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Industry Study

Final Report
Shipbuilding Industry

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SHIPBUILDING 2007

ABSTRACT: The shipbuilding industry is critical to both national security and global stability. The U.S. industry, however, is not globally competitive in the production of large oceangoing vessels and depends on government procurement and a protected domestic market to remain viable. The limited commercial market, combined with a decline in Navy shipbuilding, has resulted in excess production capacity, underutilized larger shipyards and high vessel costs. The combination of high vessel costs and limited budgets, in turn, threatens the Navy's ability to meet its stated goal of a 313-ship fleet by 2020. There are no easy solutions to the dilemma, but there are a number of steps the U.S. Government (USG) can take to bolster this critical component of the defense industrial base.

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PLACES VISITED:

Domestic

U.S. Coast Guard Shipyard, Curtis Bay, MD
Aker Philadelphia Shipyard, Philadelphia, PA
Carnival Corporation & Carnival Cruise Lines, Miami, FL
Electric Boat, Quonset Point, RI
Portsmouth Naval Shipyard, Portsmouth, NH
Bath Iron Works, Bath, ME
Northrop Grumman Ship Systems-Avondale Operations, Avondale, LA
Textron Systems-Marine & Land Operations, New Orleans, LA
Bollinger Shipyard, Lockport, LA
VT Halter Marine-Pascagoula Operations, Pascagoula, MS
Northrop Grumman Ship Systems-Ingalls Operations, Pascagoula, MS
Austal USA, Mobile, AL
North American Shipbuilding, LaRose, LA
Northrop Grumman Newport News Shipbuilding, Newport News, VA
National Steel and Shipbuilding Company (NASSCO), San Diego, CA

International

American Institute in Taiwan, Taipei, Taiwan
National Security Council, Taipei, Taiwan
Ministry of Foreign Affairs, Taipei, Taiwan
American Chamber of Commerce, Taipei, Taiwan
China Shipbuilding Corporation, Keelung, Taiwan
Ford Motor Company, Taipei, Taiwan
China Shipbuilding Corporation, Kaohsiung City, Taiwan
Taiwan Fleet Command, Kaohsiung City, Taiwan
2047 Vision Club, Hong Kong, SAR
US Consulate, Hong Kong, SAR
Hong Kong Ship Owners Association, Hong Kong, SAR
Mandarin Shipping Brief, Hong Kong, SAR
CSOC, Hong Kong, SAR
Dubai Ports, Hong Kong, SAR
HUD Shipyard, Hong Kong, SAR

Introduction

This study examines whether the U.S. shipbuilding industry adequately supports the United States national security and global stability with an acceptable level of risk. The following major assumptions were made to develop a framework to proceed:

- An indigenous shipbuilding capability is important to U.S. national security.
- A 313-ship fleet by 2020 for the U.S. Navy is sufficient for national security and global stability.
- U.S. Federal discretionary budget constraints will continue.
- Protection of the U.S. shipbuilding industry via Title X (defense), Jones Act and related laws (commercial) will continue.
- The fate of major shipyards in the United States will remain a sensitive political issue.

Industry Defined

Shipbuilding is a worldwide industry which entails the design, construction and repair of ships and boats. The core competencies necessary for a viable industry include design and engineering, a skilled labor force, suppliers of raw material and equipment, and the infrastructure to build ships. The shipbuilding and repair infrastructure, in turn, is generally divided between those shipyards capable of producing oceangoing vessels, including naval vessels and large passenger and cargo ships, and firms that build smaller vessels, such as tugboats, barges, crew boats, industrial service ships, motor boats, cabin cruisers, pleasure boats, and other water craft.

Within this worldwide enterprise, the industry has developed along product lines. The Asian shipyards, particularly South Korea, Japan and increasingly China, have concentrated on producing large ocean going commercial ships - container ships, tankers and bulk carriers - at very competitive prices, largely due to economies of scale and typically larger, more efficiently designed shipyards. The European shipyards, particularly those in Finland, Italy and Spain have focused on commercial and high tech civil ship construction. These include ferries, research vessels, large cruise ships, as well as medium-sized naval vessels. There are a number of suppliers and craftsmen within Europe to sustain their shipbuilding requirements. U.S. shipbuilders comprise less than a 1 percent share of the international market. Unable to compete globally, U.S. firms rely on domestic military and commercial markets which are protected from international competition by law and regulation. Approximately 80 percent of the U.S. shipbuilding and repair market is focused on military vessels, with the remaining 20 percent focused on U.S. commercial vessels (IBISWorld, 2006, p.6.).

Current Condition

U.S. Shipbuilders

As the number of ships constructed within the U.S. has decreased over the past thirty years, a number of shipbuilding firms and suppliers have consolidated or exited the market. There are currently only six facilities within the country that construct large military vessels. These six facilities, commonly referred to as the "Big Six", are owned by two large defense suppliers, General Dynamics and Northrop Grumman. General Dynamics operates shipyards in Groton, CT; Bath, ME; and San Diego, CA. Northrop Grumman operates shipyards in Newport News, VA;

Pascagoula, MS; and New Orleans, LA. Currently, five of the six shipyards have only military orders. General Dynamic's National Steel and Shipbuilding Company (NASSCO) in San Diego, CA has contracts to build Daewoo designed commercial vessels for the U.S. domestic trade.

In addition to the "Big Six" shipyards, there are a number of other small and medium sized shipyards, including firms such as: Marinette Marine in Marinette, WI; Austal USA in Mobile, AL; VT Halter Marine in Pascagoula, MS; Bollinger Shipyards in Lockport, LA; North American Shipbuilding in Lockport, LA; Aker Shipbuilding in Philadelphia, PA; and Textron Marine and Land Systems, in New Orleans, LA. Unlike five of the "Big Six" yards, most of the small and medium sized domestic yards are manufacturing commercial vessels in addition to competing for USG orders, and are involved in the repair of the same types of vessels. The mix of construction and repair for both government and commercial customers provides them a more balanced portfolio, which strengthens their overall economic posture. In addition, from the team's observations the smaller yards appear to be quite agile in responding to changing market requirements.

In addition to the private shipyards, there are also five public shipyards within the U.S., four of which are operated by the U.S. Navy. These shipyards are involved in the repair or conversion of existing ships. They are located at Portsmouth Naval Shipyard in Kittery, ME; the Norfolk Naval Shipyard in Norfolk, VA; Puget Sound Naval Shipyard in Bangor, WA; and Pearl Harbor Naval Shipyard in Pearl Harbor, HI. The U.S. Coast Guard operates the Curtis Bay Shipyard in Baltimore, MD, for repair of its Coast Guard vessels.

Finally, beyond the private and public shipyards, the U.S. industry relies on thousands of subcontractors and suppliers of labor, expertise, equipment, and materiel necessary to build the range of vessels constructed in the country.

Legislation and Regulation

It is impossible to understand the U.S. shipbuilding industry without understanding the myriad of laws and regulations that govern it – some dating to the establishment of the nation. The first sessions of Congress, in 1789 and 1790, imposed duties and taxes on foreign built, foreign-flagged ships engaged in U.S. trade. These laws were intended to counteract similar protectionist laws on merchant fleets in England and France. In addition, until World War I, the U.S. merchant fleet operated under an 1817 law, *An Act Concerning the Navigation of the United States*, which required use of U.S. flagged vessels for domestic shipping.

Today the main legislation governing the U.S. shipping industry is the Jones Act, Section 27 of the Merchant Marine Act of 1920. This legislation continued the language from previous laws but covered all three main aspects of the shipping industry, requiring ships that engage in domestic U.S. trade be: 1.) built in the U.S., 2.) flagged in the U.S. and 3.) crewed by U.S. citizens. The Jones Act was created to foster a strong U.S. maritime industry that could be rapidly mobilized for war (Frittelli, 2003). The intent of the Jones Act was to protect the U.S. maritime industry and allow it to flourish in the world market by providing protections similar to those in other countries' merchant fleets.

In addition to the Jones Act, the Construction Differential Subsidy (CDS) program had a significant impact to the U.S. shipbuilding industry. This program, established under the Merchant Marine Act of 1936, provided a 50 percent subsidy for the construction costs of commercial vessels built in the U.S. This subsidy was paid to the ship owner and was only available for ships that were registered under U.S. law and operated in international trades. The 1981 decision to discontinue the subsidy significantly reduced the demand for U.S. built ships used in international trade from approximately 100 ships a year to single digit requirements (Teel, 2007, p. 4).

The National Shipbuilding and Shipyard Conversion Act, passed in 1993, established a method to finance construction, reconstruction or reconditioning of export vessels. This was an effort to aid U.S. shipyards to build export ships and modernize and improve the yards so that they could be more competitive (IBISWorld, 2007, p. 18).

In addition to laws concerning commercial shipbuilding, an array of laws and regulations pertain to vessels purchased by the United States Government (USG), including warships. The Byrnes-Tollefson Amendment (10 U.S.C. § 7309) specifically prohibits foreign shipbuilders from building warships for the Department of Defense (DoD).

Finally, USG procurements are affected by many other laws and regulations including the Buy American Act of 1933, the Cargo Preference Act of 1904, the Balance of Payments Program, the Berry Amendment (10 U.S.C. § 2533a), 10 U.S.C. § 2534 (which requires DoD to procure various specified items from U.S. and Canadian sources only) and various annual appropriations and authorization acts. One researcher identified 38 additional laws impacting acquisitions.[i] Some of these laws reflect a tension between the executive and legislative branches regarding whether USG work should be left to a free market economy or reserved for particular constituencies.

To understand the current condition of the shipbuilding industry it is important to look at the two distinct sectors of the industry: Commercial shipbuilding and Government shipbuilding.

Commercial Shipbuilding

After 30 years of overcapacity, the international commercial shipbuilding industry is booming in response to burgeoning global trade. The number of large, oceangoing vessels being delivered globally each year has been growing at greater than 6 percent per year and topped the 1000 mark for the first time in 2006 (Teel, p. 4). International shipyards have extensive backlogs for orders of new ships, and vessel prices have risen sharply over the last several years. Unfortunately, the U.S. industry is not part of the boom in construction of large oceangoing vessels. At its peak, the U.S. shipbuilding industry was as vibrant and active as any other part of our wartime industrial base, and even as recently as the 1970s the U.S. easily produced at least 20 large oceangoing ships a year (Marine Board, 1996). The U.S. is no longer internationally competitive in commercial shipbuilding and relies on government protectionist legislation to survive.

The experience of the U.S. industry has been mirrored by that of other developed nations. According to some, the shipbuilding industry may be viewed as a barometer for the economic maturity of sovereign nations. As a nation's economy matures, the shipbuilding industry of that nation tends to decline. As their economies improved, labor sought higher value jobs making the labor available for manufacturing scarce and, therefore, more expensive. Those countries' shipbuilding industries were displaced by countries with available, cheaper labor. Although the U.S. and Europe dominated the industry following World War II, they began losing market share to Japan in the 1960's. Similarly, South Korea overtook Japan as the world's largest shipbuilder in the 1990's, and China is expected to surpass both Japan and Korea within a decade. As shown in Table 1, these three countries currently dominate the market for commercial cargo ships, although new production from India, Vietnam and Brazil may threaten their position in the future.

Table 1: Shipbuilding Market Share by Country and Type of Vessel

	Bulk Carrier	*Container Ships*	*Oil Tanker*	*LNG Carrier*	**LPG Carrier**
S. Korea	3.4%	47.7%	40.5%	76.7%	71.3%
Japan	47.7%	11.6%	25.4%	16.9%	21.6%
China	40.5%	20.9%	29.9%	3.2%	1.9%
Europe	6.9%	11.2%	1.6%	0.6%	3.1%
Others	1.6%	8.7%	2.6%	2.6%	2.1%

Source: China State Shipbuilding Company, presentation to Lloyd's Register Seminar in Shipping China Energy, 25 April 2007

The U.S. commercial shipbuilding industry is largely limited to those vessels destined for domestic trade where the market is restricted by the Jones Act. Production of large oceangoing Jones Act vessels has averaged approximately 12 ships per year over the last decade (Teel, p.4). Much of that activity was driven by the need to replace single-hulled tankers with double-hulled tankers in response to the Oil Pollution Act of 1990. Maintaining the current Jones Act fleet of approximately 120 large vessels will likely require construction of less than 10 vessels per year for the foreseeable future.

In addition to the construction of large oceangoing vessels, the U.S. shipbuilding industry is also engaged in the construction of numerous smaller commercial vessels, including recreation vessels, barges and tugs for transport on rivers and the Intercoastal Waterway System, and support vessels, drilling rigs and platforms for the offshore oil industry. Due in part to the rapid expansion of the offshore oil industry in the Gulf of Mexico, there is a nationwide boom in the construction of these smaller vessels, with orders filling many of the smaller and medium sized yards until approximately 2012.

The U.S. commercial shipbuilding industry is not competitive with overseas yards. Estimates vary, but there appears to be a broad consensus that building a large tanker or container ship in an American yard will cost anywhere from two to five times as much as the lowest cost yards abroad, particularly shipyards in China and Korea. European shipyards tend to dominate the market for construction of cruise ships and can reportedly build large ocean going vessels at a fraction of the cost of those vessels built in the U.S. However, there are a few niche markets where American firms appear internationally competitive. One example is the offshore petroleum support service industry where U.S. firms have maintained a competitive position by providing reliable and high-quality service while minimizing their life-cycle costs for ship construction and operation.

Given America's competitive position in so many industries, such as production of automobiles, airplanes and bulldozers, it is puzzling to the casual observer why the U.S. is unable to compete in the shipbuilding business. There are a number of contributing factors, such as higher overhead and labor costs, however, the principal factor relates to the scale of production. The worldwide requirement for ships allows shipbuilding firms to increase output from their existing capital base and benefit from strong economies of scale and spread fixed costs across a larger number of ships. Shipbuilding costs are also strongly impacted by "learning curve" effects. The learning curve (also referred to as the "improvement curve"), is based on the fact that as a task is performed repetitively, the time or cost required to perform that task will decrease. Learning curve economies accrue with the cumulative number of products produced but can be diminished or eliminated by long intervals between successive units.

If costs per ship decline the more a shipyard produces, shipyards that produce the most ships will benefit from economies of scale and move down the learning curve faster than shipyards that produce fewer ships. For a single class of ship, shipyards can focus their energies on producing multiple vessels which allows them to gain greater market share and decrease cost per ship and not only maintain but extend their competitive advantage over time. The Asian shipyards aggressively pursued market share for the production of standard classes of tankers and freighters over the last four decades and as a result, earned significant cost advantages. U.S. shipyards, on the other hand, are not currently cost competitive in any of the major classes of large ships, and their annual market is limited to the six to ten large Jones Act ships destined for the domestic U.S. trade. Since the total Jones Act requirement is only a small fraction of the output of the largest Asian yards, the U.S. shipbuilding industry is locked in a cost/quantity trap, one that it appears unlikely to escape.

Government Shipbuilding

Although the U.S. Navy's fleet has shrunk significantly since the Reagan buildup of the 1980's, the U.S. retains the largest Navy in the world and produces the greatest number of warships. The current stated Navy fleet requirement is for 313 ships by 2020, a number derived from an extensive study conducted in 2005 to determine the minimum required force structure needed to meet the security demands of the 21st century with an acceptable level of risk (Mullen, 2007). As shown in Table 2, fulfilling the Navy's 313-ship requirement will require the construction of from seven to thirteen ships annually over the near-term and from five to thirteen ships per year over the next 30 years.

Table 2: The Navy's 30-year Shipbuilding Plan

FY 2008-2037 Long-Range Naval Vessel Construction Plan

	Near Term						Mid Term							Far Term																
	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Aircraft Carrier	1				1				1					1				1				1					1			
Surface Combatant		1	1	2	1	2	1	2	2	2	2	2	2	2	2	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3
Littoral Combat Ship	3	6	6	6	6	5	6	6	5														1	2	3	4	6	6	6	6
Attack Submarines	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	1	2	1	2	1
Ballistic Missile Subs												1			1		1	1	1	1	1	1	1	1	1	1	1	1		
Exped. Warfare Ships	1									1	1		1	1	1	2	1	1	2	1	1	2	1	1	1			1		
Combat Logistics Force	1												2	2	2	2	2	2	2											
Maritime Pre-Pos Force		2	3	3	1	2																								
Support Vessels		1	1	1	1	1	1	2	1	1			2		2	3	2	1				1	1	1						
Total New Construction Plan	7	11	12	13	12	12	10	12	11	6	5	5	9	8	10	10	10	11	10	7	7	9	9	9	10	9	13	12	11	10

Source: (OPNAV N8F, February 2007, p. 6)

In addition to the Navy, other USG agencies also procure ships. The Coast Guard, for example, is currently engaged in a $24 billion, 25-year modernization program that will include eight National Security Cutters, 25 Offshore Patrol Cutters, and 58 Fast Response Cutters (Stables, 2007). The U.S. Army also maintains approximately 300 watercraft of various types, and the National Oceans and Atmospheric Administration (NOAA) and National Science Foundation (NSF) maintain vessels engaged in ocean research and icebreaking, respectively.

The production of government ships, including vessels for both the Navy and Coast Guard, is limited by the funding available from Congress. Changes in recent years to the number and types of ships proposed for the U.S. fleet have created uncertainty among shipbuilders regarding future government shipbuilding requirements.

The remainder of this paper will focus primarily on the challenges and recommendations for government shipbuilding and whether the capability is adequate to ensure U.S. national security and global stability.

Challenges

The Cost - Quantity Paradox

A major challenge for the U.S. shipbuilding industry is the cost/quantity paradox with respect to the construction of warships. Ships cost more today due in part to the low volume procurements. This is a significant factor that is driving up ship costs due to increased overhead expenses to maintain the nation's shipbuilding industrial base. The problem compounds itself as the increased cost of ships lead to low volume procurement in a fiscally constrained environment. The paradox raises the question of whether the Navy will be able to build the ships needed within future cost constraints. The Navy's fleet currently consists of 276 ships -- the lowest since 1929. In 2006, the Congressional Budget Office (CBO) concluded that "unless shipbuilding budgets increase significantly in real terms, or the Navy designs and builds much cheaper ships, the size of the fleet will fall substantially" (CBO, 2006, Summary).

An uncertain budgetary climate.

From the perspective of the number and types of ships required for the Navy fleet, the outlook for the Navy's shipbuilding budget is not bright. Although the Navy requested and received $9.4B and $9.0B for FY06 and FY07, respectively, for the construction of new ships, these were the lowest amounts received in recent years. Moreover, while the Administration has requested $14.1B for shipbuilding in FY08, the CBO believes that it may take as much as $20+B (FY08$) per year to meet the Navy's plan to build and maintain a 313-ship fleet (Fein, 26 March 2007). The Navy does not agree with the CBO's projections, but has acknowledged the challenges faced in achieving the plan. In addition, numerous projections suggest that the overall defense budget will only grow at the rate of inflation in the near future, or even be reduced by non-discretionary government spending. Even if DoD's budget grows in real terms, there is no guarantee that the Navy's share of the budget will remain constant given the pressing needs to reset the Army and Marine equipment that has been employed in Iraq and Afghanistan.

The budgetary challenge is made all the more difficult by the dilemma that Navy planners face in estimating future fleet needs. Warships are large, complex platforms that take 10-plus years to design and build and have a 30-40 year service life. Given the changes in threats and technology, it should come as no surprise that since the end of the Cold War, the Navy's requirement for battle force ships has "varied significantly" (CBO, 2006, page 5). Changes in fleet requirements, in turn, have led to Congressional concerns that the "continual shifting of priorities within the Navy's shipbuilding account indicates uncertainty with respect to the validity of requirements and budget requests in support of shipbuilding proposals." (CRS, 2006, p. 34).

The inherent uncertainty in forecasting future requirements is only one facet of the budget dilemma facing Navy leaders. In an era of increasing budget pressures, it may be difficult to convince policymakers that spending money to acquire ships that will be employed decades into the future is more important than a multitude of more current needs. This will be particularly true if the Navy cannot articulate its needs. The risk is an erosion of the nation's naval capabilities that may impact national security if the shipbuilding budget is consistently shortchanged.

The high cost of Navy ships.

The Navy's budgetary dilemma is juxtaposed against a trend of high-priced ships and cost overruns for USG shipbuilding programs. There are numerous recent examples including:

- The Navy's Littoral Combat Ship (LCS), initially budgeted at $220M, is estimated by some to cost closer to $500M (DiMascio, 2007). The Secretary of the Navy has cancelled the contract for the third LCS in the program out of cost growth concerns.
- The first-in-class amphibious assault vessel (LPD 17), USS San Antonio, commissioned in January 2006, experienced cost growth of $804 million above its initial budget--an increase of 84 percent" (Francis, 2006).
- The Virginia Class submarine program will need approximately $300 million over the next three years to cover projected cost increases (Dujardin, Feb 7, 2007).
- The Navy's newest guided missile destroyer concept, now DDG-1000, was conceived a decade ago as a $750M replacement for the Arleigh Burke class destroyer. The program has swelled to nearly $3.6B per copy. As a result, the Navy has cut its planned purchase from thirty to seven ships (Liewer, 2007).
- In addition to the Navy's problems, the Coast Guard has announced that it will take over management of its Deepwater acquisition program from a private sector consortium due to significant cost overruns in the construction of its National Security Cutter and problems in the conversion of 110-foot patrol boats (Stables, 2007).

These examples appear not to be isolated cases, but part of a longer term trend. According to a recent RAND report the "cost escalation for naval ships is nearly double the rate of consumer inflation" (Arena, et al, 2006). There are a number of reasons for the high costs including immature design, changes and Government Furnished Equipment (GFE).

Some of the cost overruns, such as for the LCS program, have arisen from a decision to begin construction while the ship design was still in an early stage of development. Other overruns relate to the extensive number of changes experienced after construction began. In testimony to Congress, Philip Teel, the president of Northrop Grumman Ship Systems, stated that for the best commercial shipbuilding programs there are only an average of 240 changes for the first ship built in a class and only two changes on average for follow-on ships. In contrast, for the Navy's LHD amphibious assault ship program, there were approximately 5,750 changes from the first ship to the second, and an average of about 3,550 additional changes for each follow-on ship (Teel, 2007, p. 6). He further noted that changes to ARLEIGH BURKE destroyers built by his company have added as much as six million labor hours to production at a cost of $160 million (Teel, 2007, p. 9).

A large component of the cost of Navy ships also has little to do with the actual cost of building the ship, but with the cost of its combat and mission systems. Many of these systems are provided as GFE to the yards. According to CBO, GFE ranges from eight percent of the budget for a Dry Cargo/Ammunition Ship (T-AKE), to as much as 48 percent of the cost of a DDG-51 destroyer (CBO, 2006, p. 81). Due to the high percentage of costs related to combat and mission systems, Northrop Grumman estimates that shipyards control only 50 percent of the total cost of surface combatants, 75 percent of the costs of large deck amphibious ships, and 85 percent of those for an auxiliary vessel (Teel, 2007, p. 6).

While these are significant cost drivers, much of the high cost of the hull, mechanical and electrical cost of naval vessels is driven by the same low volume factors that challenge the country's commercial shipbuilding sector. While the world's largest commercial yards, on average, build more than 130 ships of each design, the average for U.S. military programs is nine

(Teel, 2007, p. 7). The problem is exacerbated by the fact, that in addition to building relatively few ships, the work is spread across six large shipyards. As noted by Chao (2006):

> The massive infrastructure costs of the shipyards, the personnel overhead and all of the new technology being developed have to be absorbed in the price of a handful of ships each year. This, naturally, makes individual ships more expensive, shockingly so in some cases. Often, the reaction by Congress, to save money, is to stretch out the program or cut the number of ships to be bought. This forces the same nonrecurring costs to be spread over even fewer ships, further increasing the unit cost, shocking everyone further and raising suspicions of incompetence.

The Shipbuilding Industrial Base

While most observers agree that the USG does not procure enough vessels to justify maintaining six major shipyards, the cost/quantity paradox is compounded by the desire to maintain a U.S. shipbuilding industrial base. With the withering away of the commercial shipbuilding industry in the U.S., naval shipbuilding now represents over 90 percent of annual domestic production in terms of value (Teel, 2007, p. 5). However, according to several noted industry experts, the best the shipbuilding industry can hope for is "three or four new major combatant hulls and a few support ships a year — for six shipyards that have the physical capacity to build 40 ships a year" (Chao, et al, 2006). The industry warns that "persistently low and unstable rates of naval ship production" could have dire implications on the shipbuilding industrial base (Brown, 20 March 2007, p. 2).

Surge capacity and competition.

Two justifications are commonly used for the need to maintain the current number of major shipyards: 1) The need for a "surge capacity" to build the fleet in response to a crisis, and 2) The need to maintain competition in the industry. There are problems with both. First, while it is theoretically desirable to have the ability to mobilize for a prolonged war, it seems unlikely that the U.S. will face a future scenario where it would have the years required to build additional ships, even with the current excess shipyard capacity. As recently noted by the Secretary of the Navy "we cannot wait for an outbreak of war and then build the Navy we need to fight that war. By then it will be too late" (Winter, 2007). Furthermore, if the perceived need to produce ships quickly to support a prolonged conflict was deemed to be a legitimate concern, then the Navy's process of determining what decommissioned ships are moth-balled, sold, scrapped or sunk needs to be reviewed first. Reactivating a ship that has been laid up is a much quicker process than new construction.

The second justification, the need to maintain "competition" also deserves examination. With the current six major shipyards, the Navy has tried to maintain duplicative capabilities, with two shipyards capable of building surface combatants, two capable of building amphibious ships, two capable of building submarines, and two capable of building auxiliary vessels. With the current dearth of major programs, awarding a "winner-take-all" contract to one of the shipyards could result in the closure of its competitor, and the elimination of future competition. To avoid this scenario, shipbuilding programs have regularly been split between two yards, usually at the behest of Congress. The DDG-51 destroyers, for example, have been built at both General Dynamics, Bath Iron Works and at Northrop Grumman, Ingalls. Similarly, the Virginia class submarines are being built at Electric Boat and at Newport News Shipyard. The new DDG-1000 will have two lead ships, one built by General Dynamics and the other by Northrop Grumman, although there

may be only seven ships in the entire class. The perception this creates is that all of the "Big Six" shipyards will continue to receive Navy contracts regardless of their competitiveness. For some observers, it may appear ironic that in order to maintain "competition" among the shipyards, in theory, the USG appears to have eliminated most vestiges of competition in practice.

The lack of competition for large naval ships within the industry is compounded by the lack of synergy between the commercial and naval sides of the business in the U.S. Only one of the "Big Six" shipyards building vessels for the Navy also builds commercial ships. This phenomenon is driven, in part, by the nature of the vessels being built; warships are generally significantly more complex than commercial vessels and are built to different standards. Lack of synergy is also apparently being driven by the nature of the customer. Several yards indicated an unwillingness to either contract directly for USG ships or to work on USG requirements at all. They expressed concern that USG requirements, both ship construction related; e.g., standards, and non-construction related; e.g., reporting requirements, had a significant cost impact that would make them less competitive on the commercial market. It is telling and troubling, that in order to develop the capability to work for the USG, five of the six major shipyards may have lost their ability to work for anyone else. It is similarly troubling that some of the smaller yards, who simply build ships, have to work in partnership with one of the larger yards or with a systems integrator to navigate the labyrinthine government bureaucracy.

Capital investment.

Capital investment within the shipyards was another challenge discussed during our industry visits. Many of the shipyards were excited to share with us the many new facilities and equipment procured using funding from private or government sources. Such capital investments are important and necessary to improve efficiencies and ultimately reduce the cost of the ships being built. With low volume and uncertain ship procurement, shipyards also pointed out the difficulty in justifying additional capital investment projects, as the business case analyses did not meet internal investment criteria. During testimony before the 2007 House Seapower and Expeditionary Forces Subcommittee, numerous speakers praised the Virginia Class submarine's CAPEX program, as a step to enhance shipyard production efficiency. The American Shipbuilding Association President asked for legislation to "require the Navy to expand the use of "special incentive" fees in all Navy shipbuilding contracts for the purpose of investing in facilities and process improvements where the business case is made that the investment will result in a favorable return to the Navy" (Brown, 2007, p. 3). The challenge becomes how future shipbuilding capital investments should be funded.

Labor conditions.

The decline in U.S. shipbuilding has resulted in a corresponding decrease in the domestic shipbuilding labor force, from over 131,000 employees in 1991 to 97,800 employees in 2004. (U.S. Maritime Administration) Further reductions have put the number of employees in the U.S. shipbuilding industry at 87,900 in 2006 (IBISWorld, 2007, p. 12). Despite the downsizing, the industry is currently experiencing a shortage of experienced workers. According to all companies interviewed, shipbuilders are having difficulty in finding younger workers who are interested in providing the manual labor required to build ships, at the current wages that the industry pays. Among those who are willing, many are recent immigrants and possess poor language skills. Others lack basic technical and academic skills (IBISWorld, 2007, p. 37). To help resolve these shortages, some yards have turned to recruiting workers from Eastern Europe or Mexico under

temporary worker visa programs; however, these workers are not allowed to work on U.S. military ship construction by law.

The shortage of labor is exacerbated by high employee turnover, which is linked to a harsh working environment, an injury-accident rate more than twice that of other construction sectors, and the instability in shipyard workload (IBISWorld, 2007, p.37). The turnover of employees is even more pronounced in small and mid-sized shipyards – an average annual turnover of 39 percent according to the Shipbuilders Council of America (Gebhardt, L. & Hansen, L., 2004, p. 6). Turnover rates are extremely high in the Gulf Coast shipyards, according to a variety of industry sources, where the current boom in the oil industry has made it difficult for the industry to compete for labor. In fact, a small increase in compensation is usually sufficient to lure skilled workers away from the shipyards, especially when the workload is unstable.

One result is that the skill level in the U.S. shipbuilding industry is eroding, notably in welders, shipfitters, machinists, electricians, and marine engineers (IBISWorld, 2007, p. 37). Reviewing the construction of aircraft carriers at the Newport News shipyard, Dujardin (2007) observed that in 1998, only about 15 percent of the workers had less than five years of experience. The proportion of inexperienced workers grew to 20 percent by 2003 and has at least doubled to 40 to 45 percent on the USS GEORGE H.W.BUSH, currently under construction. The shipyard estimates that approximately 50 percent of the work force building the USS GERALD R.FORD, between next year and 2015, will have less than five years of shipbuilding experience.

The industry also must grapple with issues related to an aging workforce. While this is true for many U.S. manufacturing industries, the U.S. shipbuilding industry has been particularly affected by the lack of hiring that took place during the "peace dividend" years of the 1990's. Reduced hiring over much of that decade created a widespread gap in age and experience in the labor force. The gap exists between a group of experienced older workers and a group of relatively inexperienced younger workers. This is particularly true for those shipyards where layoffs were conducted on the basis of seniority.

Maintaining the vendor base.

The challenge in maintaining the shipbuilding industrial base goes beyond maintaining the viability of the major shipyards; it also includes maintaining a viable base of hundreds of vendors and subcontractors. The shrinking naval shipbuilding budget led to a reduction in the number of vendors who supply parts for the fleet. A RAND study concluded that the shrinking and unstable shipbuilding budget has resulted in a number of suppliers leaving the business altogether. It noted that "…shipbuilders rely on sole-source suppliers now more than ever before. More than 75 percent of VIRGINIA-class suppliers are sole sources…consequently the small source vendor base for many components and raw materials has led to increased prices and longer lead times for some critical commodities." (Arena, et al, 2006, p.54). The constraints of sole sourcing creates a high risk environment that often exacerbates the equipment obsolescence problem that occurs when manufacturers cease production of vital ship components due to low and unpredictable demands over time.

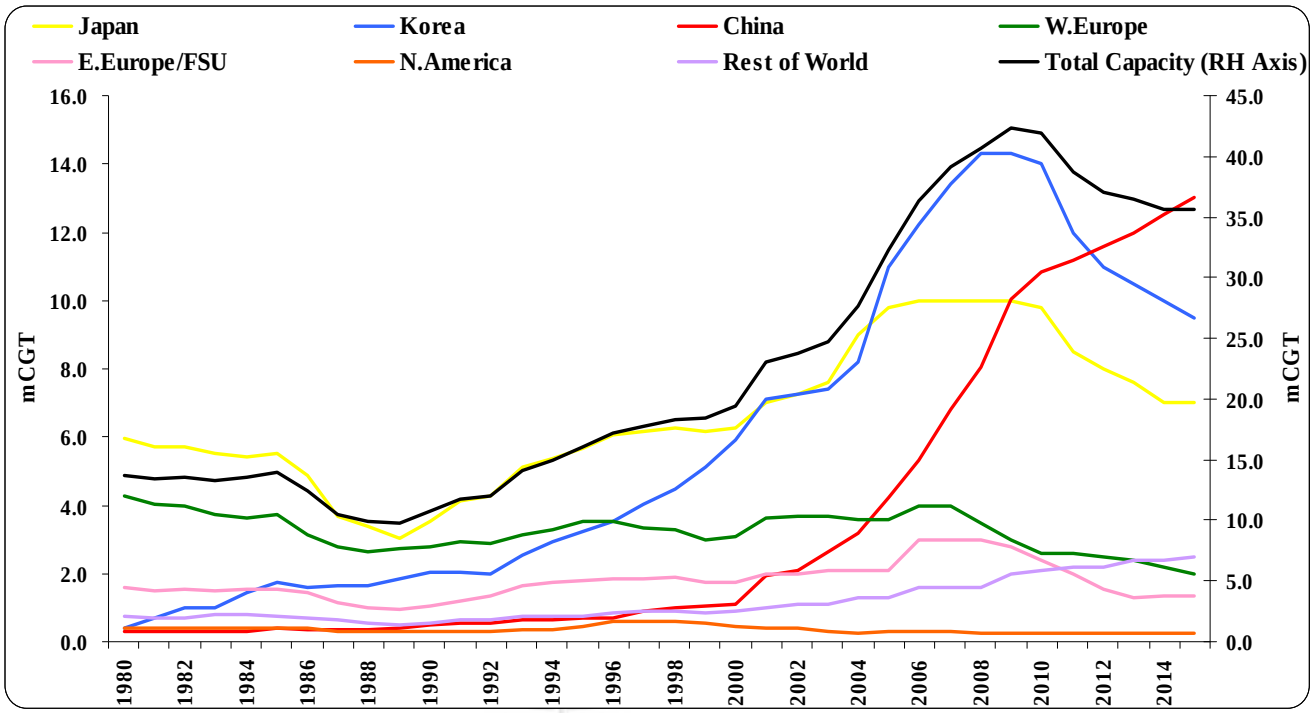
Outlook

International Industry

The worldwide shipbuilding industry is expanding rapidly to cover the demand arising from increased global trade. However, the shipbuilding industry is cyclical and industry experts expect

this boom will end soon. According to Matthew Flynn of Flynn Consulting and Tim Huxley of Lloyds Register, demand for new ship commercial construction is expected to taper off in the 2012-2015 timeframe, and the industry could again experience a period of overcapacity (see Figure 1). If these predictions come true, a buyer's market should develop by 2012 to 2015, and some ship buyers are being advised to delay placing orders to avoid the current premium prices required for earlier delivery.

Figure 1: Shipbuilding by Country, 1980-2015 (Million Compensated Gross Tons (mCGT))



Source: Lloyd's Register (2007) An Overview of the Shipbuilding Industry in China, presentation to ICAF Shipbuilding Seminar, May 9, 2007, by Hector Sewell, Vice President Marine Business Development, North Asia

In addition to the volume of shipbuilding, international trends also point toward larger and more complex ships. A burgeoning trade in energy, particularly in Asia, is expected to result in an increased demand for Very-Large- or Ultra-Large Crude Carriers and liquefied natural gas and compressed natural gas carriers. The industry has also witnessed a trend towards increasingly larger container ships, which will likely be accelerated by the projected expansion of the Panama Canal. Finally, a reduction in ice cover in the Arctic Ocean may open the possibility of new shipping lanes and create a market for icebreakers and ice-strengthened vessels.

U.S. Domestic Industry

The U.S. market for smaller vessels is at a peak. The shipbuilding team observed that several small and medium shipyards have extensive backlogs for ships. Much of the demand, particularly on the Gulf Coast, is driven by high oil and gas prices and the concurrent boom in the offshore petroleum industry. While the outlook over the short term is good, the longer term demand may be tied to the economics of oil and gas exploration and development in the deeper Gulf of Mexico.

The market for new U.S. built oceangoing vessels is less robust, limited primarily to replacements for the existing Jones Act fleet. With a Jones Act fleet of approximately 120 ships, and an average life of 20-30 years, replacement should provide a modest but relatively stable market over the next several years. While it is possible that the domestic industry could receive some spillover benefits from the current boom in the international market, increasing the domestic market significantly will likely require an expansion of the number of vessels engaged in domestic trade. To that end, the U.S. Maritime Administration (MARAD) has promoted the greater use of ocean shipping as an alternative to truck and rail transport to help relieve congested road and rail traffic along the east and west coasts. It is not yet clear if investors will bring these proposals to fruition, but they could result in a greater demand for roll-on/roll-off vessels and/or oceangoing ferries.

Continued movement of labor to higher value jobs will cause enduring shortages of labor for heavy industry in the foreseeable future. That, in turn, will result in premium labor costs for U.S. built ships, making it even less likely the U.S. will recapture a major market share of worldwide shipbuilding.

Maintaining the country's shipbuilding industrial base will probably not be achieved unless U.S. shipbuilders are able to maintain a certain threshold level of industrial activity. When a country stops building a certain class of vessel, it can rapidly lose its intellectual ability to resuscitate the industrial capability. For example, the United Kingdom required U.S. assistance in designing and building its new ASTUTE class of submarines after a hiatus from submarine construction.

Government Role

U.S. shipbuilding is inextricably linked to the government's role in the industry. The U.S. Government is both the largest customer for military shipbuilding and, through regulation of foreign competition, is the guarantor of the viability of the commercial sector. In a nation dedicated to capitalism and private enterprise, it is inherently difficult to accept that government should play such a dominant role in any sector. In shipbuilding, however, there are few good options for loosening the ties that bind the two. Eliminating protection for the commercial shipbuilding industry would promptly eliminate the production of large commercial ships in the U.S., and with it, several thousand jobs. Even to free market proponents, this presents a politically unpalatable choice whose benefits would be both ambiguous and dispersed over the future. Similarly, despite the inefficiencies and high costs of building naval vessels in the U.S., farming this out to overseas firms raises security concerns, and mandating the closure of domestic shipyards raises both political and industrial base questions.

The difficulty in determining an appropriate government role in the industry is illustrated by the question of capital investment in the shipyards. In a normal free market, capital investments in a privately owned facility are made by the corporate owner in the anticipation of an acceptable return on that capital. However, the shipbuilding industry has consistently claimed that, due to the low return on capital from USG contracts, its primary source of income, it cannot justify many beneficial investments. Therefore, the USG has, on limited occasions, provided capital investment in return for lower future ship costs. These investments have been accomplished in two ways - on a program by program basis, as seen in the Virginia Class submarine's Capital Expenditure (CAPEX) program[ii] and for disaster relief, as seen in the Gulf Coast Hurricane capital investment funding.

These programs are controversial. Some observers are fundamentally opposed to the concept that taxpayers should fund capital investments in private shipyards. In addition to being antithetical to the principles of a free market economy, they believe that such programs promote continuation of an inefficient status quo, rather than compelling shipyards to become more efficient. They are also concerned that the program would lead to public investments in shipyards that should be closed. Others believe that USG investment can be justified, in particular where the industry can demonstrate that a specific capital investment will result in greater efficiencies, and reduce the Government's future costs.

Recommendations

To help address the challenges facing the industry, we believe the USG should focus on the following broad recommendations:

Stabilize Demand

A common theme from observers of the industry is the need to stabilize the demand for naval vessels. The current volatility of demand from one year to the next leads to increased costs and makes it difficult to maintain our production and design workforce across seams, gaps, ramp-ups and ramp-downs between programs.

- Coordinate purchases across the "whole of government" to stabilize USG ship procurement. Although the Navy is the largest USG customer for ships, the Coast Guard, the Army, the National Oceans and Atmospheric Administration (NOAA), the National Science Foundation (NSF), and possibly other agencies also purchase ships. The Navy's 30-year shipbuilding plan is a good move towards stabilizing demand; a USG 30-year shipbuilding plan would be a better one.
- Stability in ship construction can be enhanced, and concerns about the feasibility of a surge capability can be mitigated with a thorough examination of the Navy's process for the disposition of decommissioned ships.

Improve Acquisition Processes

Government shipbuilding requires a greater emphasis on stability, foresight and intellect longevity in order to improve ship acquisition processes and reducing ship construction costs.

- The Navy and the Congress should shift to longer-term funding policies to stabilize shipbuilding budgets, using "multi-year" and "block-buy" procurement processes.
- Initiate construction when there is a mature design to reduce costs. As illustrated by the LCS program, beginning construction when only a small fraction of the design is complete can result in significant cost overruns.
- Building from more complete designs would also allow the USG to maximize the use of fixed-price contracting instead of cost-plus contracting. While Cost-Plus contracts are sometimes necessary to accommodate incorporation of immature technologies, as illustrated by the LPD-17 program, they create a disincentive for shipyards to find efficiencies and reduce costs.
- Another key is to rigorously control changes. This will require the Navy to impose greater discipline in requirements definition and changes process.
- The Navy should expedite the implementation of commodity councils to take advantage of bulk purchases for materiel to reduce costs.

- To take maximum advantage of learning curve effects, the Navy plans to design its future fleet around larger production runs of fewer classes of ships. To this end, the USG should explore the use of common hull forms to meet Navy, Coast Guard, and Army requirements.
- The high cost of warships is not limited to the U.S., but is shared by a number of our closest allies, and affects our collective capabilities. The USG should initiate a dialogue with them to consider acquisition strategies that may benefit all parties, including the use of joint designs, acquisition of common parts and sub-assemblies, and even the cross-acquisition of ships or modules. For example, in 2003, it was suggested that Canada trade all its future warship-building requirements to the U.S. in exchange for a relaxation of the Jones Act for Canadian builders. While such a proposal could pose enormous challenges, this type of idea merits further examination.

Enhance Competition Among Shipyards

One of the most important questions is how the USG can drive down acquisition costs through increased competition. While it would be painful to witness the closure of one or more of the existing major shipyards, this option should not be ruled out. An environment where shipyards appear to win contracts by Congressional fiat, rather than through cost competition, is not a healthy one.

- The Navy and the Congress should avoid splitting production runs of vessels between shipyards, or build more than one lead ship for a class, as has been done in the past. The extra costs of moving down the learning curve twice do not appear to be justified by the somewhat limited benefits of ensuring work for multiple shipyards.
- The Navy should promote competition among the shipyards for the production of modules, blocks, and subassemblies. The most efficient international shipyards are increasingly outsourcing the production of large blocks and modules to other shipyards, which allows for cost savings through specialization. Competition for blocks, modules and subassemblies may open competition for Navy contracts to a number of smaller shipyards.
- If other measures fail to increase competition, the Navy should consider building vessels in Navy shipyards, under a Government-Owned, Contractor Operated (GOCO) arrangement.

Pursue the agility of Mass Customization

Since mass production efficiencies are difficult to achieve, mass customization processes are essential in the low-volume highly-complex platforms of today's Navy. In today's highly technical environment, the emphasis has shifted from quantity to capability. There are also steps in the design and production of ships that can be taken to lower their cost, many of which are already being adopted by the Navy. These include:

- Design ships for lower life-cycle costs, including not only lower production costs but lower operation and maintenance costs.
- In support of lower life-cycle costs, design for production. Efficiency in ship construction begins with designers matching shipyard facilities to construction processes and scheduling. First Marine International's 2006 study cited design for production as the area in most need of improvement by US shipyards.
- Continue development of a common USG parts catalog to support standardized parts and equipment across ship classes.
- Make greater use of modularization and open architecture in future designs.

- Encourage shipyards to use "digital thread" technologies and common design software to allow the seamless sharing of information at design and the individual piece-part or module level. The construction of the Virginia Class Nuclear submarines shared between Northrop Grumman's Norfolk, VA facility and General Dynamics' Electric Boat Division in Groton, CT provides an excellent example of the potential for efficiencies and cost savings realized by digital thread and common design software.
- Encourage "Centers of Manufacturing Excellence" (CME) where shipyards invest in specific areas of manufacturing where they may have advantages that could be provided across the sector. An example is General Dynamics' automated light metal fabrication unit at their Quonset Point, RI facility.

Way Ahead

1. Interagency Shipbuilding Board

- **Recommendation:** Congress should establish an interagency shipbuilding board to seek synergies across departments and agencies.

- **Discussion:** Given the DoD's prominent role in shipbuilding, the Secretary of Defense should designate the chairman of this board, but it should also include representatives from the services, Coast Guard, and other agencies including the National Oceanic and Atmospheric Administration (NOAA) and National Science Foundation (NSF). We recognize that this recommendation would require coordination among the various Congressional committees charged with shipbuilding appropriations. The first objective of this board would be to assess the nation's shipbuilding requirements across the whole of government. A second objective of the board would be to review how the agencies might reduce shipbuilding costs. Finally, if interagency cooperation proves successful, the board should initiate a dialogue with our closest allies to see if further savings could be achieved.

2. USG Shipbuilding Plan

- **Recommendation:** Congress should require the bi-annual submission of a long range USG shipbuilding plan to coincide with DOD POM years.

- **Discussion:** The Secretary of the Navy can coordinate the Navy's 30-year shipbuilding plan with the USA, US Coast Guard, NOAA, and other agencies to develop a USG shipbuilding plan. The Navy's 30-year shipbuilding plan is an excellent first step, but the Congress should request a more comprehensive plan that also incorporates the anticipated needs of the Coast Guard, the Army, the NOAA, NSF, and possibly other agencies.

3. Government-Industry Shipbuilding Forum

- **Recommendation:** Secretary of the Navy will institute a Government-Industry shipbuilding forum to review the USG's shipbuilding plan in concert with industry and other government organizations prior to the plan's submission to Congress.

- **Discussion:** Allows industry (in a non-competitive environment) to discuss concerns, from an industry point of view, about the governments future shipbuilding plans. Industry will be allowed to comment on rates of production and scheduling for government

consideration. Inviting other government entities would provide a forum that allows visibility of other government programs and may provide the catalyst for future joint or inter-agency shipbuilding programs.

4. Longer-term Funding Policies

- **Recommendation:** Congress and the Navy should establish longer-term funding strategies such as the use of "multi-year" and "block-buy" procurements.

- **Discussion**: Establishment of a long-term shipbuilding plan, underpinned by a long-term funding strategy would establish stability in the shipbuilding industry and reduce the cost of ships.

5. Preserve the Nation's Shipbuilding Intellect

- **Recommendation:** The Navy should preserve funding for positions charged with the responsibility for naval engineering, architecture, and design.

- **Discussion:** The ability to design warships may be the most critical capability in our shipbuilding industrial base. The Navy should maintain subject matter expertise in order to provide proper oversight of design and construction. To ensure that the USG maintains design intellect, Congress should ensure the Navy allocates and preserves funding for positions charged with the responsibility for naval engineering, architecture, and design.

6. Promote competition for the production of modules, blocks, and sub-assemblies

- **Recommendation:** Under Secretary of Defense for Acquisition, Technology and Logistics with the Secretary of the Navy should develop procurement strategies promoting greater competition for modules, blocks and sub-assemblies.

- **Discussion:** This strategy would mitigate the low-volume and overcapacity situation by employing contract award criteria and other measures to encourage bids that involve multiple shipyards. Alternatively, modules, blocks and sub-assemblies could be openly competed from both private and public sources and provided as Government furnished equipment (GFE) to the prime contractor for final outfitting and integration. Sourcing modules and blocks can result in reduced costs through competitive advantages, mitigate some of the structural labor shortages being experienced throughout the domestic shipbuilding industry, and open competition to smaller shipyards for Navy shipbuilding. This effort will not only require working from mature designs, but also the use of common design tools and contracts that encourage bids that involve multiple shipyards. Ultimately, these efforts might be expanded across other agencies, as appropriate.

7. Support initiatives to promote short sea shipping.

- **Recommendation:** Congress should enact H.R. 1499, the "Short Sea Shipping Promotion Act of 2007."

- **Discussion:** H.R. 1499 promotes short sea shipping by amending Section 4462 of the Internal Revenue Code of 1986 to exempt certain domestic cargo from the Harbor Maintenance Tax. By removing this significant impediment to the development of short

sea shipping, short sea shipping can develop to accommodate not only the future growth in transportation requirements, but also relieve existing congestion on the I-5 and I-95 corridors. This growth in shipping will drive increased demand for new ships which will help address the cost-quantity paradox. Secondary benefits of shifting coastal cargo movement from the highways to the sea include reduced productivity losses due to highway congestion, lower highway maintenance cost and reduced need for new highways, reduced fuel use, and reduced pollution with associated health benefits.

8. Centralize management of capital investment

- **Recommendation:** Secretary of the Navy stand up a Program Executive Office type organization to centrally manage capital investment in public and privately owned shipyards.

- **Discussion:** Centralized management allows the government to better monitor the public and private shipyards and make more effective decisions in where to apply government capital investment funding if appropriate. By targeting investment, this office could guide individual shipyards to become technical centers of excellence in specific areas instead of duplicative investments across the industry. Investments could therefore be proposed on an overall industry business case, enhancing multiple ship building efforts versus incentives for individual programs as is the current process.

9. Disposition of decommissioned ships and surge capability

- **Recommendation:** Secretary of the Navy review the policy applied to determine the disposition of decommissioned ships and incorporate the disposition schedule into the longer-range USG shipbuilding plan.

- **Discussion:** Many decommissioned Navy ships that have remaining service life have been destroyed or sold to other governments instead of being preserved (or "moth-balled") for future surge requirements. In the event there is a surge requirement for Navy ships, reactivation of preserved ships would be faster and less expensive than a new construction project.

Conclusion

The 2007 Shipbuilding Industry Study Team visited domestic and international shipyards and interviewed numerous shipbuilders and consultants to determine whether the U.S. shipbuilding industry can adequately support global stability and the national security of the United States with an acceptable level of risk. The consensus of the Industrial College of the Armed Forces Shipbuilding Industry team is that with the recommendations included in this study, the U.S. shipbuilding industry is capable of supporting national security and global stability.

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Endnotes

[i] The 38 regulations include USC 10 § 2362 (d), USC 10 § 2538 (d), USC 10 § 2208, USC 10 § 2208(j), USC 10 § 2469(a), USC 10 § 2474, USC 10 § 2563, USC 10 § 2667, USC 10 § 4543, USC 10 § 2473, USC 10 § 7300, USC 22 § 2754, USC 22 § 2770, FAR 45.4, USC 10 § 2539(b), USC 10 § 2460, USC 10 § 2465, USC 10 § 2451, USC 10 § 2452, USC 10 § 2453, USC 10 § 2454, USC 10 § 2456, USC 10 § 2457, USC 10 § 2458, USC 10 § 2462, USC 10 § 2463, USC 10 § 2464, USC **10 § 2466**, USC 10 § 2469, USC 10 § 2470, USC 10 § 2472, USC 10 § 2473, USC 10 § 2475, USC 10 § 2572, USC 10 § 2574, USC 10 § 2575, USC 10 § 2576
Title 10, Section 2466, U.S.C., Limitations on the Performance of Depot-Level Maintenance of Material (a) Percentage Limitation.— Not more than 50 percent of the funds made available in a fiscal year to a military department or a Defense Agency for depot-level maintenance and repair workload may be used to contract for the performance by non-Federal Government personnel of such workload for the military department or the Defense Agency. Any such funds that are not used for such a contract shall be used for the performance of depot-level maintenance and repair workload by employees of the Department of Defense.

[ii] "The VIRGINIA Class Capital Expenditure (CAPEX) program is a 1.5 percent special incentive that is included in the VIRGINIA Class Block II multi-year ship construction contract. This program allows a portion of the overall contract profit to be diverted to fund a series of incentives. To earn the incentive, the shipbuilder has to show the cost/benefit analysis of the improvement. The Navy has up to $91 Million available to fund this program over the life of the contract (through 2008)." (Sullivan, 2007)