taipei Times*, May 23, 2011. http://*www.taipeitimes.com/News/taiwan/archives/2011/05/23/2003503945/2*; and U.S. Office of Naval Intelligence, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics*, 2009, p. 22.

72. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 47;

Loro Horta, "China Steals a March on Russia Arms," *Asia Times Online*, December 13, 2013. *http://www.atimes.com/atimes/China/CHIN-02-131213.html*; and BBC, "China Buys Fighter Jets and Submarines from Russia," March 25, 2013. *http://www.bbc.co.uk/news/world-asia-21930280*.

73. William Murray, "Underwater TELs and China's Antisubmarine Warfare: Evolving Strength and Calculated Weakness," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 27.

74. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 68; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

75. Commission judgments based on the following sources: Daniel Kostecka, "Aerospace Power and China's Counterstrike Doctrine" in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 57–58; David Shlapak, "Chinese Air Superiority in the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 65.

76. Dean Cheng, "Taking China's Carrier Operations Seriously," *War on the Rocks*, May 14, 2014. *http://warontherocks.com/2014/05/taking-chinas-carrier-operations-seriously/*; Richard Fisher, "Liaoning Completes Successful First South China Sea Trip," *IHS Jane's*, January 5, 2014. *http://www.janes.com/article/32100/liaoning-completes-successful-first-south-china-sea-trip*.

77. *Want China Times* (Taiwan), "PLA Navy Set to Build 10 Aircraft Carriers," August 12, 2014; Tate Nurkin, "The Global Implications of China's Military Modernization," *IHS Jane's*, 2014. *http://www.ihs.com/tl/quarterly/features/chinas-military-modernization.aspx*; *Want China Times* (Taiwan), "PLA Could Commission Four Carrier Battle Groups: Kanwa," May 28, 2014; and *Defense News*, "China To Build 2 More Aircraft Carriers: Taiwan," May 21, 2012. *http://www.defensenews.com/article/20120521/DEFREG03/305210003/China-Build-2-More-Aircraft-Carriers-Taiwan*.

78. Commission judgments based on the following sources: Andrew S. Erickson and Gabe Collins, "China Carrier Demon Module Highlights Surging Navy," *National Interest*, August 6, 2013. *http://nationalinterest.org/commentary/china-carrier-demo-module-highlights-surging-navy-8842*; Peter W. Singer and Jeffrey Lin, "About those Chinese Aircraft Carrier Pics: What We Know and What We Can Guess," *Defense One*, August 5, 2013. *http://www.defenseone.com/technology/2013/08/those-chinese-aircraft-carrier-pics-what-we-know-what-we-can-guess-and-what-we-cant/68114/*; U.S. Office of Naval Intelligence, unclassified interview with Commission staff, Washington, DC, June 2013; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 6.

79. Claudette Roulo, "Greenert: China Moving Quickly to Modernize Navy," DoD News Defense Media Activity, July 26, 2014.

80. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; U.S. Office of Naval Intelligence, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics*, 2009, pp. 27–28.

81. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; U.S. Office of Naval Intelligence, *The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics*, 2009, p. 18.

82. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, pp. 6–7; J. Michael Cole, "China's Growing Long-Range Strike Capability," *Diplomat*, August 13, 2012. *http://thediplomat.com/2012/08/chinas-growing-long-range-strike-capability/*.

83. David Axe, "Looks Like China's Building a Giant New Warship, Possible Missile Cruiser Could Outweigh Rival Surface Combatants," *War Is Boring*, Undated. *https://medium.com/war-is-boring*; David Axe, "New Chinese Cruiser—Not as Big as We Thought, But Still Pretty Big," *War Is Boring*, Undated. *https://medium.com/war-is-boring*; and Bill Gertz, "China Reveals New Carrier Jet Prior to Hagel Visit," *Washington Free Beacon*, April 9, 2014. *http://freebeacon.com/national-security/china-reveals-new-carrier-jet-prior-to-hagel-visit/*.

84. Andrew Erickson (Associate Professor, Naval War College), e-mail interview with Commission staff, June 16, 2014.

85. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 9; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

86. John Patch, "Chinese Houbei Fast Attack Craft: Beyond Sea Denial" in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 11.

87. Commission judgments based on the following sources: U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014,* June 2014, p. 9; U.S. Office of Naval Intelligence, unclassified interview with Commission staff, Washington, DC, April 2014; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

88. Commission judgments based on the following sources: *Strategy Page*, "Logistics: And the Chinese Replenishment Ships Just Keep Coming," June 12, 2014. *http://www.strategypage.com/htmw/htlog/articles/20140612.aspx*; U.S. Office of Naval Intelligence, unclassified interview with Commission staff, April 2014; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; and Andrew Erickson and Gabe Collins, "China's Real Blue Water Navy," *Diplomat*, August 30, 2012. *http://thediplomat.com/2012/08/chinas-not-so-scary-navy/?allpages=yes*.

89. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Congressional Research Service, July 5, 2013), pp. 3–38; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, pp. 7–8, 39.

90. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, pp. 56, 76; Dennis Blasko, *PLA Amphibious Capabilities: Structured for Deterrence* (Jamestown Foundation, August 19, 2010). *http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews[tt_news]=36770%tx_ttnews[backPid]=25%cHash=5c40a5009d#.U8e2n7Ggfvc*.

91. U.S. Navy Seventh Fleet, meeting with Commissioners, Yokosuka, Japan, July 2013; U.S.-China Economic and Security Review Commission, *Hearing on China's Maritime Disputes in the East and South China Seas*, testimony of Peter Dutton, April 4, 2013; and U.S.-China Economic and Security Review Commission, *Hearing on China's Maritime Disputes in the East and South China Seas*, written testimony of Michael McDevitt, April 4, 2013.

92. U.S. Office of Naval Intelligence, unclassified interview with Commission staff, Washington, DC, June 2013; Jin Chang and Zhu Yu, "State Council Plans to Reorganize SOA, Set Up National Oceanic Commission; SOA to Protect Sovereignty, Enforce Laws in Name of PRC Coast Guard," *China Ocean Daily*, March 12, 2013. Open Source Center translation. ID: CPP20130312680007.

93. U.S. Office of Naval Intelligence, unclassified interview with Commission staff, Washington, DC, June 2013.

94. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 41.

95. U.S. Pacific Command Headquarters, "About U.S. PACOM: Organization." *http://www.pacom.mil/AboutUSPACOM.aspx*; U.S. Chief of Naval Operations, *CNO's Navigation Plan: 2015–2019* (Washington, DC, August 20, 2014).

96. U.S. Chief of Naval Operations, *CNO's Navigation Plan: 2015–2019* (Washington, DC, August 20, 2014); Jonathan Greenert, *Statement of Admiral Jonathan Greenert, U.S. Navy Chief of Naval Operations, Before the House Armed Services Committee on FY 2015 Department of the Navy Posture*, March 12, 2014.

97. Senate Armed Services Committee, *Statement of Admiral Samuel J. Locklear, U.S. Navy Commander, U.S. Pacific Command before the Senate Committee on Armed Services on U.S. Pacific Command Posture*, March 25, 2014. *http://www.armed-services.senate.gov/imo/media/doc/Locklear_03-25-14.pdf*.

98. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 78; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

99. Commission judgments based on the following sources: Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 40; U.S. National Air and Space Intelligence Center, unclassified interview with Commission staff, April 2014; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; and David Shlapak, "Equipping the PLAAF: The Long March to Modernity," in Richard P. Hallion et al., eds., *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities* (Washington, DC: National Defense University Press, 2012), pp. 191–198.

100. David Shlapak, "Chinese Air Superiority in the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 61.

101. Carlo Kopp, *The PLA–AF's Aerial Refueling Programs* (Air Power Australia, April 2012). *http://www.ausairpower.net/APA-PLA-Tanker-Programs.html*; U.S. Defense Science Board, *Defense Science Board Task Force Report on Aerial Refueling Requirements*, May 2004. *http://www.fas.org/irp/agency/dod/dsb/aerial.pdf*; and Andrew Erickson, "Naval and Air Forces," in Ashley J. Tellis and Travis Tanner, eds., *Strategic Asia 2012–13: China's Military Challenge* (Seattle, WA: The National Bureau of Asian Research, 2012), p. 112.

102. Commission judgments based on the following sources: Gabriel Collins, Michael McGauvran, and Timothy White, "Trends in Chinese Aerial Refueling Capacity for Maritime Purposes," in Andrew S. Erickson and Lyle J. Goldstein, eds., *Chinese Aerospace Power: Evolving Maritime Roles* (Annapolis, MD: Naval Institute Press, 2011), pp. 194–195, 199; Michael D. Swaine, *China's Military and the U.S.-Japan Alliance in 2030: A Strategic Net Assessment* (Washington, DC: Carnegie Endowment for International Peace, 2013), p. 53.

103. Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014; Jeffrey Lin and P.W. Singer, "Finally, a Modern Chinese Aerial Tanker," Popular Science Easter Arsenal Blog, April 2, 2014. *http://www.popsci.com/blog-network/eastern-arsenal/finally-modern-chinese-aerial-tanker*.

104. Andrew Erickson and Gabe Collins, "Limited Liftoff Looming: Y–20 Transport Prepares for 1st Test Flight," *Diplomat*, January 8, 2013.

105. Commission judgments informed by Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014.

106. Richard Fisher, "Fourth Known J–20 Prototype Makes First Flight," *IHS Jane's Weekly*, July 29, 2014; David Cenciotti, "Third Prototype of China's Stealth Jet Makes Maiden Flight and Shows Improvements," *Aviationist*, March 2, 2014. *http://theaviationist.com/2014/03/02/j-20-3rd-prototype-comparison/*; and David Axe, "China's Latest Stealth Fighter Prototype Has, Well, Actual Stealth Feature," *War is Boring*, January 20, 2014. *https://medium.com/war-is-boring/chinas-latest-stealth-fighter-prototype-has-well-actual-stealth-features-6b8ebf775795*.

107. David Shlapak, "Chinese Air Superiority in the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 69.

108. Jack Mulcaire, "China's Stealth Fighters Ready to Soar?" *National Interest*, April 16, 2014. *http://nationalinterest.org/blog/the-buzz/chinas-stealth-fighters-ready-soar-10252*; Zachary Keck, "China Says J–31 Fighter Will Compete with F–35 for Sales," *Diplomat*, September 27, 2013. *http://thediplomat.com/2013/09/china-says-j-31-fighter-will-compete-with-f-35-for-sales/*.

109. Commission judgments based on the following sources: Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014; Peter Wood, "How China Plans to Use the Su-35," *Diplomat*, November 27, 2013. *http://thediplomat.com/2013/11/how-china-plans-to-use-the-su-35/?allpages=yes*; Wendell Minnick, "China's New Jet, Radar Complicate U.S. Posture," *Defense News*, July 6, 2013. *http://www.defensenews.com/article/20130706/DEFREG03/307060004/China-s-New-Jet-Radar-Complicate-US-Posture*; Sofia Wu, "Talk of the Day—China Aims to Buy 24 Su-35 Fighters," *Central News Agency* (Taiwan), June 24, 2013. Hosted by the Open Source Center. ID: CPP20130624968172; and Feng Cao, *Making Sense of Massive China-Russia Arms Deal* (U.S. Naval Institute, April 5, 2013). *http://news.usni.org/2013/04/05/making-sense-of-massive-china-russia-arms-deal*.

110. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China*, May 2013, pp. 42, 81; Ian Easton, *The Assassin under the Radar: China's DH–10 Cruise Missile Program*

(Project 2049 Institute, October 2009), p. 3. *http://project2049.net/documents/assassin_under_radar_china_cruise_missile.pdf*; and Robert Hewson, "Chinese Air-Launched Missile Emerges from the Shadows," *Jane's Defense Weekly*, January 31, 2007.

111. Hans Kristensen, "Air Force Briefing Shows Nuclear Modernizations but Ignores U.S. and UK Programs," *FAS Security Blog*, May 29, 2013. *http://blogs.fas.org/security/2013/05/afgsc-brief2013/*; Ian Easton, *The Assassin under the Radar: China's DH–10 Cruise Missile Program* (Project 2049 Institute, October 2009). pp. 1–6. *http://project2049.net/documents/assassin_under_radar_china_cruise_missile.pdf*.

112. *Want China Times* (Taiwan), "Long-Range Stealth Bomber under Development in China," January 1, 2014. *www.wantchinatimes.com/news-subclass-cnt.aspx?id=20140119000025%cid=1101*; *Want China Times* (Taiwan), "Is China's H–18 Bomber a Joke? Asks Duowei," November 13, 2013. *http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20131113000004%cid=1101*.

113. Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014.

114. *Want China Times* (Taiwan), "Russia and China Can Jointly Develop Bomber: Voice of Russia," February 17, 2014. *http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20140217000019%cid=1101*.

115. Zhao Huanxin, "Confidence Sky-High Over Jumbo Cargo Plane," *China Daily*, March 19, 2013. Hosted by the Open Source Center. ID: CPP20130319968029.

116. Open Source Center, *Summary: PRC Expert Says Yun-20 Transport Makes Strategic Air Force Possible*, January 27, 2013. ID: CPP20130128787028.

117. Richard Fisher, "China's NDU Recommends 400-Strong Y–20 Fleet," *HIS Jane's Defense Weekly*, July 28, 2014.

118. Commission judgments based on the following source: Open Source Center, *Summary: Guangdong Journal Views Strategic Card of 'Yun-20' Jumbo Air Freighter*, January 31, 2013. ID: CPP20130214695013; Andrew Erikson and Gabe Collins, "The Y–20: China Aviation Milestone Means New Power Projection," *Wall Street Journal: China Real time Report*, January 28, 2013. *http://blogs.wsj.com/chinarealtime/2013/01/28/the-y-20-china-aviation-milestone-means-new-power-projection/*.

119. Andrew Erickson, "Chinese Air- and Space-Based ISR," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 90–95.

120. Andrew Erickson, "Chinese Air- and Space-Based ISR," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 90–95.

121. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014.

122. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 33; J. Michael Cole, China Flies Bombers and Drone Near Japanese Skies," *Diplomat*, September 10, 2013. *http://thediplomat.com/2013/09/china-flies-bombers-and-drone-near-japanese-skies/*

123. Subcommittee on Europe, Eurasia and Emerging Threats, Foreign Affairs Committee of the United States House of Representatives, *Hearing on China's Maritime and Other Geographic Threats*, written testimony of Richard Fisher, October 30, 2013.

124. Kimberly Hsu, *China's Unmanned Aerial Vehicle Industry* (U.S.-China Economic and Security Review Commission, June 13, 2013). *http://origin.www.uscc.gov/sites/default/files/Research/China%27s%20Military%20UAV%20Industry_14%20June%202013.pdf*.

125. U.S.-China Economic and Security Review Commission, *Hearing on China's Emergent Military Aerospace and Commercial Aviation Capabilities*, written testimony of Roger Cliff, May 20, 2010; U.S.-China Economic and Security Review Commission, *Hearing on China's Emergent Military Aerospace and Commercial Aviation Capabilities*, written testimony of Bruce Lemkin, May 20, 2010.

126. U.S. Department of Defense, *Annual Report to Congress: Military Power of the People's Republic of China 2009*, 2009, p. 50.

127. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 83; U.S.-China Economic and Security Review Commission, *Hearing on China's Emergent Military Aerospace and Commercial Aviation Capabilities*, written testimony of Bruce Lemkin, May 20, 2010.

128. Zachary Keck, "Putin Approves Sale of S–400 to China," *Diplomat*, April 11, 2014. *http://thediplomat.com/2014/04/putin-approves-sale-of-s-400-to-china/*; Peter Dunai and Matthew Smith, "Russia, China S–400 Deal Moves Forward," *IHS Jane's*

360, March 31, 2014. *http://www.janes.com/article/36226/russia-china-s-400-deal-moves-forward*.

129. Wendell Minnick, "China's New Jet, Radar Complicate U.S. Posture," *Defense News*, July 6, 2013. *http://www.defensenews.com/article/20130706/DEFREG03/307060004/China-s-New-Jet-Radar-Complicate-US-Posture*; Wendell Minnick, "Time Running Out for Taiwan if Russia Releases S–400 SAM," *Defense News*, May 25, 2013. *http://www.defensenews.com/article/20130525/DEFREG/305270012/Time-Running-Out-Taiwan-Russia-Releases-S-400-SAM*.

130. Zackary Keck, "Putin Approves Sale of S–400 to China," *Diplomat*, April 11, 2014. *http://thediplomat.com/2014/04/putin-approves-sale-of-s-400-to-china/*.

131. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 10.

132. Commission judgments based on the following sources: U.S.-China Economic and Security Review Commission, *Hearing on Recent Developments in China's Relations with Taiwan and North Korea*, written testimony of William Murray, June 5, 2014; U.S. National Air and Space Intelligence Center, unclassified interview with Commission staff, April 2014; Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 37–38; and U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Lee Fuell, January 30, 2014.

133. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014,* June 2014, p. 6; U.S. Defense Intelligence Agency, *Annual Threat Assessment: Statement Before the Senate Armed Services Committee*, February 11, 2014; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat,* July 2013; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 5; and U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2012*, May 2012, p. 29.

134. Hans Kristensen, "DoD Report Shows Chinese Nuclear Force Adjustments and US Nuclear Secrecy," *FAS Blog*, June 11, 2014. *http://fas.org/blogs/security/2014/06/china-dodreport2014/*.

135. U.S.-China Economic and Security Review Commission, *Hearing on Recent Developments in China's Relations with Taiwan and North Korea*, written testimony of William Murray, June 5, 2014.

136. U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, July 2013, p. 13.

137. Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 37–38; U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat,* July 2013, p. 13; and J. Michael Cole, "PRC Missile Could Render PAC–3 Obsolete," *Taipei Times*, March 18, 2011. *http://www.taipeitimes.com/News/front/archives/2011/03/18/2003498473/1*.

138. U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, July 2013, p. 13.

139. Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014.

140. U.S. National Air and Space Intelligence Center, unclassified interview with Commission staff, April 2014.

141. Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), p. 38.

142. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Lee Fuell, January 30, 2014; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 42.

143. Ian Easton, *China's Evolving Reconnaissance-Strike* Capabilities (Project 2049 Institute, February 2014), p. 7.

144. Andrew Erickson, *How China Got There First: Beijing's Unique Path to ASBM Development and Deployment* (Jamestown Foundation, June 7, 2013). *http://www.jamestown.org/programs/chinabrief/single/?tx_ttnews%5btt_news%5d=40994%tx*

_ttnews%5bbackPid%5d=25%cHash=913594fd5785c82b653cc6b00de7850c#.Ueh_F5U-aX1; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, pp. 5–6, 42.

145. Mark Stokes, "Expansion of China's Ballistic Missile Infrastructure Opposite Taiwan," *AsiaEye* (blog), April 18, 2011. *http://blog.project2049.net/2011/04/expansion-of-chinas-ballistic-missile.html*.

146. Ron Christman, "China's Second Artillery Force: Capabilities and Missions for the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 33–34.

147. Mark Stokes, "Expansion of China's Ballistic Missile Infrastructure Opposite Taiwan," *AsiaEye* (blog), April 18, 2011. *http://blog.project2049.net/2011/04/expansion-of-chinas-ballistic-missile.html*.

148. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2011*, May 2011, p. 78.

149. Ian Easton, *China's Evolving Reconnaissance—Strike Capabilities* (Project 2049 Institute, February 2014), p. 8; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 81. *http://www.project2049.net/documents/aerospace_trends_asia_pacific_region_stokes_easton.pdf*; and Ian Easton, *The Assassin Under the Radar: China's DH–10 Cruise Missile Program* (Project 2049 Institute, October 2009), p. 3. *http://project2049.net/documents/assassin_under_radar_china_cruise_missile.pdf*.

150. U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, July 2013, p. 29.

151. China's Information Office of the State Council, *The Diversified Employment of China's Armed Forces*, April 16, 2013. Hosted by the Open Source Center. ID: CPP20130416968060.

152. Larry Wortzel, *The Dragon Extends its Reach* (Washington, DC: Potomac Books, 2013), p. 101.

153. M. Taylor Fravel and Evan Medeiros, "China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure," *International Security* 35.2 (Fall 2010): 80.

154. U.S.-China Economic and Security Review Commission, *2012 Annual Report to Congress*, November 2012, p. 173.

155. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 31.

156. U.S. National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*, July 2013, p. 3.

157. U.S.-China Economic and Security Review Commission, *Hearing on Developments in China's Nuclear and Cyber Capabilities*, written testimony of Mark Stokes, March 26, 2012; Hans Kristensen, "No, China Does Not Have 3,000 Nuclear Weapons, *FAS Strategic Security Blog*, December 3, 2011. *http://fas.org/blogs/security/2011/12/chinanukes/*.

158. Hans Kristensen and Robert Norris, *Chinese Nuclear Forces, 2013, Bulletin of the Atomic Scientists* 69.6: 1 (November 2013). *http://bos.sagepub.com/content/69/6/79.full*.

159. Taiwan Ministry of National Defense, *National Defense Report*, 2013, Table 2–3. *http://report.mnd.gov.tw/en/m/part4.html*.

160. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, pp. 29–31; Andrew Erickson and Michael Chase, *China Goes Ballistic* (National Interest, May/June 2014).

161. Hans Kristensen, *DoD Report Shows Chinese Nuclear Force Adjustments and U.S. Nuclear Secrecy," FAS Strategic Security Blog*, June 11, 2014. *http://fas.org/blogs/security/2014/06/china-dodreport2014/*; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 201*3, June 2014, p. 28.

162. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013,* May 2013, p. 11; Andrew Erickson and Michael Chase, *China Goes Ballistic* (National Interest, May/June 2014); and Nicolas Giacometti, "China's Nuclear Modernization and the End of Nuclear Opacity," *Diplomat*, April 10, 2014. *http://thediplomat.com/2014/04/chinas-nuclear-modernization-and-the-end-of-nuclear-opacity/*.

163. U.S. Office of Naval Intelligence, unclassified interview with Commission staff, Washington, DC, June 2013; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, pp. 10, 31.

164. U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2013*, May 2013, p. 31.

165. Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (Congressional Research Service, April 26, 2014), pp. 19; U.S.-China Economic and Security Review Commission, *Hearing on PLA Modernization and Its Implications for the United States*, written testimony of Jesse Karotkin, January 30, 2014; and Hans Kristensen, "New Nuclear Notebook: Chinese Nuclear Force Modernization," *FAS Security Blog*, November 13, 2013. *http://fas.org/blogs/security/2013/11/chinanukes2013/*.

166. Pei Shen, "China Has Undersea Strategic Nuclear Deterrent against United States for the First Time," *Global Times*, October 13, 2013. Open Source Center translation. ID: CHR2013100762536387.

167. Patrick Tyler, "As China Threatens Taiwan, It Makes Sure U.S. Listens," *New York Times*, January 24, 1996. *http://www.nytimes.com/1996/01/24/world/as-china-threatens-taiwan-it-makes-sure-us-listens.html*.

168. Commission judgments based on the following sources: *Kanwa*, "DF41 ICBM Capable of Covering Whole United States," June 1, 2014. Hosted by the Open Source Center. ID: CHR2014060931184116; Bill Gertz, "China Fields New Intermediate-Range Nuclear Missile," *Washington Free Beacon*, March 3, 2014. *http://freebeacon.com/national-security/china-fields-new-intermediate-range-nuclear-missile/*; Bill Gertz, "China Conducts Second Flight Test of New Long-Range Missile," *Washington Free Beacon*, December 17, 2013. *http://freebeacon.com/national-security/china-conducts-second-flight-test-of-new-long-range-missile/*; and Zhang Han and Huang Jingjing, "New Missile Ready by 2015," *Global Times Online*, February 18, 2011. Open Source Center translation. ID: CPP20110218722001.

169. Zachary Keck, "Is China Preparing MIRVed Ballistic Missiles?" *Diplomat*, August 8, 2014. *http://thediplomat.com/2014/08/is-china-preparing-mirved-ballistic-missiles/*; Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014; J. Michael Cole, "Analysis: Questions Remain on China's Nuclear Stance," *Taipei Times*, May 23, 2011. *http://www.taipeitimes.com/News/taiwan/archives/2011/05/23/2003503945/2*.

170. Bill Gertz, "China Conducts Flight Test of New Mobile ICBM," *Washington Free Beacon,* October 2, 2014. *http://freebeacon.com/national-security/china-conducts-flight-test-of-new-mobile-icbm/*.

171. Richard Fisher (Senior Fellow, International Assessment and Strategy Center), e-mail interview with Commission staff, June 20, 2014.

172. Jane's Space Systems and Industry, "Yaogan Series"; Andrew Erickson, "China's Air- and Space-Based ISR: Integrating Aerospace Combat Capabilities over the Near Seas," in Peter Dutton, Andrew Erickson, and Ryan Martinson, eds., *China's Near Seas Combat Capabilities* (Newport, RI: Naval War College, February 2014), pp. 97–102; and Kevin Pollpeter, "Controlling the Information Domain: Space, Cyber, and Electronic Warfare," in Ashley J. Tellis and Travis Tanner, eds., *Strategic Asia 2012–2013: China's Military Challenge* (Washington, DC: National Bureau of Asian Research, 2012), pp. 167–171.

173. S. Chandrashekar and Soma Perumal, *China's Constellation of Yaogan Satellites and the ASBM* (International Strategic and Security Studies Program, National Institute of Advanced Studies, January 22, 2014). *http://isssp.in/chinas-constellation-of-yaogan-satellites-the-asbm/*.

174. Kevin Pollpeter, "Controlling the Information Domain: Space, Cyber, and Electronic Warfare," in Ashley J. Tellis and Travis Tanner, eds., *Strategic Asia 2012–2013: China's Military Challenge* (Washington, DC: National Bureau of Asian Research, 2012), p. 169.

175. *Want China Times*, "China Makes Large Strides in Satellite Intelligence: Duowei," August 26, 2014. *http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20140826000160%cid=1101%MainCatID=11*; Collin Skockik, "China Launches Gaofen-2 Satellite," *SpaceFlight Insider*, August 19, 2014. *http://www.spaceflightinsider.com/space-flight-news/china-launches-gaofen-2-satellite/*.

176. Xinhua, "China Targeting Navigation System's Global Coverage by 2020," March 3, 3012. *http://news.xinhuanet.com/english/sci/2013-03/03/c_132204892.htm*.

177. Xinhua, "China Launches 3rd Satellite in its Global Data Relay Network," July 26, 2012. *http://news.xinhuanet.com/english/sci/2012-07/26/c_131738886.htm*.

178. Zhang Xiaoxia, "Relay Satellites: The Satellite of Satellites—An Interview of Experts on Developing and Building China's Relay Satellite System," *China Military News*, July 28, 2012. Open Source Center translation. ID: CPP20120831090004.

179. Jonathan McDowell, "China Satellite Update: 2014," *Jonathan's Space Report*, June 2014. *http://planet4589.org/space/papers/china2014.pdf*; Kevin Pollpeter (Deputy Director, Study of Innovation and Technology in China, University of California, San Diego), e-mail interview with Commission staff, June 16, 2014; and Jonathan McDowell (Astrophysicist, Harvard-Smithsonian Center for Astrophysics), e-mail interview with Commission staff, June 15, 2014.

180. Jonathan McDowell, "China Satellite Update: 2014," *Jonathan's Space Report*, June 2014. *http://planet4589.org/space/papers/china2014.pdf*; Jonathan McDowell (Astrophysicist, Harvard-Smithsonian Center for Astrophysics), e-mail interview with Commission staff, June 15, 2014.

181. U.S. Department of Defense, *Annual Report to Congress on Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 11.

182. Andrew Erickson and Amy Chang, "China's Navigation in Space," *Proceedings* (April 2012): 42–47; Stephen Chen, "China Has Tracking Station in Australia," *South China Morning Post* (Hong Kong), November 5, 2011. *http://www.scmp.com/article/983889/china-has-tracking-station-australia*.

183. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, p. 11.

184. U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, June 2014, pp. 10–11; Mark Stokes and Dean Cheng, *China's Evolving Space Capabilities: Implications for U.S. Interests* (Project 2049 Institute, April 26, 2012), pp. 37–39. *http://project2049.net/documents/uscc_china-space-program-report_april-2012.pdf*.

185. Craig Murray, *China Missile Launch May Have Tested Part of a New Anti-Satellite Capability* (U.S.-China Economic and Security Review Commission, May 22, 2013). *http://origin.www.uscc.gov/sites/default/files/Research/China%20Missile%20Launch%20May%20Have%20Tested%20Part%20of%20a%20New%20Anti-Satellite%20Capability_05.22.13.pdf*.

186. Kevin Pollpeter, *China's Space Robotic Arm Programs* (University of California Institute on Global Conflict and Cooperation, October 2013). *http://igcc.ucsd.edu/assets/001/505021.pdf*.

187. Marcia S. Smith, "Surprise Chinese Satellite Maneuvers Mystify Western Experts," *Space Policy Online*, August 19, 2013. *http://www.spacepolicyonline.com/news/surprise-chinese-satelllite-maneuvers-mystify-western-experts*; Robert Christy, "Chinese Satellites Playing Tag . . . Now There are Three!" *Zarya*, August 17, 2013. *http://www.zarya.info/blog/?p=1396*.

188. David Wright, Laura Grego, and Lisbeth Gronland, *The Physics of Space Security: A Reference Manual* (Cambridge, MA: American Academy of Arts and Sciences and Union of Concerned Scientists, 2005). *http://www.ucsusa.org/assets/documents/nwgs/physics-space-security.pdf*.

189. Craig Murray, *China Missile Launch May Have Tested Part of a New Anti-Satellite Capability* (U.S.-China Economic and Security Review Commission, May 22, 2013). *http://origin.www.uscc.gov/sites/default/files/Research/China%20Missile%20Launch%20May%20Have%20Tested%20Part%20of%20a%20New%20Anti-Satellite%20Capability_05.22.13.pdf*.

190. Leonard David, "China's Space Docking is a Step Toward Ambitious Future in Space," *Space.com*, June 14, 2013. *http://www.space.com/21566-china-shenzhou-10-mission-space-ambitions.html*; Clara Moskowitz, "China Successfully Docks Manned Space Capsule at Orbiting Module," *Space.com*, June 18, 2012. *http://www.space.com/16179-china-manned-space-docking-shenzhou-9.html*; Mike Wall, "China Succeeds in First Space Docking by 2 Spaceships," *Space.com*, November 2, 2011. *http://www.space.com/13477-china-space-docking-success-shenzhou8-tiangong1.html*.

191. Xinhua, "China Carries out Land-Based Mid-Course Missile Interception Test," January 28, 2013. *http://news.xinhuanet.com/english/china/2013-01/28/c_124285293.htm*; Xinhua, "China conducts test on ground-based midcourse missile interception," January 11, 2010. *http://news.xinhuanet.com/english/2010-01/11/content_12792329.htm*.

192. Brian Weeden, *Anti-Satellite Tests in Space—The Case of China*, (Secure World Foundation, August 29, 2013). *http://swfound.org/media/115643/China_ASAT_Testing_Fact_Sheet_Aug2013.pdf*; Li Bin, *What China's Missile Intercept Test Means* (Carnegie Endowment for International Peace, February 4, 2013). *http://carnegieendowment.org/2013/02/04/what-china-s-missile-intercept-test-means/fa45*.

193. Mike Gruss, "U.S. State Department: China Tested Anti-Satellite Weapon," *Space News*, July 28, 2014. *http://www.spacenews.com/article/military-space/41413us-state-department-china-tested-anti-satellite-weapon*.

194. Brian Weeden, *Anti-Satellite Tests in Space—The Case of China* (Secure World Foundation, August 29, 2013). *http://swfound.org/media/115643/China_ASAT_Testing_Fact_Sheet_Aug2013.pdf*.

195. U.S. Department of Defense and U.S. Department of State, *Risk Assessment of United States Space Export Control Policy*, March 2012, section 4.3. *http://www.defense.gov/home/features/2011/0111_nsss/docs/1248_Report_Space_Export_Control.pdf*.

196. Commission judgments based on the following source: Bryan Kreskel, Patton Adams, and George Bakos, *Occupying the High Ground: Chinese Capabilities for Computer Network Operations and Cyber Espionage* (U.S.-China Economic and Security Commission, March 7, 2012). *http://origin.www.uscc.gov/sites/default/files/Research/USCC_Report_Chinese_Capabilities_for_Computer_Network_Operations_and_Cyber_%20Espionage.pdf*; Chang Xianqi, *Military Astronautics* (2nd edition) (Beijing, China: National Defense Industries Press, 2005), pp. 59–71. Open Source Center translation. ID: CPP20091231572001.

197. House Armed Services Subcommittee on Strategic Forces and the Subcommittee on Seapower and Projection Forces, *Joint Hearing on the People's Republic of China's Counterspace Program and the Implications for U.S. National Security*, written testimony of Ashley Tellis, January 28, 2014.

198. Yasmin Tadjdeh, "New Chinese Threats to U.S. Space Systems Worry Officials," *National Defense*, July 2014. *http://www.nationaldefensemagazine.org/archive/2014/July/Pages/NewChineseThreatstoUSSpaceSystemsWorryOfficials.aspx*; Senate Armed Services Subcommittee on Strategic Forces, *Fiscal Year 2015 National Defense Authorization Budget Request for National Security Space Activities*, written statement of William Shelton, March 12, 2014.

199. AFP, "Kendall: China Threatens U.S. Military Superiority," January 29, 2014. *http://www.defensenews.com/article/20140129/DEFREG02/301290037/Kendall-China-Threatens-US-Military-Superiority*.

200. Evan Braden Montgomery, "Contested Primacy in the Western Pacific: China's Rise and the Future of U.S. Power Projection," *International Security* 38:4 (Spring 2014): 117.

201. Senate Armed Services Committee, *Inquiry into Cyber Intrusions Affecting U.S. Transportation Command Contractors,* September 17, 2014. *http://www.armed-services.senate.gov/imo/media/doc/SASC_Cyberreport_091714.pdf*.

202. Senate Armed Services Committee, Inquiry into Cyber Intrusions Affecting U.S. Transportation Command Contractors, September 17, 2014. *http://www.armed-services.senate.gov/imo/media/doc/SASC_Cyberreport_091714.pdf*; Bryan Krekel, Patton Adams, and George Bakos, *Occupying the Information High Ground: Chinese Capabilities for Computer Network Operations and Cyber Espionage* (U.S. China Economic and Security Review Commission, March 7, 2012). *http://origin.www.uscc.gov/sites/default/files/Research/USCC_Report_Chinese_Capabilities_for_Computer_Network_Operations_and_Cyber_%20Espionage.pdf*.

203. U.S.-China Economic and Security Review Commission, *2011 Annual Report to Congress*, November 2011, p. 358. *http://origin.www.uscc.gov/sites/default/files/annual_reports/annual_report_full_11.pdf*.

204. Helene Cooper, "Pentagon Says Chinese Fighter Jet Confronted American Navy Plane," *New York Times*, August 22, 2014. *http://www.nytimes.com/2014/08/23/world/asia/us-says-chinese-fighter-jet-confronted-american-navy-plane.html?_r=0*.

205. Lloyd Thrall (Project Associate, RAND Corporation), interview with Commission staff, Washington, DC, June 2, 2014.