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**Final Report
*Shipbuilding Industry***



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Abstract

A robust US shipbuilding industry remains vital to our national security. At present, the government sector of the US industry can meet the current and projected national security needs. Further, the US commercial sector, while protected from foreign competition by legislation, provides some risk reduction benefit in the national security realm as well. Both sectors are challenged however by the shortage of skilled workers, a problem that is only expected to worsen and specific recommendations are provided within the body of the paper to address this workforce issue. The government sector is also challenged by a Navy shipbuilding plan that is caught in a paradigm where it is seeking increases in the number of ships and the complexity of the ships being procured, while operating in a budget constrained environment. These challenges are also addressed within the body of the paper and focus on stabilizing the Navy's shipbuilding plan and improving program execution.



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Domestic Places Visited

Carnival Corporation and Cruise Lines, Miami, FL
 General Dynamics Electric Boat, Quonset Point, RI
 Portsmouth Naval Shipyard, Portsmouth, NH
 General Dynamics Bath Iron Works, Bath, ME
 Aker, Philadelphia, PA
 United States Coast Guard Yard, Curtis Bay, Baltimore, MD
 Northrop Grumman Newport News Shipbuilding, Newport News, VA
 Northrop Grumman Ship Systems-Ingalls Operations, Pascagoula, MS
 Austal USA, Mobile, AL
 Naval Sea Systems Command, Washington DC
 Bollinger Shipyard, Lockport, LA
 North American Shipbuilding, LaRose, LA
 VT Halter Marine-Pascagoula Operations, Pascagoula, MS
 Northrop Grumman Ship Systems, Avondale Operations, Avondale, LA
 Waterman Steamship Corporation, Mobile, AL

International Places Visited

DCNS, Toulon, France
 Thales, Brest, France
 ENSIETA Engineering College, Brest, France
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 Normandy Battleground, France
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Introduction

The world's oceans have contributed to the United States' (US) ability to achieve its national security objectives since the nation's founding. Militarily, the oceans provide a large maneuver space from which to project power abroad and influence events. The US has historically utilized forward deployed naval vessels to deter aggression, and where deterrence has failed, help win our nation's wars. Recently, these forces have also provided the US with an effective crisis response capability to deliver timely disaster and humanitarian relief across the globe. Economically, the world's oceans transport approximately 90% of all traded goods. As the forces of globalization continue to widen and deepen the economic interdependence among nations, this transportation of goods across the world's oceans will remain critical to US prosperity and economic security.

The US reliance on the world's oceans to support the military and economic elements of national power has led the authors of this paper to conclude that **the US shipbuilding industry remains vital to our national security**. Possessing the industrial base and skilled workforce to produce ships allows the US to protect itself at home, project and sustain power abroad, and to actively participate in the trade opportunities offered by a globalized world economy. **The purpose of this report is to assess the ability of the shipbuilding industry to support US national security objectives today and in the future with an acceptable level of risk.** To conduct this assessment, the authors were able to meet with key personnel from government and industry to discuss relevant issues. We also visited several shipyards and related industry and government organizations within the US, France and the United Kingdom. This report reflects our analysis of information gained from these meetings as well as that gained through independent research.

The Shipbuilding Industry Defined

The shipbuilding industry comprises establishments operating shipyards to build and repair ships. **The US industry generated revenues of over \$14.5 billion in 2006, but remains a minor producer worldwide, accounting for only 1.3% of new commercial ship construction in terms of tonnage.** The US has 24 first tier shipyards currently constructing or capable of constructing ships of 400 feet or greater¹, and more than 200 lower tier shipyards in 33 states capable of constructing and repairing smaller ships². Geographically, the shipyards on the eastern and gulf coasts accounted for over eighty percent of the industry's revenues. The current US shipbuilding workforce is approximately 89,500 and has remained fairly stable over the last five years.³ Another 60,000 are employed as a result of the shipbuilding industry, including mariners. **The industry consists of government and commercial sectors** that are differentiated primarily by the complexity of the ships produced, the markets in which they operate, and the frequency with which ships are ordered and constructed. For practical analytic purposes, this differentiation has effectively created two separate industries, a conclusion supported by the small number of firms operating simultaneously in both sectors.

The government sector accounts for 70% of all US shipbuilding revenue and primarily supplies the US Navy, which at 279 ships and more than 325,000 sailors, is the

world's largest. Firms within this sector also supply cutters to the US Coast Guard and ships to other government agencies, including research and maritime pre-positioning vessels. The sector is dominated by two firms, General Dynamic and Northrop Grumman, which operate the "big six" shipyards: Electric Boat, Bath Iron Works, NASSCO and Avondale, Ingalls, Newport News, respectively. This sector is also serviced by five public shipyards, four operated by the Department of the Navy and one operated by the Coast Guard, that primarily execute repair work for their respective organizations.

Despite being a minor world producer in terms of tonnage, the US commercial shipbuilding sector constructs in excess of 2,000 vessels a year, including dry cargo ships, bulk carriers, passenger ships, tankers, and fishing and industrial vessels. Further, it services a domestic commercial fleet that includes over 44,000 vessels representing a capital investment of more than \$26 billion by US companies⁴.

Shipbuilding Industry Status

In the last two decades world trade by sea has steadily increased: 3.3 billion tons of cargo in 1980, to 4.3 billion tons in 1995, to a projected 5.5 billion tons in 2010. In 2002, the levels of worldwide commercial ship production through 2010 are forecasted for between 1500 to 2000 ships. The building of commercial ships worldwide has increased every year for the last ten years, or 137 percent from 1988 to 1998. At the same time, cargo vessel market shares have shifted dramatically. Western Europe has declined from thirty three percent to eighteen percent, while South Korea has increased one percent to twenty-nine percent. The largest share was held by Japan at over thirty-nine percent. Prior to the emergence of China onto the global shipbuilding scene, Japan and Korea held two-thirds of the total global ship production.⁵

Despite these opportunities, it is well documented that **the US commercial shipbuilding industry is not internationally cost competitive**; particularly in the construction of vessels over one thousand gross tons. Labor costs are the main reason why US ships costs so much more to build. While labor costs by the hour are not that disparate, US shipbuilders are less efficient, taking significantly longer to produce a ship. Foreign shipbuilders tend to have more modern plants as they came into the industry later and skipped a generation of technology. Certain foreign governments (particularly South Korea) subsidize or are even partially own shipyards. Their lower cost leads these firms to build more ships, allowing them to benefit from the steep learning curve that occurs in shipbuilding. Even with the falling US dollar making prices cheaper and US shipbuilders acquiring more advanced equipment, US shipbuilders remain comparatively inefficient because it takes longer and therefore costs more to build a ship in the US. It is a vicious cycle: US ships cost too much to compete in an international market so no one buys them, depriving US shipbuilders of benefiting from the learning curve, leading to US ships costing too much.

Of the approximately 250 private firms in the US industry, about ten percent of the companies accounted for eighty-five percent of the revenues. The "big six" shipyards accounted for up to two-thirds of the industry's total revenue, with over ninety-five percent of these firms' revenue being generated by defense-related work.⁶

These disparate figures are indicative of the lack of commercial competitiveness displayed by the “big six” shipyards. Over ninety-five percent of their revenues are specifically tied to the US government. Granted, the shipyards are meeting a strategic need, but, there is risk when a private company’s financial umbilical cord is tied to the US government. As the industry learned in the 1980’s, driven by political and economic decisions (and realities), operating and construction differential subsidies to the shipbuilding industry were cut by the Reagan Administration and the industry has yet to recover.

The US position in the global shipbuilding industry continues to suffer due to continued dependency on military work. The US shipbuilding dependency on military production has pushed the US further behind in all aspects of commercial production. Our foreign competitors continue to recapitalize and modernize their commercial production lines. While the US shipbuilding industry’s ability to produce naval vessels is unmatched worldwide, there is no global market for these highly complex and costly vessels. As a result, the US shipbuilding industry continues to focus on the means necessary to build a better *military* product, not commercial, and the global competition in the commercial market continues to outpace the US.

The Political / Legislative / Regulatory Environment

The shipbuilding industry cannot be fully defined and understood without considering the political, legislative and regulatory environment in which it operates. As with many industries, this environment exerts significant influence on shipbuilding and its associated markets.

Given shipbuilding’s importance to national security, the US government, through legislation and regulation, plays an integral role in ensuring the industry’s viability and long-term survival⁷. The government has historically executed that role by implementing legislation to protect the interests of US shipbuilders and operators. This political process is often affected by the inherent tension between the executive and legislative branches of government. In the commercial sector, five pieces of legislation are most pertinent:

1. The Cargo Preference Act of 1904: This legislation stated that Department of Defense (DoD) cargo must be carried exclusively on US-flag vessels, if available, at reasonable rates.
2. The Merchant Marine Act of 1920 (The Jones Act): This legislation limits the transport of cargo between US ports to American made, owned and crewed vessels.
3. The Merchant Marine Act of 1936: This legislation established that it is the policy of the US to promote and preserve the US fleet, supporting commercial ship construction and providing operating subsidies. This act also established the Title XI government loan financing program.⁸
4. The Cargo Preference Act of 1954: This act mandates that for government procurements requiring ocean transportation, at least fifty percent of the gross tonnage is to be transported on privately-owned US-flagged commercial vessels (when available and at fair reasonable rates).⁹

5. The Passenger Services Act of 1886: This legislation states that no foreign vessel shall transport passengers between ports or places in the US.

In the regulatory arena, DoD's directives for transporting cargo or forces also emphasize the use of commercial shipping. DoD Instruction 4500.57, "Transportation and Traffic Management," dated March 18, 2008, established policy on how DoD cargo will be moved. As stated in the instruction, "DoD components shall use the transportation services of U.S. commercial sources to the maximum extent practicable...DoD Components shall not use Government-owned transportation assets to compete with or supersede the use of U.S. commercial transportation capability."¹⁰ Although the directive later states that in order to optimize costs, a government-owned vessel, if activated, can be (and should be) given preference when assigning a DoD lift, the key point is that there is direction within the DoD to emphasize the use of US shipping.

The government sector of the shipbuilding industry is also influenced by legislation with protectionist qualities. In this sector, the primary pieces of legislation are:

1. The Byrnes-Tollefson Amendment: This legislation provides for restrictions on construction or repair of government vessels in foreign shipyards. It does however permit the President to authorize exceptions when in the national security interest.
2. The Buy American Act of 1933: This legislation mandates preferences for the purchase of domestically produced goods in direct procurements by the US Government. This requirement may also be waived under certain circumstances.

Further, yearly Defense Authorization and Appropriation acts often stipulate the manner in which the government procures ships, which in turn influences the industry. As an example, the 1998 National Defense Authorization Act required the Navy to contract for the first four VIRGINIA Class submarines in accordance with a legal agreement entered into by Electric Boat and Newport News. The agreement stipulated that Electric Boat would be the prime contractor for VIRGINIA Class construction contracts and that Newport News would equally share the construction and assembly work through a subcontracting arrangement. Subsequent authorization acts have continued this requirement through the tenth hull. Prior to the 1998 legislation, the Navy had planned to procure the submarines from a single firm as a cost savings measure, potentially eliminating the other firm from the submarine construction business. This type of congressional influence is not unique to this program however, as similar examples can be cited for other military shipbuilding programs.

As noted above, the industry employs a significant number of people and does so in relatively concentrated geographic areas. This effectively forms a **political constituency associated with the shipbuilding industry that has historically exerted influence in both the executive and legislative branches**. In assessing the health of the industry, it is important to acknowledge its existence and its ability to impact how the industry functions.

The authors considered several alternatives to the legislation currently in place, including elimination of individual provisions to sun-setting the legislation completely

over time. Despite the net drain on the US economy, the authors **do not recommend any changes to the protectionist legislation currently in place.** This legislation has effectively maintained the second tier shipyards and they remain a viable source for some government procurements (i.e. Littoral Combat Ship, Coast Guard ships, and research vessels). These yards also provide ships that support inter-coastal trade, the energy sector and other economic development activities. Further, they provide a workplace for key shipbuilding skills that could enable a surge in naval vessel construction if required. The authors believe the **economic impact of this net drain is minimal when compared to the national security benefits** derived from these second tier shipyards.

Issues Facing the Industry: Workforce

Given the US shipbuilding industry's concentration in the government sector, it is not surprising that a large percentage of the 89,500 person workforce is located in the private and public shipyards supporting US government programs, as indicated in table 1.

Table 1: Shipbuilding Workforce Supporting US Government Programs

Firm / Organization	Workforce
General Dynamics Shipyards	20,000 ¹¹
Northrop Grumman Shipyards	24,000 ¹²
US Naval Shipyards	23,200 ^{13 14 15 16}
US Coast Guard Shipyard	900 ¹⁷
Total	68,100

This **shipbuilding workforce is specialized with the majority of the labor force either highly or moderately skilled.** Norfolk Naval Shipyard is representative of the workforce composition of both the public and private shipyards. It currently has a workforce that is seventy percent highly skilled, twenty percent moderately skilled and only ten percent unskilled.¹⁸ It includes trades such as electrical and electronics, machining, piping, rigging, sheet metal and ventilation, welding, woodworking, sandblasting, painting and insulation¹⁹ with associated skill levels ranging from apprentice to journeyman to craftsman. These skills are not easily transportable to or from other markets and take considerable time to develop. It takes two to three years just to become a minimally capable submarine mechanic and over ten years to become a craftsman.²⁰ It takes an average of six to eight years to train and fully qualify workers to the journeyman level so they are technically skilled to work on nuclear submarines and aircraft carriers.²¹

In addition to shipyard personnel, the Naval Sea Systems Command (NAVSEA) employs approximately 30,000 personnel to execute technical oversight of the Navy's ship design and construction programs²². NAVSEA "builds, buys and maintains the Navy's ships and submarines and their combat systems..." and "...has the further responsibility of establishing and enforcing technical authority...to ensure systems are engineered effectively, and that they operate safely and reliably."²³ This workforce is also highly specialized. In general, seventy-nine percent of the government's acquisition workforce possess post high school degrees and specialized training in their career field.²⁴

Having a very large and specialized workforce, the shipbuilding and repair industry is vulnerable to current human capital threats and challenges. As such, **the ability to attract and maintain a highly skilled workforce is critical to the health of the industry.**

At present, **shortages of skilled and experienced workers exist in nearly all areas of the industry**, including production, ship design, engineering and acquisition. The recruitment of workers into the shipbuilding industry is becoming more and more challenging every day. Al Krekich, president of BAE Systems Ship Repair in Norfolk, Virginia voiced this concern as the ship repair industry's biggest challenge.²⁵ These workforce shortages are largely due to the reduction in the number of ships the government ordered over the last decade and the manner in which they are typically awarded, scheduled, and funded. With the declining number of ships on order, it has been difficult for companies to meet today's delivery requirements while still retaining workforce for future programs. The common trend within the industry is to lay off workers based on seniority.²⁶ Although this maintains skilled workers for the present, it has caused a large gap in the workforce. The heart of the shipbuilding industry is skilled dedicated workers who understand the art of building great ships and that experience can not be replaced overnight.²⁷

In addition to a shortage of workers, the majority of the existing workforce is approaching retirement age, with the potential to compound the problem. It is commonly known that the US is facing a serious issue of an aging workforce. This is becoming a dual threat because the US not only needs replacements for the retirees, but its growing economy will put additional demands on the workforce. Within the next two decades, seventy-six million Americans are expected to retire with only an estimated forty-six million entering the workforce to replace them.²⁸ The challenge is expected to be greater in the public sector, particularly within the DoD acquisition workforce which has an average age of forty-seven and a half years.²⁹ **Because of the specialized nature of their work, replacing these retiring workers will take considerable time.** Much like its public sector counterpart, the private sector shipbuilding workforce is also battling the aging workforce issue. The current average age of the shipyard workforce in the US is forty-five and over thirty-three percent of shipyard workers are over the age of fifty.³⁰ The anticipated high rate of retirements will seriously threaten the shipyards' ability to maintain a skilled and effective workforce over the next decade.

The risks of losing the skills associated with this workforce are significant. The construction of the SSN 23 submarine emphasizes this point. In the year 2000, requirements drove the Navy to add a large hull section to the SSN 23 submarine. Not only was this a complex integration of next generation weapons, sensors and unmanned undersea vehicles, but the Navy needed it within four years. If the design workforce of NAVSEA and General Dynamics was not intact, the program would have taken twelve to fourteen years to execute and been substantially more costly.³¹ The British Navy provides another example of losing critical skills. When the British Navy started their new Astute class submarine program, most of their design and engineering capability was depleted. They tried to ramp up their capability, but after serious schedule delays and cost increases, General Dynamics had to provide a team of designers and engineers to go overseas and complete the design.³² This demonstrates the potential dangers of losing critical skills and capabilities and having to rely on it being existent somewhere else in

the world. Due to the downsizing experienced in the US shipbuilding industry over the last decade, the US is in danger of losing critical skills.

Meeting the Workforce Challenge

In order to meet these challenges, a rejuvenation of the skilled workforce is required to regain the critical capabilities that support our national security objectives. Initiatives from both the public and private sectors are necessary to facilitate this rejuvenation.

In the private sector, the **shipbuilding companies must focus on ways to fill the gap in the workforce**. One of the ways in which they have been accomplishing that goal in the commercial shipbuilding sector is to recruit and hire workers from abroad. Many of the commercial sector shipyards the authors visited regularly recruited workers from outside the US, predominately from Mexico and Eastern Europe. Despite the costs associated with recruitment, the work visa process, transportation, and establishing living arrangements here in the US, the use of foreign labor was viewed as critical in meeting the workload at many of these firms. The limiting factor on the utility of these employees can be the length of the work visa they receive. Currently, these workers are only eligible for a 10 month visa. Given the time it takes to train a proficient shipbuilder, the 10 month visa is barely long enough to allow the workers to get oriented. While the workers are able to apply for a second 10 month visa, after returning to their home country, this process is cumbersome at best and injects additional costs and inefficiencies into the commercial sector's business. **The authors recommend that Congress, in conjunction with the appropriate federal agencies (Department of Labor, Department of State, Department of Homeland Security) endeavor to lengthen the work visa for these employees from 10 months to 2 years.** This would allow these workers to develop at least some level of proficiency at their trade, potentially allowing them to reach the journeyman level during their second visa.

The authors were encouraged that many of the shipyards visited retained active apprentice programs to attract, train and retain domestic workers as well. Another way to fill the workforce gap is to reevaluate those programs. Traditionally, the apprentice program has focused on young inexperienced workers in their teens and early twenties who want to learn a new trade. Opening up the program to workers in their thirties will broaden the talent pool and help fill the age gap. Their previous work experience and desire for stable work can be leveraged and potentially shorten their training time to less than the six to eight years it is now. Of course, innovative recruiting must be implemented in order to compete for these resources with other industries/markets that are experiencing the same challenges. In order to recruit the younger generation, the industry must understand what drives these potential workers and **provide flexible and rewarding apprenticeship programs**.

Workforce stability is also an issue that the Department of Defense and Department of Navy must address if the shipbuilding industry is to retain its skilled workforce. The government sector of the shipbuilding industry in the US has mostly divorced itself from the global commercial shipbuilding market. Ideally, the sector would diversify into the commercial sector or other industrial markets, stabilizing the

workflow to a greater degree and in turn, help retain and grow the skilled workforce. To date, the differences between the sectors previously noted (complexity of the ships produced, the markets in which they operate, and the frequency with which ships are ordered and constructed) have precluded the “big six” firms from achieving these synergies. Until these firms diversify, they are reliant on Navy shipbuilding work and **perturbations of the nature recently experienced in the Navy’s 30 year shipbuilding plan do not give the industry sufficient confidence to hire, train, and retain a workforce for the long term.**

Stability in the Navy’s 30 year shipbuilding plan has been singled out by nearly every stakeholder as a critical element in achieving affordability for the Navy’s proposed shipbuilding program and one of the primary impacts is in the workforce. Specific recommendations to achieve greater stability in the 30 year shipbuilding plan are provided below in the discussion on naval acquisition, its influence on the workforce is noted here however. On the ship design and engineering side of the industry, the Navy’s shipbuilding plan also has effects. To maintain the flexibility of meeting new complex requirements in a short amount of time, maintaining a skilled design and engineering workforce is also critical. This can be maintained by **lengthening the design work on new generation ships and submarines.** Although this also lengthens the overall acquisition schedule, it allows the industry and the Navy to sustain a level loaded, effective workforce capable of providing the next generation of naval ships, when needed.

Similar to the private sector shipyards, the public yards are faced with the same age gap and recruitment issues. **NAVSEA must continue to foster the “One Yard – Four Locations” concept** of managing shipyard workload and potentially team with the US Coast Guard Yard if that aids in leveling the load among the various sites. This concept allows for the transportability of skilled labor to the work necessary to maintain a critically skilled workforce.

The authors also see a need to incentivize education and training in the skills required by the shipbuilding industry, both in the skills required for ship production and in the skills required for ship design and engineering. In technical fields, statistics clearly show that students in this country are moving away from studies in Science, Technology, Engineering and Mathematics (STEM) at an increasing (and alarming) rate. In 1994, 32 percent of American students obtained College level degrees in STEM, but by 2004 that number was reduced to 27 percent.³³ At the same time Non-STEM degrees have grown from 1.1 million in 1994 to 1.5 million students in 2005.³⁴ The authors **recommend that the US government (Department of Education and the Naval Services) partner with industry to establish scholarships and grants for trade schools and post-secondary education specializing in shipbuilding skills,** both production and technical. One aspect of a program of this nature should be to guarantee and require job placement, following completion of the training, inside both the government (e.g. NAVSEA) and the private firms within the industry.

Issues Facing the Industry: US Navy Acquisition

The Acquisition Paradigm...Quantity versus Budget versus Capability: As the US Navy moves forward with plans for a 313 ship fleet, it faces a series of challenges

which will likely dictate their overall success. Ultimately the Navy is trying to increase the overall number of ships in the fleet, provide for a significant increase in the capability and sophistication of these ships, and secure significant increases in the shipbuilding budget over the next 10 to 20 years to do so. Achieving any one of these goals presents a significant challenge, but the pursuit of all three simultaneously incurs substantial risk and threatens the plan's overall credibility. Of course none of these parameters is independent of the others and trade-offs between quantity, capability, and budget are anticipated.

Quantity: The Navy is planning to reach 313 ships by 2020 as shown in Figure 1. Today there are 279 ships in the Navy's inventory which is well below the 600 ship Navy of the Cold War. In addition to increasing the overall number of ships, the plan calls for the retirement of some classes and the introduction of new classes into the inventory. While the authors were unable to rationalize or validate the "calculus" behind the current plan, for the purposes of this *industry* analysis, a fleet size ranging from 275 to 325 ships is viewed as most plausible. What is significant about the number of ships is the procurement profile required to reach the planned 313. The plan increases the yearly purchase of ships from seven in 2009 to fourteen by 2013. At a minimum this is an aggressive procurement schedule regardless of the type or cost of the individual ships and it is compounded by the risks associated with the uncertainty in the DoD budget over the next five to ten years.

Navy Budget: The Navy's initial 313-ship building plan and associated budget have been heavily scrutinized over that last several years and suffered criticisms from members of Congress, the Congressional Budget Office (CBO), Government Accountability Office (GAO) and other defense organizations.³⁵ The current FY09 budget as submitted by the President to Congress requests over \$14B for shipbuilding, representing an increase of over forty percent from FY07. The planned shipbuilding budget is expected to eclipse \$20B by 2013. However, an independent assessment from the CBO indicates that the Navy's long term budget execution plan has been underestimated by as much as 35% and historical trends further support that the Navy's current budget is suspect and cannot support the 313-plan.

The significant increases from FY07 to FY09 and beyond are required to produce the quantity of ships required as well as support the new programs planned. Yet, these budgets are heavy in risk because they assume success in meeting program cost, schedule and performance thresholds and assume that amphibious ships, cruisers and destroyers will remain operational beyond their original service life.³⁶ Based on past performance in any program across any service the Navy and Congress can expect both cost increases and schedule delays at levels that may well result in Nunn McCurdy breeches for new shipbuilding programs. Specific examples where the Navy's budget has failed to align with independent estimates include the DDG-1000s and the Littoral Combat Ships (LCS). The Navy estimated the procurement cost for the first two DDG-1000s at \$6.3 billion with a 45% confidence rating that actual costs will meet the Navy's estimate. In October 2007, an independent Cost Analysis Improvement Group (CAIG) estimated that the two ships would cost closer to \$7.2 billion or about 14% more than the Navy's estimate. The

2008 CBO estimate for the first two DDG-1000s is about 56% higher than the Navy estimates.³⁷ Similar cost estimating challenges have been noted in the LCS program as the cost for the first two sea frames, originally forecasted to be \$220M each, are now estimated to be over \$400M per sea frames, with a \$460M per sea frame cost cap set by Congress.³⁸

With a new incoming administration that may have different expectations for the budget as well as the need to reset and re-equip DoD equipment across the board, the Navy shipbuilding budget to achieve the 313 ship fleet is at risk.

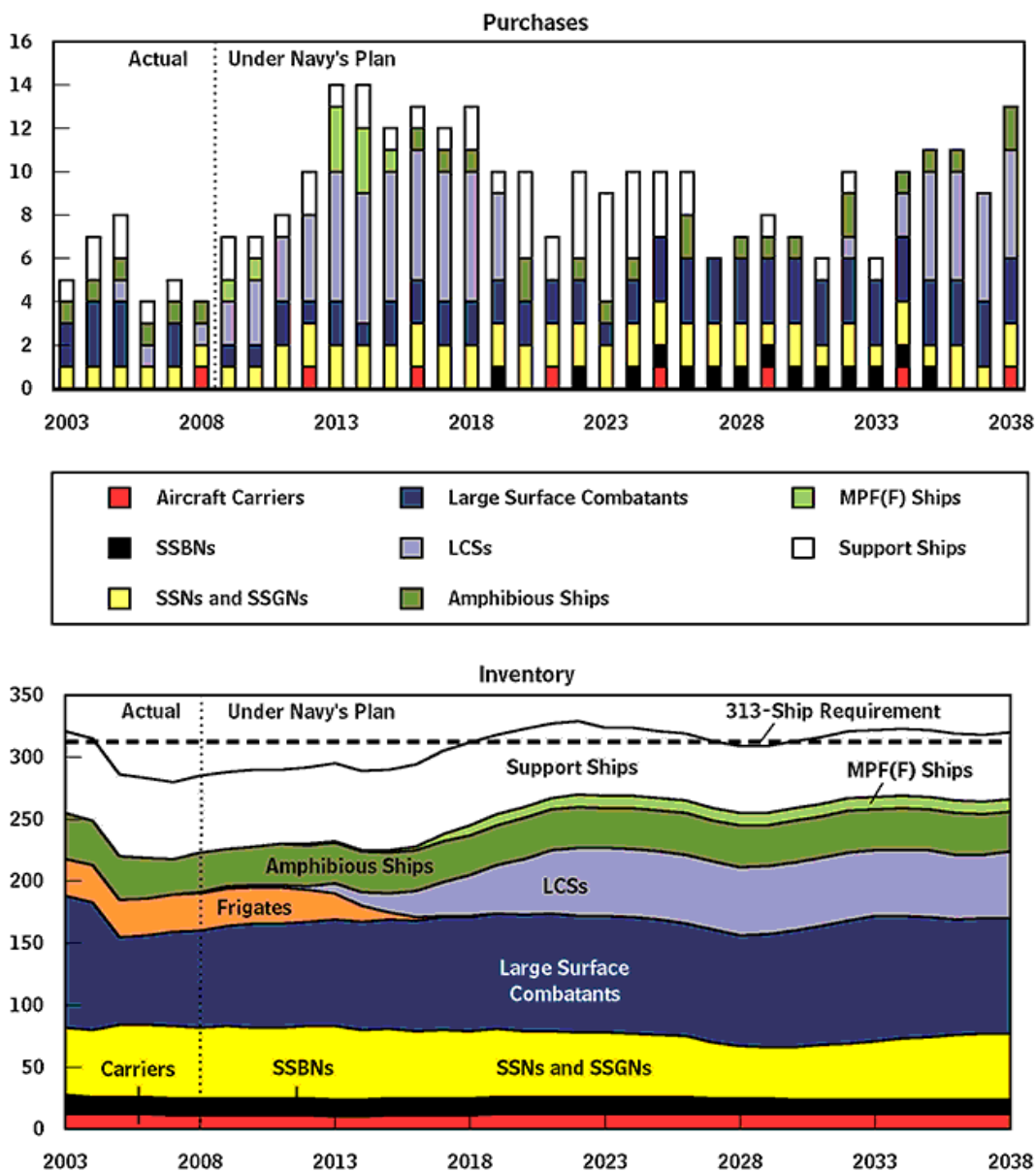


Figure 1: US Navy Procurement and Inventory Plans³⁹

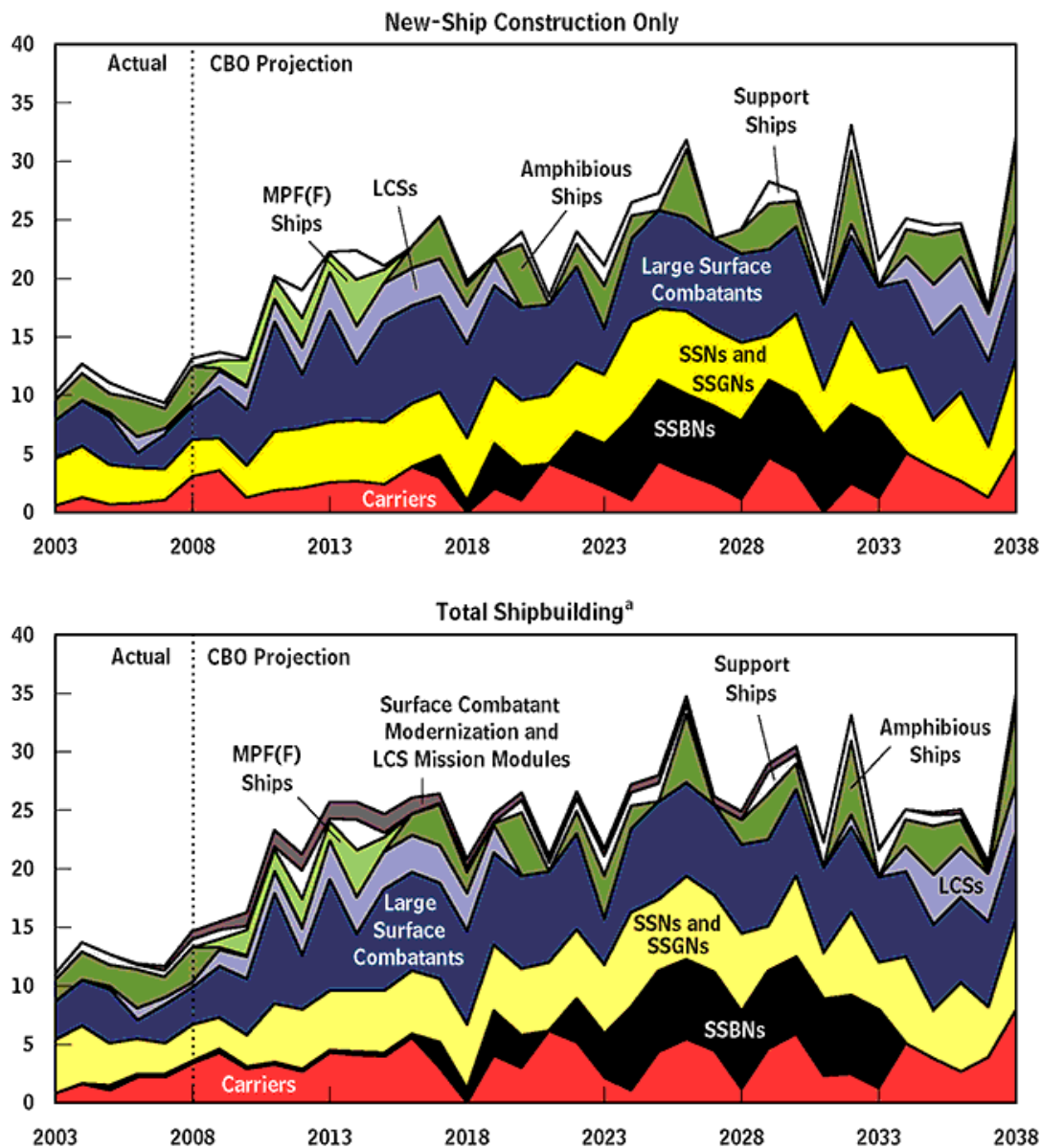


Figure 2: US Navy Shipbuilding Plan⁴⁰

Capability: The global naval shipbuilding industry faces a growing challenge with declining demand for warships but an increasing demand for greater sophistication of complex and expensive systems and weaponry. Technological superiority is the basis for increased US demand for more complex naval warships with smarter systems. As technological advances expand the capability edge, the United States Navy relies on new and complex technology to build greater defense capability. No longer is US national defense based on the quantitative force of manpower alone as modern defense forces seek

strategic advantage through advanced technology and qualitative efficiency.⁴¹ However, the worldwide trend for greater technological sophistication creates significant challenges. Advancing technology and spiraling costs, particularly in the design and development of state-of-the-art communication and combat systems⁴², has led the United States Government to reduce the acquisition of larger numbers of modern, complex and expensive warships, seeking instead, strategic advantage through fewer but more technologically advanced vessels.

In the acquisition of new naval capability, the United States of America faces the tension between new and advancing technologies and the financial capacity to afford these complex and expensive systems. In testimony before the House Armed Services Committee on Shipbuilding in April 2006, Vice Admiral Paul Sullivan stated that the costs of combat and weapons systems are the *“single largest driver in shipbuilding, even if costs of the weapons themselves are excluded”*.⁴³

The US military has often sought a strategic advantage by harnessing advanced technologies and the Navy’s shipbuilding plan is in keeping with this methodology. Several new ships are being placed under contract as part of the Navy’s current shipbuilding plan. For example, production of the DDG-51 Arleigh Burke Class destroyer will be ending, and a new destroyer called the DDG-1000 Zumwalt Class will start construction in 2008. This ship represents a major increase in capability over the DDG-51 in the areas of survivability, performance, and lethality, and provides an overall reduction in manpower required to operate the vessel. This increase in overall sophistication and capability comes with an increased cost as well as risks. The first of class for the DDG-1000 are expected to cost in excess of \$3B when compared to the \$1.1B cost for the DDG-51. The Arleigh Burke class destroyer provides a significant tactical advantage over any foreseeable threat, and the DDG-1000 will assure a continued tactical advantage for many years. However, the cost and schedule risks associated with the DDG-1000 program as well as the unproven performance and manpower claims put the Navy shipbuilding plan at risk. This new destroyer also puts at risk a production base that is currently capable of delivering two DDG-51 ships per year at multiple shipyards.

The DDG-1000 is a major contributor to the Navy’s 313 ship plan and delays or cost issues with the production of these vessels will impact the plan as well as the credibility of the Navy and industry to achieve their goals. The authors believe that the program can eventually become a major success. It’s a matter of how much money and time is needed to bring this significant increase in capability to the Fleet. The Virginia class submarine is a great example of a program that was once at risk due to cost and schedule issues, but is now considered a mainstay of the fleet as well as a model program. There are similar issues being experienced today with the Navy’s the Littoral Combat Ship (LCS) program which has significantly less war fighting capability than DDG-1000, but is struggling to meet cost and schedule goals. The Navy needs to continue to validate their overall requirements with respect to capability and it is well within their purview to insist on capabilities that assure a decisive tactical advantage over any current or future threat. However, the risks in the plan are not only in achieving a 313 ship Navy but also closing the door on production for several viable and capable programs like the DDG-51.

Program Execution Challenges – Managing Costs and Requirements: For government shipbuilding programs, there is a need for government program managers to both minimize cost growth on the programs and to ensure that the programs are progressing according to plan. As part of the idea of expectation management, both ship builders and ship repair entities have stressed the need to keep work requirements stable in order to control costs. It is a basic fact of program management that requirements changes disrupt the design process, add risk to program execution and increase the cost of the effort. The earlier in the design process that the requirements can be stabilized, the better. It is even more costly to make requirements changes once ship construction has begun. Both the Virginia Class Submarine and the Littoral Combat Ship (LCS) are recent examples of programs whose costs increased due to requirements changes. This issue also applies to ship modernization/ship repair projects as well.

Management tools exist that allow both the government and industry program teams to assess the actual progress of the program against the planned effort. Use of the Earned Value Management System (EVMS) is one such tool that is commonly used on government programs. This is a system that needs to be actively used on a monthly basis by the program teams to assess the contractor's actual progress against the planned work schedule, discuss any problem areas, look closely at how the contractor intends to get back on track (if they are behind), and to manage risk. Navy program offices need to ensure that their program management teams are actively using this valuable tool. This may entail providing training to the government teams on how to use this tool to its full capability. Additionally, the program teams should work with DCMA or SUPSHIP to ensure that their contractors have an adequate EVMS capability in place.

Meeting the Navy Acquisition Challenge

Recommendations: The authors provide the following recommended actions to address the quantity, capability, and budget paradigm:

- The Navy should perform a detailed review of the current shipbuilding plan and adjust it accordingly. They should focus on current and future operational needs and balance the benefits and risks of current programs against the need to achieve enhanced performance and capability. They need to prioritize what is more important; quantity or capability, and be prepared to trade one off for the other.
- The government needs to ensure that their program management teams are actively using valuable tools to predict and assess program costs. This may entail providing training to the government teams on how to use tools such as Earned Value Management System to its full capability. Additionally, the program teams should work with DCMA or SUPSHIP to ensure that their contractors have adequate tools in place to effectively manage their programs. The government needs to invest in tools and personnel to provide additional rigor in program cost estimating to include confidence rating.
- The Navy, Industry, and Congress need to work toward a common baseline. The Navy is looking to increase their overall capability while industry wants to maintain commonality in order to control and lower the overall costs for ships.

Congress wants to ensure an effective Navy while supporting the companies who provide a significant amount of employment within their state or district.

Conclusions

A robust US shipbuilding industry remains vital to our national security. At present, the government sector of the US industry can meet the current and projected national security needs. The industry has sized itself to satisfy today's shipbuilding requirements in terms of the number of ships required to be produced, their complexity, and their cost. Although the authors believe there is some excess industrial capacity, that excess is minimal. Given the projected government shipbuilding requirements and the funding to meet them, this sector will remain viable of the foreseeable future.

The commercial sector in the US represents only a small fraction of the worldwide industry and remains viable only because of protectionist legislation. While the US is generally committed to maintaining open markets, this legislation does provide some benefit to national security as it maintains sources for smaller government ships and maintains a skilled workforce that could be called upon to help meet naval shipbuilding needs if necessary. As such, the authors do not recommend any changes to the protectionist legislation currently in place.

Both sectors are challenged however by the shortage of skilled workers, a problem that is only expected to get worse with the aging population and the expected increase in competition for human resources from other sectors of the economy. To aid in addressing this issue, the authors have proposed three recommendations: increasing the visa length for foreign workers supporting the commercial sector, stabilization of the Navy's shipbuilding plan, and education incentives. While the recommendations outlined represent a net increase in government spending, maintaining a skilled workforce is essential to the health of the shipbuilding industry. Nations that have allowed these skills to atrophy have found it exceedingly difficult and costly to reconstitute them.

The government sector is also challenged by a Navy shipbuilding plan that is caught in a paradigm where it is seeking increases in the number of ships and the complexity of the ships being procured, while operating in a budget constrained environment. This issue should be addressed through the conduct of an independent assessment of the Navy's shipbuilding plan and a stabilization of its requirements. In addition, the Navy's acquisition leadership must focus its efforts on realistic cost and schedule management.

End Notes

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