Andrew S. Erickson, Personal summary of discussion at "China's Naval Shipbuilding: Progress and Challenges," conference held by China Maritime Studies Institute at U.S. Naval War College, Newport, RI, 19-20 May 2015.

CHINA MARITIME STUDIES INSTITUTE (CMSI) CONFERENCE
"CHINA'S NAVAL SHIPBUILDING: PROGRESS AND CHALLENGES"

PERSONAL SUMMARY OF DISCUSSION BY ANDREW S. ERICKSON

THIS IS A COMPILATION OF MY OBSERVATIONS FROM THIS CONFERENCE BASED ON THE VIEWS EXPRESSED BY THE PARTICIPANTS. IT DOES NOT REFLECT THE POLICIES OR ESTIMATES OF THE U.S. NAVY, THE U.S. NAVAL WAR COLLEGE, OR ANY OTHER ORGANIZATION OF THE U.S. GOVERNMENT.

Background: CMSI held a conference at the Naval War College on 19-20 May 2015, entitled "China's Naval Shipbuilding: Progress and Challenges." The key questions addressed included:

- What are China's prospects for success in key areas of naval shipbuilding?
- What are the likely results for China's navy?
- What are the implications for the U.S. Navy?

Key Findings:

- The growth of China's shipbuilding industry is more rapid than any other in modern history, involving a 13-fold increase in Chinese commercial shipbuilding output between 2002 and 2012. Although advancements in recent years are substantial in aggregate, they vary significantly by specific field.
- China was able to "leap frog" some naval development, engineering, and production steps and achieve tremendous cost and time savings by leveraging work done by the U.S. and other countries in a process of "imitative innovation."
- Fleet design and quality improvement efforts are driven by two factors. People's Liberation Army Navy (PLAN) shipbuilding choices are informed by a combination of technological and strategic analysis produced by the PLAN's two main research organizations. Ship construction is increasingly subject to a detailed set of National and Navy Military Standards.
- China's shipbuilding industry is poised to make the PLAN the second largest Navy in the world by 2020, and—*if current trends continue*—a combat fleet that in *overall order of battle (i.e., hardware-specific terms)* is quantitatively and even perhaps qualitatively on a par with that of the U.S. Navy by 2030.
- By 2030, the PLAN would still be in the early stages of increasing operational proficiency and its ability to engage in high-intensity operations in distant waters, but could nevertheless—together with other PLA forces—develop tremendous ability to

actively oppose U.S. Navy operations in a zone of contestation for sea control in the Near Seas (Yellow, East China, and South China Seas), while extending layers of influence and reach far beyond.

- By 2020, China is on course to build ships able to deploy greater quantities of anti-ship cruise missiles (ASCMs) with greater ranges than those systems used by the U.S. Navy.

Additional Findings:

Chinese Shipyards: The Chinese Communist Party (CCP) has assigned the shipbuilding industry a key role in China's development as a great power, including support for China's geostrategic endeavors. The state-owned shipyards also offer a major job and skills development program serving larger CCP economic objectives. A likely area of future growth will be development of the supporting and maintenance infrastructure for in-service vessels following the fast pace of recent construction—a difficult task even for the U.S. Navy.

State-owned versus Private Shipyards: China's leading state-owned shipbuilding enterprises—China Shipbuilding Industry Corporation (CSIC) and China State Shipbuilding Corporation (CSSC)—possess great overall resources and capacity, but retain tremendous inefficiencies. Their institutional culture is still influenced by legacy values, norms, and incentives. Their monopoly structure remains one of the central impediments to improving efficiency and innovation. On the other hand, private yards are oriented toward short-term, profit-minded thinking and are not funded to do long-term R&D-intensive projects. While CSIC and CSSC have increasingly undertaken naval and para-naval business to absorb excess yard capacity after commercial "Peak Ship" construction occurred around 2012, private yards have largely been left to fend for themselves. Throughout the industry, bureaucratic barriers to efficiency and effectiveness remain a problem, especially for propulsion and shipboard electronic systems and their integration into ships.

Chinese Shipbuilding Standards: Specific Chinese shipbuilding plans and military standards are derived from the Weapons and Armament Development Strategy (WADS), a highly classified document drafted by the General Armament Department (GAD) and approved by the Central Military Commission (CMC). It includes sections assessing the international security environment, military equipment requirements, analysis of the strengths and weakness of Chinese armaments in relation to naval objectives, and assessments of S&T development. One of China's most important national military shipbuilding standards is the *Guojia Junyong Biaozhun* (GJB) 4000-2000 publication series, *General Specifications for Naval Ships*, a massive compendium focused on new and planned construction. It represents a major advance from the copycat assimilation of thousands of U.S. standards during the 1980s and '90s.

Programmatic Decision-making: To drive requirements, PLAN leadership integrates the analysis of its two main research entities—the technically focused Naval Armament Research

Institute (NARI), and the strategically focused Naval Research Institute (NRI)—to rationalize ship and weapon system design with naval strategy. The increasing diversity of PLAN mission areas (e.g., massive expansion of area air-defense) is having a significant effect on Chinese naval ship design. Increasing capabilities demand increased processing power and sensor load. Greater payloads and supporting systems drive increases in ship size.

Naval Ship Design: New design and production technologies, e.g., CAD/CAM software from Japan and Europe, are being imported into China, adapted, and deployed for military use. Advances in ship design are achieved through "imitative innovation," an official technology transfer policy based on a process of Introduce/Digest/Absorb/Re-innovate (IDAR). IDAR takes existing technology and adds value to it by making it cheaper, better suited to Chinese needs, or otherwise improving it. Modular construction is expanding for both commercial and military ships. Modularity improves production efficiency—by enabling standard modules to be constructed and stored to better accommodate shipbuilding schedules—and also offsets uncertainties by employing common systems and sub-components.

Military-Civil Disconnect: The greatest variation across China's uneven but improving shipbuilding industrial base stems from its military-civil bifurcation. While subject to the inefficiencies described above, the naval side appears to have by far the best funding, infrastructure, research institutes, designers, and workers. State-owned shipyards on the Ministry of Industry and Information Technology's favored "white list"—the ones building most of China's warships—receive not only preferential treatment, but preferential support. Learning is occurring rapidly. It typically takes 10-20 repeats to double labor efficiency and the PLAN is ordering longer production runs of fewer series, facilitating advancements in shipbuilding knowledge and efficiency. That said, China's military shipbuilding industry still faces challenges in subcomponents (especially propulsion/power) and some sensors (e.g., ASW versions). On the commercial side, in marked contrast, many private shipyards risk bankruptcy and closure. The civilian shipbuilding work force remains undereducated. Worker quality, lower than in South Korea and Japan, remains a major drag on productivity and high-end achievement. With regard to commercial shipbuilding, therefore, China has a massive capacity to build small, less complex ships and large, non-complex ships, but has demonstrated less capacity to build large, complex ships. However, even the commercial side is improving over time. For instance, partnerships between shipyards and "feeder" technical schools are being created to help improve the quality of the workforce and to offer guaranteed jobs for graduates.

Particular Propulsion Weakness: Compared to the U.S., China has particular shipbuilding limitations in propulsion, some electronics, and certain advanced weapons systems. Propulsion is the single biggest shortcoming and is unlikely to progress until China's precision manufacturing capability improves. Conventional propulsion in submarines is moving toward advanced lithium-ion batteries, possibly as an alternative to air independent power (AIP) systems. Nuclear

propulsion advances—especially in power density and acoustic quieting—remain difficult to ascertain, but a key variable affecting future progress will be the degree of Russian assistance.

Points of Disagreement:

(1) Will Chinese state-owned shipyards re-merge? CSIC and CSSC were unified until 1999, then divided along geographic and functional lines so as not to compete directly (CSIC has the majority of R&D centers, for instance). Some believe reintegration will occur to increase efficiency and available resources and to reach a State Council-mandated reduction in the number of commercial shipyards from several hundred to 60. Those believing merger will not occur noted that most mergers to date exploit geographical efficiencies and have been completed. They also note that CSIC and CSSC naval yards have already pared down to only 7 major facilities between them.

(2) What are China's prospects for reducing organizational barriers and increasing technological diffusion and absorption? China is responding to organizational and technological impediments by emphasizing integration of commercial and naval shipbuilding processes, which some industry experts believe could improve quality and efficiency. Others maintain that this will actually reduce efficiency and increase challenges because of the fundamentally different natures of naval and commercial shipbuilding.

(3) Are Chinese shipbuilding standards effective design and construction tools, given cultural barriers to standardization and regulation? Some highly knowledgeable experts believe that overall they "offer a workable road" to improved future construction. Others believe they are "hopelessly convoluted," outdated, and probably used selectively. Of note, in China's space industry it took top-level leadership intervention before program managers actually started to follow standards consistently.

Implications for the U.S. Navy:

(1) Chinese ship-design and -building advances help the PLAN to contest sea control in a widening arc of the Western Pacific. Four key competitions susceptible to disruptive technology advances will affect future outcomes—Hiding vs. Finding, Understanding vs. Confusion, Network Resilience vs. Network Degradation, and Hitting vs. Intercepting, all of which will be affected by advances in China's technology base, shipbuilding, and design.

(2) Experts generally agreed that in 2020, the PLAN will be the world's second most powerful navy, with naval assets dedicated to distant waters ("Far Seas") missions greater in capability than those of the UK, France, Japan, or India. Given the likelihood of continued government investment, cost advantage, and pursuit of integrated innovation, China's shipbuilding industry appears to be on a trajectory to build a combat fleet that could be, *in hardware terms*, quantitatively and qualitatively on a par with that of the U.S.

Navy by 2030. Whether it can stay on this trajectory, given downside risks to China's economy, is another question.

(3) Regardless of China's precise economic trajectory, the PLAN—together with other PLA forces—will be increasingly capable of contesting U.S. sea control within growing range rings extending beyond Beijing's unresolved island and maritime claims in the Near Seas. Experts generally agreed that by 2020, China is on course to deploy greater quantities of missiles with greater ranges than those systems used by the U.S. Navy against them. China is on track to have quantitative parity or better in surface-to-air missiles (SAMS) and ASCMs, parity in missile launch cells, and quantitative inferiority only in multi-mission land-attack cruise missiles (LACMs). Retention of U.S. Navy superiority hinges on next-generation long-range ASCMs (the Long-Range Anti-Ship Missile/LRASM and the vertical launch system-compatible Naval Strike Missile/NSM variant)—which are still "paper missiles," un-fielded on U.S. Navy surface combatants. Additionally, new U.S. ASCMs may be unable to target effectively under contested A2/AD conditions. Failing to fill this gap would further imperil U.S. ability to generate and maintain sea control in the Western Pacific.