

Spring 2009
Industry Study

Final Report
Shipbuilding Industry



The Industrial College of the Armed Forces
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Fort McNair, Washington, D.C. 20319-5062

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE Spring 2009. Industry Study. Shipbuilding Industry				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Defense University, The Industrial College of the Armed Forces, Washington, DC, 20319				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 25	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

SHIPBUILDING 2009

ABSTRACT: As a maritime nation, it is vital to the national security of the United States to be able to acquire and maintain a capable maritime fleet of vessels and associated corps of professional mariners, both civilian and military, in order to utilize and ensure access to sea lines of communication. Correspondingly, maintaining a capability to build the required ships in the United States further enhances the ability of the nation to meet its national security challenges. The U.S. shipbuilding industry, both commercial and military/governmental, is effectively meeting the national security needs of the nation and is positioned to continue to do so for the next 10–15 years. However, both the industry and government face two serious problems; 1) an aging shipbuilding workforce, and 2) shipbuilding requirements and acquisition processes that are stovepiped, inefficient, unrealistic, and contributes to the increasing cost of acquiring ships. Facing the certain prospect of decreased federal discretionary budgets and increasing costs of building ships, the U.S. Government (USG) must become more disciplined and effective in how it determines its shipbuilding requirements and then subsequently acquires those vessels. If it does not, the USG will continue along the current path where fewer and fewer ships are being built each year. No matter how technically advanced and capable a ship may be, at some point the quantity of ships the nation can put to sea matters and an insufficient number can adversely affect the ability of the United States to achieve its desired goals in support of national security interests. This paper provides a report of the current status of the global and U.S. shipbuilding industries as well as recommendations to improve the U.S. shipbuilding industry and the overall process of how the USG acquires ships.

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PLACES VISITED

Domestic

Aker Philadelphia Shipyard, Philadelphia, PA
Carnival Corporation and Carnival Cruise Lines, Miami, FL
General Dynamics Electric Boat, Quonset Point, RI
General Dynamics Bath Iron Works, Bath, ME
Northrop Grumman Shipbuilding, Avondale, LA
Northrop Grumman Shipbuilding, Pascagoula, MS
V.T. Halter Marine, Pascagoula, MS
Austal USA, Mobile AL
North American Shipbuilding, LaRose, LA
Portsmouth Naval Shipyard, Kittery, ME
Naval Sea Systems Command, Washington, DC

International

U.S. Consulate, Ho Chi Minh City, VN
VINASHIN Southern Headquarters, Ho Chi Minh City, VN
Saigon Shipbuilding Enterprise, Ho Chi Minh City, VN
Saigon Ship Marine Company, Ho Chi Minh City, VN
Provincial People's Committee, Vung Tau City, VN
Vung Tau Shipyard, Vung Tau City, VN
Strategic Marine Co., Ltd., Vung Tau City, VN
Korea Shipbuilders' Association, Seoul, KS
U.S. Embassy, Seoul, KS
Ministry of Knowledge Economy, Automobile and Shipbuilding Division, Seoul, KS
Hyundai Heavy Industries, Ulsan, KS
Hyundai Automotive, Ulsan, KS
Samsung Shipyard, Geoje, KS

INTRODUCTION

The ability of a maritime nation to acquire, maintain, and operate civilian and military maritime fleets is vital to its national security. As a maritime nation, the United States relies heavily upon these fleets and mariners to utilize and ensure access to sea lines of communication throughout the world. The following report is a result of the efforts of fifteen students studying the U.S. shipbuilding industry over the course of a semester while attending the Industrial College of the Armed Forces (ICAF) at the National Defense University. The primary purposes of the study and report are to determine the current status of the U.S. shipbuilding industry, assess whether or not it adequately supports U.S. national security interests, and submit recommendations for improvement.

The following major assumptions underlie this report:

- A domestic shipbuilding capability is important to U.S. national security. This is especially true in time of war to provide any required surge of commercial and military ships and to mitigate the risk posed by being overly dependent upon foreign countries as sources of civilian and military vessels.
- Constraints on the U.S. Federal discretionary budget will continue.
- Decisions regarding the awarding of contracts for major shipbuilding programs and the closure, merger, or relocation of major U.S. shipyards will remain sensitive political issues.

THE INDUSTRY DEFINED

The U.S. shipbuilding industry¹ consists of some 600 establishments primarily engaged in operating shipyards to build and/or repair ships. Shipyards construct ships for carrying cargo or passengers, naval ships, vessels and structures supporting the oil and gas industries, and other watercraft; and/or provide repair services. IBISWorld estimates that shipbuilding accounts for 85 percent of the domestic shipbuilding market while the remainder is in repair services. IBISWorld further segments the shipbuilding market into defense and government, which has 70 percent of the market share, and commercial with 30 percent. This 2009 Shipbuilding Industry Study Report will focus on the shipbuilding segment of the industry (defense/government and commercial), although some of the data used in the study aggregates both shipbuilding and ship repair markets because segregated market data is not readily available. This report excludes the boat building industry, which is “primarily engaged in the building of vessels for personal and recreational use”.²

CURRENT CONDITION AND OUTLOOK

Global Shipbuilding Industry

Since 2000, and up until the recent global economic recession, the global shipbuilding industry has seen a steady growth in new ship orders and completions. This growth was primarily driven by globalization and the associated increase in international trade, most of which is transported by sea. Currently 95 percent of U.S. foreign trade is moved by ship.³ During the same period, competition intensified between shipbuilders causing them to develop

added building capacity. Additionally, shipbuilders have reduced their prices to gain new orders and have simultaneously pursued aggressive and effective measures to reduce costs. One such method of reducing cost is to use cheaper labor; thus the industry has shifted its production base from Europe to Asia.

Within Asia there has been an intense competition between South Korea, China, and Japan to gain the top producer position. South Korea currently holds the No. 1 position with 35-40 percent of the world market share, leading China, Japan, and Europe. Recently, China leaped ahead of Japan to become the second-largest shipbuilder. Korea, China, and Japan combined accounted for 77.9 percent of global production in 2006.⁴ In 2008, South Korean shipbuilders continued to dominate the construction of all commercial vessel types except bulk carriers, in which China took over the top producer position. CARE, a shipbuilding research and consulting firm, reports, “the order books of the South Korean shipbuilders weighed 1.14, 2.19 and 7.56 times the [compensated gross tons (CGT) of] the Chinese, the Japanese and the European shipbuilders, respectively.”⁵

Several factors have contributed to the rapid growth and dominance of South Korean shipbuilders. A series of Five Year Economic Development Plans, starting in 1962, laid the foundation for economic growth, improved industrial and export competitiveness, and strengthened the role of the private sector while reducing government intervention in economic management. This market-oriented approach with emphasis on investment in new technologies, market liberalization, “green field” shipyards⁶, flexibility, highly competitive labor costs, high engineering capability, and environmentally sound waste management produced success starting in the 1990s. It should also be noted the South Korean government provided significant subsidies to its shipbuilders until the Organization for Economic Cooperation and Development and the European Union acted through the World Trade Organization to force South Korea to withdraw these subsidies.⁷

The order books of shipyards reflect the size of shipbuilding industry. Despite the global economic downturn many of the global shipyards are still reporting a significant backlog of orders to be delivered in the next few years. As of December 31, 2008, South Korea reported orders of 67.7 million CGT for 2,338 ships, followed by China (60.8 million CGT for 3,577 ships), Japan (29.7 million CGT for 1,429 ships), Germany (3 million CGT for 153 ships), Philippines (2.8 million CGT for 118 ships), Vietnam (2.7 million CGT for 209 ships), and India (2.4 million CGT for 251 ships)⁸. However, with economic growth slowed and trading volumes subdued, the industry is beginning to see the effect of the global economic downturn on the order books. As of December 2008, the year-to-year growth rate had slowed significantly to 6.44 percent from the previous year’s 14.26 percent⁹.

Legislation and Regulations Affecting the U.S. Shipbuilding Industry

In order to fully understand the current status of the U.S. shipbuilding industry, one must also have an understanding of the laws and regulations that have shaped the environment in which the industry developed and under which it operates today. While there are a myriad of laws, regulations, and policies that influence the industry, the Jones Act, Passenger Vessel

Services Act, and Byrnes-Tollefson Amendment have the most significant impact on the U.S. shipbuilding industry.

As stated in the Passenger Vessel Services Act of 1886 (46 U.S.C. § 55103), "no foreign vessel shall transport passengers between ports or places in the United States, either directly or by way of a foreign port, under a penalty of \$300 for each passenger so transported and landed." The Merchant Marine Act of 1920 (46 App. Chap. 27 U.S.C. § 1101), commonly referred to as the "Jones Act", requires that ships operating between U.S. ports be built, maintained, documented, owned, and crewed by U.S. citizens. Finally, the Byrnes-Tollefson Amendment (10 U.S.C. § 7309) states that "no vessel to be constructed for any of the armed forces, and no major component of the hull or superstructure of any such vessel, may be constructed in a foreign shipyard¹⁰."

Many view the above laws and regulations as protectionist and also argue that they have shielded the U.S. shipbuilding industry from competition in the U.S. market, which has in turn resulted in U.S. shipbuilders losing their ability to compete on the world market. While this may be true, these three laws also ensure that the U.S. retains the ability to build both military and commercial vessels as well as maintain a corps of professional merchant mariners. These laws provide a form of strategic insurance for the U.S. given the importance civilian and military maritime operations have for U.S. economic and national security interests.

Economic Data on Overall U.S. Shipbuilding Industry

The U.S. commercial and military/governmental shipbuilding industry has a minor share of the global shipbuilding market and accounts for a very small percentage of U.S. gross domestic product (GDP). In 2008 the domestic shipbuilding and repair industry contributed \$10.8 billion¹¹ towards the \$14.2 trillion¹² economy and employed less than one tenth of one percent¹³ of 144 million workers¹⁴. As a result of the aforementioned laws and regulations, the industry survives largely on military/government orders and is assisted by the USG with programs such as the U.S. Maritime Administration's (MARAD) Title XI Ship Financing Program.

U.S. Commercial Shipbuilding Industry Segment

The U.S. commercial shipbuilding industry is comprised of some 600 mid-tier and smaller shipyards that typically employ fewer than 800 people. These shipyards tend to build small to medium sized ships less than 650 feet in length and typically attract lower levels of investment than the six largest shipyards. This is a diverse segment; several of the yards act as subcontractors to the largest shipyards; some build offshore drilling platforms, oil industry support vessels, ferries, survey ships, cargo ships, and other commercial carriers. Although some vessels are built for foreign owners, most of the ships are built for the Jones Act market.

Most shipyards focus solely on building ships for the commercial market. However, a few mid-tier shipyards build both commercial and military/government vessels in the same facilities. Others do the work in different facilities. In general, security requirements and the greater complexity of naval vessels have prompted companies to separate their commercial and

military/government construction facilities. They have learned that shipyards have to be configured specifically to design and construct the ships in the chosen product mix in order to maximize efficiency and minimize costs.¹⁵

The U.S. commercial shipbuilding segment achieved a slow and steady growth rate from 2000 until the global economic downturn in late 2008. In 2008, the commercial shipbuilding and repair market generated about 30 percent of the industry's total revenue of \$17.3 billion. However, the global recession and tight credit markets have impacted the industry severely, as evidenced by a reduction in the number of new orders in 2008 and projected decline of 6.6 percent for 2009.¹⁶

Regarding the international market for commercial ships, U.S. shipbuilders face steep competition from shipbuilders in Asia who offer lower prices, are more efficient, and have higher industry best practice ratings. This is particularly true for the construction of vessels over 1,000 tons. This can be partially attributed to U.S. protectionist policies, such as the Jones Act, that have shielded domestic shipbuilders from the pressures of global competition. Thus while U.S. shipbuilders have remained competitive within the U.S. market, they are less so compared to foreign shipyards. None of the shipyards that the Industry Study Team visited expressed confidence that U.S. shipyards, as they are currently configured, could compete effectively in the global shipbuilding market.

Despite the relative lack of competitiveness, U.S. shipbuilders are becoming; U.S. labor costs are becoming more in line with those of South Korea and Europe. As shown in Table 1, the level of industry productivity and best practice of U.S. shipbuilders improved significantly by 2005/2006 from 1999/2000 and is approaching the benchmark levels of international competitors.¹⁷

Table 1: Improvement in the Best Practices Rating of U.S. Mid-Tier Shipyards

Group	U.S. yards average rating 1999/2000	U.S. yards average rating 2005/2006	International yards average rating 2006
Steelwork production	2.2	2.4	2.9
Outfit manufacturing and storage	2.5	2.6	3.4
Pre-erection activities	2.4	2.5	2.8
Ship construction and outfitting	2.7	3.1	3.3
Yard layout and environment	2.5	2.6	3.6
Design, engineering and production engineering	2.7	3.2	3.4
Organization and operating systems	3.2	3.4	3.8
Overall industry rating	2.6	2.9	3.3

U.S. Military/Government Shipbuilding Industry Segment

The military/government segment accounts for approximately 70 percent of the entire U.S. shipbuilding industry revenue.¹⁸ Traditionally, this industry segment receives a small number of ship orders each year. While the Department of the Navy (DoN) is the largest single buyer in this segment, it is not the only one. As illustrated by Table 2, the U.S. Coast Guard (USCG) and the Department of the Army (DoA) also share some of the U.S. military and governmental shipbuilding budgets.¹⁹

**Table 2: U.S. Military/Government Shipbuilding & Conversion Budgets
(in millions of \$)**

	FY 2007	FY 2008	FY 2009
U.S. Navy ²⁰	10,151.5	13,506.0	12,732.9
U.S. Coast Guard ²¹	56.5	45.0	69.0
U.S. Army ²²	19.7	5.1	2.9
Total	10,227.7	13,556.1	12,804.8

As a result of this segment's dependence upon military/government contracts, national security requirements and the corresponding federal budgets translate more or less directly into the defense contractor firms' revenues. The government's 2009 shipbuilding budgets will decrease by 5.5 percent or \$750 million.²³ As these are significant contracts that take several years to be completed, a decrease in the government budget does not automatically result in a decrease in the industry's revenue. However, a series of reduced shipbuilding budgets can negatively affect the industry. Furthermore, as the cost of ships rises and fewer ships are built, losing out on a bid for a ship can have severely impact a shipbuilders ability to maintain its facility and workforce.

Given the relatively few remaining shipyards that have the capability to build complex warships and that these yards are becoming more specialized, the problem of ensuring these yards have an adequate workload to sustain their operations becomes even greater. Predictable workload demand is extremely important for this industry segment to efficiently allocate all three factors of production - capital, labor and material. Given the overall small size of the industry segment and its high dependence on federal contracts, stable long-term planning and production based on multi-year government budgets are important for the industry to meet national security requirements.

This industry segment is mature and is primarily dominated by Northrop Grumman Shipbuilding (NGSB) and General Dynamics (GD). Between these two corporations, they operate the six biggest yards in this segment which focus almost exclusively on the military/government segment. NGSB owns Newport News Shipyard in Virginia and the Ingalls and Avondale yards in Pascagoula, Mississippi and New Orleans, Louisiana, respectively. GD operates the Bath Iron Works in Maine, Electric Boat in Groton, CT, and North American Steel and Shipping Company (NASSCO) in San Diego, CA. These shipyards tend to be among the

largest employers, if not the largest, in the regions where they operate, generating substantial political influence.

Northrop Grumman Shipbuilding (NGSB)

NGSB is made up of the former Gulf Coast operations of Northrop Grumman Ship Systems and the Northrop Grumman Newport News shipyard in the Hampton Roads area of Virginia. It is the nation's "sole industrial designer, builder and refueler of nuclear-powered aircraft carriers."²⁴ NGSB is also capable of designing and building nuclear powered submarines. With a long history of providing aircraft carriers, submarines, *Arleigh Burke*-Class destroyers, and all of the Navy's recent classes of large amphibious ships, NGSB has secured its position as the largest producer of ships that support U.S. national security. Annual revenues in 2008 were about \$6.1 billion with a backlog currently estimated above \$22.4 billion. NGSB carries almost 40,000 employees on its payroll, making it one of the largest employers in each region.²⁵

NGSB-Newport News is the sole designer and builder of American nuclear powered aircraft carriers. It also produces *Virginia*-Class nuclear powered submarines. The shipyard is situated on over 550 acres of land and employs nearly 19,000 people. It is the largest industrial employer in Virginia and boasts the largest drydock and crane in the Western Hemisphere.²⁶

NGSB Gulf Coast companies claim that more than 70 percent of U.S. surface combatant ships have been built in Gulf Coast shipyards. NGSB Gulf Coast is a large firm with more than 18,000 employees consisting of 11,000 in Pascagoula, MS, 4,800 in New Orleans, LA, and several thousand others scattered throughout other shipyards. These numbers make NGSB Gulf Coast the largest manufacturing employer in Mississippi and Louisiana, as well as a significant contributor to the local economy in Alabama.²⁷

General Dynamics

General Dynamics Marine Systems (GDMS) is the second major U.S. builder of military ships. The company has three subsidiaries including Bath Iron Works in Maine; Electric Boat in Groton, CT; and NASSCO in San Diego, CA. GDMS has built and is capable of building almost every type of military ship from surface combatants (including the DDG-1000) and nuclear submarines to military logistics ships such as the T-AKE.

As with the shipyards of NGSB, the GD shipyards are also some of the largest employers in their states. Bath Iron Works employs roughly 5,500 employees and is one of the largest private employers in the state of Maine. As of January 2007, NASSCO, in San Diego, was one of Southern California's larger manufacturing employers with about 4,600 personnel.²⁸ Finally, Electric Boat's two shipyards in Rhode Island and Connecticut are also among the largest employers in their states with about 7,400 and 4,000 employees respectively.²⁹

REQUIREMENTS FOR THE U.S. SHIPBUILDING INDUSTRY IN SUPPORT OF NATIONAL SECURITY

Requirements Framework to Preserve National Security Interests

The Constitution of the United States explicitly requires that “the Congress shall ... provide and maintain a Navy.” To fulfill this mandate and meet U.S. national security requirements, the United States must have access to an effective shipbuilding industrial base. Several recent strategic documents present realities that make this a tremendous challenge at this particular point in the nation’s history.

The current (2006) U.S. National Security Strategy (NSS) states, “the United States is in the early years of a long struggle, similar to what our country faced in the early years of the Cold War.”³⁰ The NSS identifies nine essential tasks for preserving national security, including the need to “transform America’s national security institutions to meet the challenges and opportunities of the 21st century” and to “engage the opportunities and confront the challenges of globalization.”³¹ Transforming national security institutions and confronting the challenges of globalization are certainly the cornerstones of a strategic framework for preserving the U.S. shipbuilding industrial base. Additionally, these efforts must take place within the context of a severely constrained federal budget environment over the next decade.

The Cooperative Strategy for 21st Century Seapower, a maritime security strategy (MSS) agreed to by the chiefs of the sea services (Navy, Marines and Coast Guard), is based on the NSS and National Military Strategy (NMS). The maritime strategy emphasizes using seapower in cooperation with other nations “to protect and sustain the global, inter-connected system through which we prosper.”³²

Neither the NSS nor the MSS adequately addresses resourcing or preserving the U.S. shipbuilding industry. However, these issues are foundational to both strategies, since an effective shipbuilding industry is vital to achieving their objectives. Given dynamic changes in security threats and the projected fiscal constraints on discretionary spending, a new strategic framework is needed for preserving the U.S. shipbuilding industrial base. The cornerstones of this strategic framework include transforming the USG ship acquisition process, maintaining a capable shipbuilding workforce, and leveraging the opportunities of globalization. This strategic framework will facilitate fulfilling the constitutionally mandated requirement “to provide and maintain a Navy.”³³

Threats, Capabilities, and Shipbuilding Requirements In Support of National Security Interests

Eight years after the attacks on the World Trade Center and the Pentagon, the United States finds itself in a complex and constantly evolving security situation. To address this challenge, the USG developed a long-term national strategy to preserve U.S. security. Violent extremists use terror and subversion, engage in modern forms of irregular and insurgency warfare, and pursue weapons of mass destruction to inflict catastrophic damage on the United States and its allies. China is concentrating on conventional and nuclear armed ballistic missiles,

information warfare capabilities, anti-satellite weaponry, submarines, high-speed cruise missiles and other capabilities that could threaten the United States' access to the global commons of space, cyberspace, the air, the seas and the undersea, and possibly to U.S. allies and partners in East Asia. Hostile and potentially unstable countries like North Korea and Iran have developed or may soon develop nuclear arsenals with which they could intimidate America's allies and challenge the US military's ability to protect vital national interests.

Table 3: National Security Threat Matrix

DEPARTMENT OF DEFENSE NATIONAL SECURITY THREAT MATRIX		Type of Threat																							
		Major War Force-on-Force Conventional Military Threats				Small and Irregular War Conventional Military Threats				High-Tech Delivery System WMD Weapons Threats				Low-Tech Delivery System WMD Weapons Threats				Non-Combatant Disruptive Violence or Piracy Threats				Disruptive Cyber Attack Threats			
Target of Threat	U.S. Homeland									X					X					X	X	X	X		X
	U.S. Personnel & Property Deployed Overseas	X	X			X	X	X	X	X	X				X	X			X	X	X	X	X		X
	U.S. Allied Nations w/ Defined Treaty Protections	X	X			X	X	X	X	X	X				X	X			X	X	X	X	X		X
	Regions or Nations w/ Vital Commercial Interest to U.S.	X	X			X	X	X	X	X	X				X	X			X	X	X	X	X		X
	Regions and Nations w/ Vital Humanitarian Interest to U.S.	X	X			X	X	X	X	X	X				X	X			X	X	X				
Source of Threat	Advanced Military Nations Openly Hostile to U.S.																								
	Advanced Military Nations Non-Aligned with U.S.																								
	Weak/Failing/Failed/Genocidal Nation-States																								
	Transnational Militant Groups																								
	Transnational Criminal Groups																								

Lt Col Clark M. Groves, ICAF, 2009

To meet the current and projected threat environment, the *Cooperative Strategy for 21st Century Seapower* lists the following capabilities required of U.S. maritime forces:

- Forward Presence
- Deterrence
- Sea Control
- Power Projection
- Maritime Security
- Humanitarian Assistance and Disaster Relief

In order to evaluate the requirements for the U.S. shipbuilding industry in 2019, the team evaluated the capabilities identified above against the projected threat environment summarized in Table 3. To achieve the maritime capabilities listed above to fulfill the national security and global stability objectives in the 2019 environment, the U.S. shipbuilding industry must:

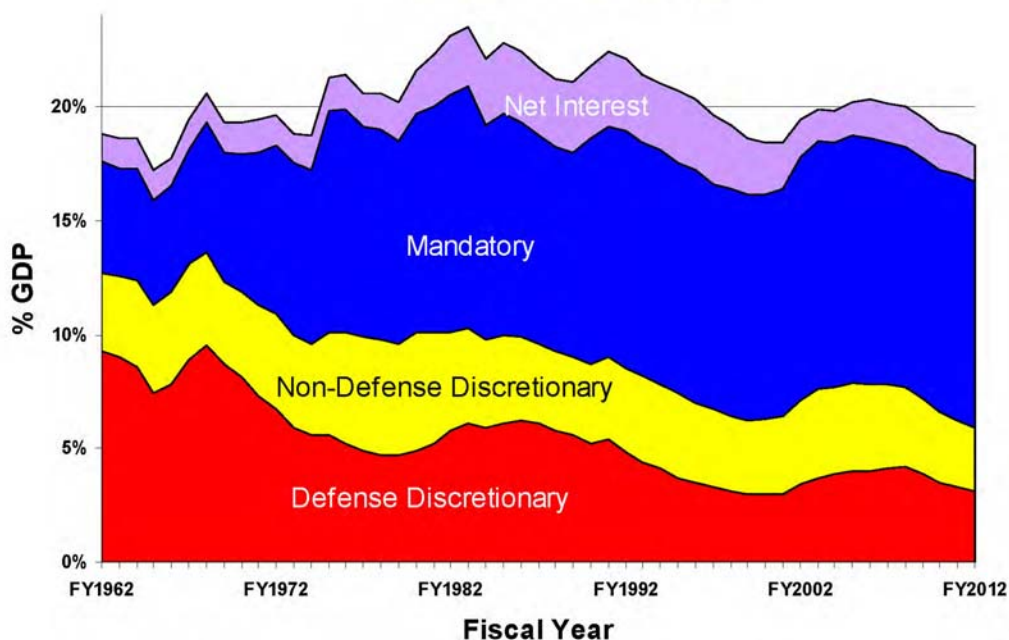
1. Meet Department of Defense (DoD) and Department of Homeland Security (DHS) stated maritime capabilities (scope must include technology and platforms; such as, CVN, surface and subsurface combatants, logistics and other platforms),
2. Provide surge construction capacity to meet emergent national security threats,

3. Provide repair and refit capacity to sustain U.S. maritime assets,
4. Respond to the current and projected fiscal environment,
5. Comply with legal and policy constraints (environmental regulations, legal requirements for American-made content, financial and performance reporting requirements, etc.).

CHALLENGES

A recent report from the U.S. Office of Management and Budget (OMB), *A New Era of Responsibility: Renewing America's Promise*, states "...there are the years that come along once in a generation, when we look at where the country has been and recognize that we need a break from a troubled past, that the problems we face demand that we begin charting a new path. This is one of those years."³⁴ The budget constrained environment will directly impact the acquisition of ships and the U.S. military/government shipbuilding industry. Although the 2010 Budget for the DoD requests \$533.7 billion, an increase of four percent from the 2009 enacted level of \$513.3 billion,³⁵ the President's budget projects that defense discretionary spending as a percentage of GDP will decline, as captured in the graph below. This downward funding pressure will continue to increase as the national debt and non-discretionary expenditures grow and domestic spending increases in priority. As a result of these fiscal challenges, it will become increasingly important to solve some of the problems that contribute to the rising costs of building and acquiring ships.

Federal Outlays by Category as % GDP FY1962-FY2012



Source of Graph: Stephen Daggett, Congressional Research Service, “Defense Sustainability”³⁶
Problems with the Current USG Ship Acquisition Process

The current processes for determining requirements for and acquiring USG vessels are not efficient and result in higher per unit costs. Consequently, the USG is able to procure and operate fewer vessels than it requires. From a national security perspective, this increases risk - having fewer platforms means a smaller ratio of vessels to sea/air space. While technological advances certainly help individual ships cover greater volumes, these improvements are costly and finite; ships simply cannot be everywhere at once and can only cover limited air and sea space. As Lenin purportedly said, “Quantity has a quality all its own.” Given that shipbuilding costs are rising and shipbuilding budgets are falling, the USG is heading down a path leading to increased risk.

Multiple Acquisition Programs and Insufficient Number of Contract Specialists

There are several USG departments, armed services, and agencies that require vessels to execute their respective missions. However, each department (and, in some respects, each service) has its own distinct system for establishing requirements, developing, and acquiring those vessels. This is not an efficient use of resources and prevents the USG from capitalizing on the buying power and associated cost savings it can achieve by placing larger orders, by being one large customer as opposed to several small customers. Having different acquisition systems also makes it more challenging for USG employees to be moved from one agency or department to another. This lack of procedural commonality makes it more difficult to shift people to where the demand for acquisition personnel is greatest.

There is also a shortage of contract specialists in the acquisition communities to deal with the smaller dollar-value contracts for services and systems. While most attention is paid to the large, multi-million dollar contracts – where there are an adequate number of contract specialists – the smaller contracts have a purchase order backlog, thereby increasing the overall length of time in the procurement process, increasing costs. While overall contract costs may be smaller compared to the large multi-million dollar contracts, these cost increases still represent an overall and avoidable loss to the taxpayer.

Extreme and Changing Requirements

The advent of technology has produced an ever increasing number of sensors and weapons that can be placed onboard vessels. When designing and developing a new weapon system, it seems only natural for one to want the “latest and greatest” equipment in that weapon system. However, this can take the focus away from what is really needed and is most cost-efficient to obtain; some proposed system improvements look suspiciously like a technology or capability in search of a requirement. On the other hand, the ever increasing pressure of rising costs and decreasing numbers of vessels results in vessels being required to be multi-mission capable which in turn makes ships even more costly.

Also contributing to rising costs is the practice of commencing construction of a vessel before all necessary plans or technologies are fully developed. For example:

"in the Littoral Combat Ship (LCS) program, design instability resulted from a flawed business case as well as changes to Navy requirements. From the outset, the Navy sought to concurrently design and construct two lead ships in the LCS program. Complicating LCS construction was a compressed and aggressive schedule. When design standards were clarified with the issuance of Naval Vessel Rules and major equipment deliveries were delayed (e.g., main reduction gears), adjustments to the schedule were not made. Instead, with the first LCS, the Navy and shipbuilder continued to focus on achieving the planned schedule, accepting the higher costs associated with out of sequence work and rework."³⁷

While it is normal to expect changes during the manufacture of the first few units of a new system, the Navy has not performed well as compared to commercial sector. Historically, first ships in commercial programs average 240 changes for the first ship in the class and only two per follow-on ship. The U.S. Navy's LHD program had over 5,700 changes from LHD-1 to LHD-2 and an average of more than 3,500 additional changes for the follow-on ships.³⁸ These examples are consistent with findings from a recent Government Accountability Office (GAO) report where they reported many DoD programs they evaluated entered system development without mature technologies or sound preliminary design, continued to move into system demonstration and production without achieving design stability, and entered production without demonstrating acceptable manufacturing and test performance.³⁹ These poor practices increase the overall cost of acquiring a vessel. Costs can also increase if the requirement changes once a contract has been signed; this is commonly referred to as a change order.

In one GAO study, 63 percent of the programs examined had requirement changes after system development began, resulting in a cost increase of 72 percent in contrast to a cost increase of only 11 percent for programs that did not have a change in requirements.⁴⁰ The U.S. Navy has also been guilty of engaging in this inefficient and wasteful practice. For example:

"We estimate that change order activity on Northrop Grumman built *Arleigh Burke*-class destroyers have added as much as 6 million labor hours to production at a cost of \$160 million. In addition to experience loss, change orders impact shipbuilders' design costs, labor costs, and material costs. The elimination of such changes could dramatically reduce ship production costs, but must be considered in light of the need to deliver the most advanced technological solution to the warfighter."⁴¹

Poor Cost Estimates

Historically, DoD has not been very accurate at estimating the total acquisition costs of its weapon systems and is getting worse at doing so. According to the GAO, "total acquisition costs for the FY 2007 portfolio of major defense acquisition programs increased 26 percent from first estimates, whereas the 2000 portfolio increased by 6 percent."⁴² The U.S. Navy has contributed to this growth by not being very accurate at estimating the total cost of procuring vessels (e.g., LCS). There are several possible explanations for this.

Some costs may have been “optimistically estimated” or even intentionally underestimated in the early stages of program development in order to help sell the program and get it established as a program of record before the actual costs are recognized or realized. Alternatively, it appears that the Navy has made unrealistic assumptions on cost savings it can achieve through operations, manpower, and productivity initiatives. For example, the Navy assumed that ongoing ship programs would experience no cost growth and the costs of prospective new ships would meet strict cost targets.⁴³ This is ahistorical and not realistic. A third explanation is that there are an insufficient number of cost estimators in the USG. Related to this, due to fears of appearance of impropriety or favoritism, there has been a hesitance to involve industry in the early stages of developing cost estimates.

Regardless of the cause for unrealistically low cost estimates, the reality is that the Navy is facing a serious problem due to the current misalignment between its 30-year shipbuilding plan and predicted resources. According to the Congressional Budget Office (CBO), “between FY '03 and '08, the Navy spent an average of \$11.1 billion a year for new-ship construction (in constant FY 2009 dollars). In comparison, the average annual cost for new-ship construction projected by the Navy and CBO is \$20.4 and \$22.4 billion, respectively. Moreover, these costs do not include the substantial resources necessary to build the twelve replacements for the current strategic ballistic missile submarine force.”⁴⁴ In addition to the increased costs, the current portfolio of programs has experienced an average 21-month delay in delivering initial operational capability to the warfighter.”⁴⁵

End Result: Fewer Platforms for All

In the end, the combination of the above factors has resulted in an ever shrinking, in terms of total number of ships, battle force. In 1987, the Navy had 594 ships and was building toward a force size (never realized) of 600 ships. Today, the Navy has 283 ships as it strives toward a 313-ship battle force. Informed observers consider the Navy will be fortunate to have 290 ships by 2019. As a result, there needs to be a reassessment of the combined capabilities the USG requires to field in peacetime and war and subsequently determine the mixture and number of platforms required to put forth those capabilities in support of national interests.

RECOMMENDATIONS

To address the challenges facing the U.S. shipbuilding industry as well as the USG in its pursuit of acquiring and maintaining an adequate maritime fleet, the 2009 ICAF Shipbuilding Industry Study Team submits the following recommendations:

1. Develop, Implement, and Oversee an Integrated U.S. National Maritime Strategy

▪ Specific Actions:

- The U.S. Congress should establish Maritime Committees in both houses. Such bodies would direct and oversee the formulation and execution of a national maritime strategy. These committees should absorb some of the functionality from the Armed Services Committees and other maritime related subcommittees with respect to authorizations for the purchase of maritime vessels for the USG.

- The Maritime Committees should establish a Maritime Executive Steering Board, co-chaired by senior executives from MARAD and DoD to formulate a National Maritime Strategy. The board should also be comprised of representatives from the DoN, USCG, Department of Commerce, Department of Transportation (DoT), and other USG agencies/departments that have a requirement for maritime vessels or responsibility for maritime matters, as well as representatives from U.S. shipbuilding companies and organizations.
- **Discussion:** There is currently no integrated national vision or strategy regarding the United States' overall maritime interests, requirements, and capabilities. Presently each department or agency develops its own strategy and associated ship acquisition program in isolation without looking at the broader picture of U.S. maritime requirements. By bringing together all of the various parties that have an interest in the health and welfare of the U.S. maritime and shipbuilding industry capability and capacity, a comprehensive and integrated approach can be formulated to establish vision and goals, and strategies to achieve those goals. The establishment of Maritime Committees in the Legislative Branch will help ensure that the required integration and long-term planning is occurring and that the developed strategies are resourced appropriately. The initial goal of the Maritime Executive Steering Board should be to integrate existing strategies, such as the *National Strategy for Marine Transportation System*, *Maritime Administration Strategic Plan*, and the *DoD Cooperative Strategy for 21st Century Seapower*. Follow-on responsibilities of this board should also include formation of a permanently established Maritime Interagency Board to serve as the executive decision authority regarding the acquisition of vessels for the USG.

2. Develop a Realistic, Integrated USG 30-year Shipbuilding Plan

- **Specific Actions:**
 - The USG should generate and commit to a realistic, comprehensive shipbuilding plan that lays out a steady annual demand for ship construction and repair. The plan should reconcile requirements and available resources. This will allow shipyards to more effectively plan capital improvements, manage labor demand, and order materials in bulk buys, and will allow shipyards to better leverage economies of scale.
 - DoN should stabilize the 30-year shipbuilding plan and limit annual changes, particularly near-term changes, to an absolute minimum. Preferably, DoN should coordinate with the DoA, USCG, DoT, and National Oceanographic and Atmospheric Administration to issue a joint interagency 30-year shipbuilding plan designed to level long-term ship orders and provides continuity of demand across the shipyards. Ship repair, overhaul, and conversion budget requests and schedules should be proactively integrated into the overall ship production plan. This integrated USG 30-year plan should be communicated to Congress in such a manner as to highlight the advantages to local economies and employment afforded by a steady, predictable industrial demand.

- DoN and other USG agencies should establish realistic budget requests based on sound assumptions and supported by historical data. Budget estimates should not be based on “best on best” or “go – go” estimates or assumptions, and should be presented with accompanying risk analyses as to the probability of receiving the stated budgets. External budget factors such as the looming increase in non-discretionary governmental spending and the effects of the current economic recession should be considered when forecasting budgets.
- DoN and other USG agencies should utilize multiyear and multi-ship construction contracts to provide cost savings and continuity of shipyard operations. Agencies should avoid the use of fixed price contracts for first ships of a class due to the inherent risks and uncertainties of systems integration, testing, and the lack of contractor cost data for the new ship class.
- **Discussion:** The USG should establish a realistic ship end strength and production numbers based on the ability of the USG to resource such a fleet. A maritime strategy that cannot be enacted due to a lack of funding does a disservice to the nation’s security. DoD, DHS, and other governmental agencies with maritime vessel requirements need to make critical cost vs. security trade-offs to judiciously scale back maritime ambitions using fleet levels affordable under the existing budget. These scaled-back ambitions should subsequently be reflected in realistic and affordable ship production and repair orders. The national security risks incurred by the resultant maritime force reductions should be assessed and reported to appropriate authorities.

3. Rigidly Adhere to Established Acquisition Rules and Guidelines

- **Specific Actions:**
 - All USG agencies should more rigorously follow and enforce established systems engineering and program management disciplines.
 - The DoN and other USG agencies should apply renewed discipline and rigor to minimize requirements changes, especially during late design efforts. Increasingly high levels of approval for requirements and design changes should be required as designs mature and production activities begin.
 - The DoN and other USG agencies should provide policies and processes to assure drawings are reviewed for produceability. Designs should reflect and take advantage of modern marking, cutting, shaping, and welding machine tools, and should complement and enhance modern unit/block construction techniques. DoN should assure drawing review processes at contractors, the Supervisor of Shipbuilding, and Naval Sea Systems Command meet minimum standards of control and accountability, and should assure design review functions are fully staffed and personnel are fully trained.

- DoN and other USG agencies should clarify the use and applicability to naval vessels of classification society maritime standards, and the role of such societies in certifying ship designs, construction, and testing. DoN should develop criteria for the proper application of classification society standards to various classes of naval vessels as a standard exception to Naval Vessel Regulations. If so adopted, procedures for the alternate use of these standards should be codified in standard Navy procedures.
- **Discussion:** Ship designs should be sufficiently defined (i.e., released specifications and drawings) before production is allowed to begin. Discipline should be reestablished during technical, design, and program reviews to assure critical technical, programmatic, and cost thresholds are achieved with an acceptable degree of risk before advancing beyond established milestones. Following already established acquisition rules will allow ship designers to better design ships and it will cut the per ship cost of overall production.

4. Maximize Use of Common Equipment, Systems, and Hull Forms

- **Specific Actions:**
 - USG (DoN, DoA, DHS, etc.), together with industry, should establish government-wide common material, component, and assembly specifications and standards for use during all ship design and repair efforts.
 - DoN, in conjunction with the DoD, should work with regulatory officials to modify portions of the Federal Acquisition Regulations regarding material purchases for individual ship construction contracts to permit shipyards to buy steel plate, piping, and other ship components in large bulk buys to fulfill the needs of multiple existent and future contracts.
- **Discussion:** The selected specifications and standards should pare down the universe of available components to a minimum set of standard items acceptable for government use. Standardization of steel plate thicknesses, piping diameters, stairs and ladders, etc. should also be considered. This will streamline design, production, testing, and logistics processes and will result in cost savings throughout the life cycle of USG products. Shipyards should be enabled to buy steel plate, piping, and other ship components in large bulk buys to fulfill the needs of multiple existent and future contracts. This will allow shipyards to more fully leverage common bulk buys of materials and components and thus better achieve economies of scale.

5. Leverage the Global Marketplace

- **Specific Actions:**
 - DoN, in concert with DoA and USCG, should develop policies and procedures to leverage global markets for materials, components, and assemblies.
- **Discussion:** DoN should coordinate with DoD to develop interpretations of the Buy American Act to allow shipbuilders more leeway to use lower cost items from foreign

sources. If required, DoN should seek a permanent exception from Congress to permit the purchase from foreign sources of items with large domestic/foreign cost differentials. In addition, DoN should team with other allied and coalition partners to jointly finance, design, construct, and logistically support naval vessels and combat/weapons systems. Joint designs should leverage foreign capabilities, and should result in operational products employed in US and other stakeholder navies.

6. Substantially Increase the Navy's Organic Workforce in the Areas of Acquisition, Contracting, and Budgeting.

▪ Specific Actions:

- DoN should reenergize its acquisition, systems integration, contracting, and budgeting capabilities. Additional personnel should be hired, and existing personnel should be fully trained and certified in accordance with the requirements established in the Defense Acquisition Workforce Improvement Act (DAWIA).

- **Discussion:** DoN should develop the capabilities of Navy program offices to better manage and integrate programs, and improve managerial, contractual, and technical skills to enable the Navy to be a smarter customer. Personnel targets for staffing and training should be established throughout the department, and components should report against these targets through established chains of command to the appropriate office under the Secretary of the Navy.

- DoN should improve and increase its cost estimating capabilities. More specialists should be hired, trained, and groomed for cost estimation of ship design and construction, and combat and weapons systems development and production. Cost estimation tools should incorporate appropriate inputs from industry and should be validated by an independent organization(s) using historical data.
- Government personnel should be hired, trained, and groomed to be systems integrators capable of combining separate programs into systems of systems.
- Appropriate numbers of contract specialists should be hired, trained, and certified/warranted to assure contracts are issued, administered, and closed in a timely manner.
- Acquisition workforce should be allocated dedicated time to complete required DAWIA training.

7. Promote and Maintain a Productive, Efficient, and Skilled Workforce

▪ Specific Actions:

- MARAD and the American Shipbuilding Association (ASA) should develop recruiting strategies and embark upon a national campaign to promote naval

engineering, mariner, and other related jobs required to build, operate, and maintain ships to ensure a strong workforce is maintained.

- U.S. shipbuilders should continue to partner with community colleges, universities, and vocational schools to offer educational opportunities for existing and future employees.
 - The U.S. Congress, ideally under the recommended new Maritime Committees, should work with MARAD and ASA to develop and provide incentives for the shipbuilding industry to pursue the above recommendations.
 - The U.S. Congress and MARAD should expand and streamline the Title XI Ship Financing and Small Shipyard Grant programs such that shipyards can make capital investments for machines and facilities that improve efficiencies and productivity to reduce the overall cost of ships. Many shipyards complain that the current process is too hard and restrictive.
 - U.S. shipbuilders should continue to offer incentives to its workforce to seek bottom up input on how to make processes more efficient and productive to further drive down costs.
 - U.S. shipbuilders and labor unions should continue to seek ways of cross-training personnel in order to maximize their versatility and flexibility.
 - U.S. shipbuilders should negotiate with labor unions to ensure that a minimum future man-year capability is maintained should layoffs be required. The intent is to develop a method, like a “reverse order of merit,” such that the most junior people are not automatically fired, since this causes a loss of people that are needed in the long run to help replace an aging workforce in the shipbuilding industry.
 - The U.S. Congress should work with MARAD, ASA, and DHS to develop policies and guidance in order to expand the number of visas granted to personnel who desire to come to the United States to work at a shipyard. In order to ensure that U.S. citizens are being given priority preference for hiring, shipyards could be required to demonstrate that they indeed have a shortage of workers that cannot be satisfied from the surrounding population.
- **Discussion:** The age of shipyard workers in the U.S. is relatively high and growing older. In 2002 "the nationwide average age of shipyard production workers was 42.1 years, maritime professionals 43.5 years and administrative workers 45.1 years. This trend indicates that the shipbuilding industry is quickly reaching a crisis situation, as replacements are not readily available."⁴⁶ There are several contributing factors to explain the aging workforce. Firstly, working in a shipyard is physically demanding and dirty work due to the nature of the shipbuilding industrial environments. Secondly, many Americans view working in a shipyard as unrewarding and undesirable. Because of these

factors and perceptions, it has been difficult to recruit and retain younger workers; therefore shipyards are increasingly looking to foreign workers to supplement their workforces to meet demand. Expanding and streamlining the process for foreign workers to obtain visas can help in the short-term; however, this is not a long-term solution. By expanding and furthering some of the existing initiatives as well as implementing the above recommendations, the U.S. shipbuilding industry can begin to recruit and train a new generation of young and skilled workers. This is an aspect that should be included in the national maritime strategy since it will be extremely important to be able to continue to attract and retain skilled and competent operators, maintainers, engineers, and builders of the ships needed for the nation's economic and physical security.

8. Incentivize U.S. Shipbuilders to Build More Ships by Further Promoting MARAD's Marine Highway Initiatives

- **Specific Actions:**
 - MARAD and the U.S. Congress should jointly develop policies and incentives that make it more profitable for companies to ship cargo over water vice via rail or highway.
 - MARAD and U.S. shipping companies should identify impedances in infrastructure to enable and realize the Maritime Highway. Furthermore, they should also coordinate with state and local port authorities to eliminate bottlenecks and roadblocks.
- **Discussion:** The current transportation environment does not make it profitable for civilian companies to use marine transportation as their primary method of shipping goods. The USG should provide companies with incentives to ship cargo utilizing Jones Act hulls. This will benefit the overall economy by lowering transportation cost, reducing terrestrial highway congestion, and increasing safety. Increased usage of the Maritime Highway will increase the demand for Jones Act hulls. This will boost production in U.S. shipyards, which will potentially reinvigorate the industry to become more competitive and adopt more modern shipbuilding practices.

9. Maintain the Jones Act and Passenger Vessel Services Act

- **Discussion:** The Jones Act was enacted "with the aim of maintaining a merchant marine of the best equipped and most suitable types of vessels owned and crewed by U.S. citizens, sufficient to carry the greater portion of U.S. commerce and serve as a naval or military auxiliary at time of war."⁴⁷ The original reason these acts were implemented is still applicable today. While it is true that this act and related legislation have reduced the competitiveness of resulted in U.S. shipbuilders and shippers in the international market, the acts serve an extremely important strategic economic and wartime role. In addition to ensuring that the U.S. maintains the capability to manufacture ships, this legislation (particularly the Jones Act) also helps maintain a workforce of trained merchant mariners. Repealing these acts would most likely result in the collapse of U.S. commercial shipbuilders in the face of international competition. This would pose

considerable strategic risk in time of war, since the U.S. would be forced rely upon allies and partners to provide marine vessels.

CONCLUSION

The 2009 ICAF 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 the national security interests of the United States. The team concluded that the U.S. shipbuilding industry is meeting the needs of America's national security interests and will continue to do so for the next 10-15 years. However, the team identified several recommendations to improve the process by which the United States as a nation determines its maritime requirements and how it subsequently acquires ships. Additionally, the team identified several recommendations to help ensure that a productive, efficient, and skilled shipyard workforce is maintained. Implementation of the recommended actions will help address these two areas and further enhance the U.S. shipbuilding industry's ability to support U.S. national security interests.



ENDNOTES

¹ IBISWorld, "IBISWorld Industry Report," *Ship Building in the US:33661a*, January 22, 2009, 3.

² IBISWorld, "IBISWorld Industry Report," *Boat Building in the US:33661b*, February 12, 2009, 5.

³ U.S. Maritime Administration, *Leading the Future: 2008-2013 Strategic Plan*, August 2008, http://www.marad.dot.gov/documents/Strategic_Plan_Text_Cover-R2_WP.pdf, accessed on May 21, 2009.

⁴ IBISWorld, "IBISWorld Industry Report," *Ship Building in the US:33661a*, January 22, 2009, 31.

⁵ Ibid, 8.

⁶ "Green field" shipyards are those constructed on a previously undeveloped industrial site. Such sites allow companies to lay out the yards in the most efficient manner rather than being constrained by existing facilities.

⁷ IBISWorld, "IBISWorld Industry Report," *Ship Building in the US:33661a*, January 22, 2009, 31.

⁸ Clarksons, CARE Research, "The Global Shipbuilding Tracker – February 2009," 9.

⁹ Ibid, 8.

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²¹ Department of Homeland Security, "Budget details," Budget and Finance Documents (2009): 30, <http://www.dhs.gov/xabout/budget/>.

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- ²⁴ <http://www.sb.northropgrumman.com/about/index.html>
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- ²⁶ http://www.sb.northropgrumman.com/about/assets/Newport_News_Facts.pdf
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- ²⁹ Hartford Courant, <https://advertise.courant.com/portal/page/portal/Hartford%20Courant/Market%20Profile/mhc-market-employers>
- ³⁰ The White House. "The National Security Strategy Of The United States Of America" (Washington, DC., March 2006), 1.
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