SHIPBUILDING

ABSTRACT

The purpose of this study was to examine the shipbuilding industrial base and its ability to support the United States national security strategy. We found that commercial shipbuilding in the United States has been completely surpassed by the global shipbuilding industry to the point where it survives only to fulfill the niche market of the protected Jones Act fleet. At the same time, the unit cost of United States naval vessels is so high the US Navy can not afford the fleet it says it needs. This is the industry studied by the 2005 Industrial College of the Armed Forces Shipbuilding Seminar, an industry in peril of maintaining the industrial base necessary to design, build, and maintain the most technically advanced and capable naval vessels in the world.

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PLACES VISITED

Domestic:
Curtis Bay Shipyard, US Coast Guard, Baltimore, MD
Newport News Shipbuilding, Northrop Grumman Ship Systems, Newport News, VA
Kvaerner Philadelphia Shipyard, Philadelphia, PA
Carnival Corporation Headquarters, Miami, FL
Electric Boat Quonset Point Facility, Quonset Point, RI
Portsmouth Naval Shipyard, Kittery, ME
Bath Iron Works, Bath, ME
National Steel and Shipbuilding Company, General Dynamics, San Diego, CA
Textron Marine and Land Systems, New Orleans, LA
Avondale Operations, Northrop Grumman Ship Systems, Avondale, LA
Waterman Steamship Corporation, New Orleans, LA
VT Halter Marine Incorporated, Pascagoula, MS
Ingalls Operations, Northrop Grumman Ship Systems, Pascagoula, MS
Austal USA, Mobile, AL

International:
Dalian Commodity Exchange, Dalian, China
Dalian Software Park, Dalian, China
Regional Headquarters, Wal-Mart, Dalian, China
Jiao Tong University, School of Naval Architecture, Ocean & Civil Engineering, Department of Shipbuilding, Shanghai, China
Shanghai Association of Shipbuilding Industry, Shanghai, China
Wartsila China LTD, Shanghai, China
Shanghai Maritime University, Shanghai, China
Nantong COSCO KHI Ship Engineering Co. LTD, Nantong, China
Fincantieri Naval Vessels Business Unit Headquarters, Genoa, Italy
Muggiano Naval Shipyard, Genoa, Italy
Fincantieri Commercial Shipyard, Malfolcone, Italy
Wartsila Marine Diesel Assembly Plant, Trieste, Italy
Guidecca Ship - Squero. Venice, Italy

INTRODUCTION

"The Congress shall have power…To provide and maintain a Navy"
US Constitution Article 1, Section 8

Fifteen members of the Industrial College of the Armed Forces class of 2005 undertook a five month study of the domestic and international shipbuilding industry to examine the shipbuilding industrial base and ascertain its ability to support the national security of the United States. In the study we evaluated the industry's current condition, its challenges, and future outlook. The seminar members included ten US military senior field grade officers, three senior Department of Defense (DoD) civilians, one Department of State (DoS) Foreign Service Officer, and an International Fellow from the Ministry of Defense, Republic of Georgia. This report is a compilation of individual examination of industry segments; domestic and international field studies to meet with top shipyard management officials and observe construction and repair methods; and group collaboration on conclusions and recommendations.

Since colonial times, our country has depended heavily on the ocean for both trade and defense. Although air travel has shrunk the globe and changed public perception of transportation, the fact remains that the US and its allies are vitally dependent on sea transport for bulk of their trade. Ninety-five percent of all raw and finished materials entering the US come by sea. The same percent of exported goods are shipped by sea. The oceans are essential to our national security both from an economic and a physical security perspective. A powerful Navy gives the nation command of the seas. With command of the seas, the nation can project military power to all corners of the globe and protect and defend the international commercial fleet so vital to the global economy.

The domestic naval shipbuilding and repair industry designs, builds and maintains the most technically advanced and capable naval vessels in the world today. This industry includes government and commercially owned shipyards, associated subcontractors and suppliers. The commercial domestic shipbuilding industry mainly provides for the niche market of port-to-port commerce within the US, which is protected by the cabotage law commonly referred to as the Jones Act. The commercial domestic shipbuilding industry accounts for less than one percent of the world's production of large commercial ships.

This dichotomy—being the current world leader in naval construction at the same time being insignificant in the global commercial market—puts great stress on the US shipbuilding industry. Naval vessel costs have skyrocketed in the last few years, and the lack of a viable and vibrant commercial shipbuilding industry has played a role. The excess capacity of our large yards is reflected in the higher cost of the few vessels currently being ordered by the US Navy. The few ships currently being built in US yards barely maintain this vital industrial capacity. Worse still, shipyards depend on throughput—large numbers of ships—to maintain the proficiency of their highly skilled workforce and to train the next generation of workers. The skills of the US workforce are suffering in the current climate.

We note that the lack of stability in planned naval ship procurement is also causing upward pressure on delivered vessel cost. The US Navy is increasingly unable to define future operational concepts and materiel requirements. The constant changes in

the shipbuilding plan make it more and more difficult for shipyards to plan for future requirements. The capital investment both in infrastructure and human resources required in this industry is vast. Because of this, only a stable procurement rate can make it fiscally viable to invest in modernization and efficiency initiatives necessary for modern construction.

A cause of instability in the shipbuilding plan is the inability to accurately estimate cost and program funds accordingly. Current law mandates full funding of ships in the years of procurement, which becomes increasingly difficult in today's resource constrained environment. The incentive is to provide "affordable" estimates, which can be adjusted in later years, impacting future ship procurements. The high costs of individual ships—billions of dollars in almost every case—make them lucrative targets for budgetary action. Delaying the construction of a major naval vessel by just one year can free up significant amounts of budgetary authority.

At the same time, we are faced with overcapacity of existing shipyards. While multiple shipyards provide competitive savings and a surge capability, overcapacity also increases total shipyard overhead resulting in increased ship costs. The Government must take a more active role in determining the level of capacity it is willing to maintain to meet current and surge requirements.

Finally, we conclude that the current cabotage laws have not protected the domestic shipbuilding industry from foreign competition. Foreign yards build the world's great modern commercial carriers. The Jones Act fleet, as the few ships that supply the US to US port trade are called, is a relatively minor number of carriers compared with the international merchant fleet. Sustaining the Jones Act fleet barely maintains minimal infrastructure to provide a capability to surge commercial construction in time of national emergency. The government can and should consider incentives to increase commercial ship construction: to increase volume, protect and train the workforce and spread overhead allocations.

We believe the US shipbuilding industry is in crisis and national security will be in jeopardy if the shipbuilding industry is allowed to founder. We strongly recommend the following actions:

- The DoD actively determine the level of capacity necessary to support current and surge requirements.
- The DoD take action to stabilize the long term shipbuilding program.
- The Congress and DoD remove the requirement for full funding of ships in the year of authorization.
- The Congress and Executive Branch review current laws and policies with an eye toward strengthening the domestic commercial shipbuilding industry.

THE SHIPBUILDING INDUSTRY DEFINED

The shipbuilding industry is a worldwide enterprise which includes the construction and repair of all manner of water craft. For the purposes of this report, the shipbuilding industry was defined as those shipyards capable of producing naval vessels, large passenger vessels, and large commercial bulk freight, container, and special purpose vessels. This industry is a mix of public and private yards that includes facilities ranging from huge industrial complexes, such as those found in Asia, moderately large shipyards,

such as those found in the US and Europe, and smaller facilities spread throughout the world. The shipbuilding industry includes all the design, skilled and unskilled labor, manufacturing processes, infrastructure, and secondary and tertiary suppliers needed to construct these sojourners of the seas.

The shipbuilding industry has attained a balance across the spectrum of ship classes. The Asian countries, China, Japan, and Korea, have achieved a virtual monopoly in the construction of large commercial ships—oil tankers, bulk carriers, container ships and roll-on/roll-off vessels. This monopoly is supported by a considerable supply of trained, experienced labor and the regional availability of steel, engines and other ship components. The volume of ship construction in these yards promotes investment in automation and labor, and results in decreasing ship cost. The result in the current market is that Asian capacity is fully utilized through 2009. Europe, including Italy, Spain and Finland, has maintained its control of high tech civil and commercial construction, including ferries, research vessels, cruise liners and medium sized naval vessels. Europe maintains its own stable of first and second tier suppliers, including a unique sector of craftsmen to support the outfitting of luxury cruise ships. Europe also seems to have significant export sales of medium size, medium complexity naval vessels, which provides additional workload to allocate overhead, protect the workforce and promote investment. The US has a limited share of the market: specializing in highly capable, highly complex naval vessels at the same time the US builds a small number of commercial vessels required for the Jones Act trade. There is no significant export market for US naval or commercial ships. The US maintains a healthy ability in secondary shipyards to build small to medium sized, special purpose ships.

Within the definitions of the study, the US has six major private shipyards, which constitute the first tier of naval construction, and five public yards which construct or repair naval and commercial vessels. Two giant defense contractors, Northrop Grumman Inc. and General Dynamics, Inc, own the six shipyards capable of producing the US Navy's most advanced warships and submarines.

The US Navy operates four public yards for depot level repair of fleet vessels. They are the Portsmouth Naval Shipyard located in Kittery, ME (which at the time of this report was announced for closure by the Pentagon's recommendation to the Base Re-Alignment and Closure Commission), the Norfolk Naval Shipyard located in Portsmouth, VA, the Puget Sound Naval Shipyard, located in Bangor, WA, and the Pearl Harbor Naval Shipyard located in Pearl Harbor, HI. In addition to the US Navy yards, the US Coast Guard operates the Curtis Bay Shipyard, located in Baltimore, MD for repair and construction Coast Guard vessels.

On the commercial side, where a total of almost 100 ships were built annually in the early 1980's, now less than 7 vessels are built per year, there are 9 active shipbuilding yards capable of constructing ships more than 122 meters (400 feet) in length. An additional 80 yards exist to construct smaller ships, or to provide maintenance, upgrade or repair services. These yards employ 66% of the total US industry workforce and provide only 1% of the global delivery of new ships.

The industry's second tier shipyards include facilities such as Bollinger Shipyards in Lockport, LA, Textron Marine and Land Systems in New Orleans, LA, VT Halter Marine Shipyard in Pascagoula, MS, and Austal USA in Mobile, AL. These yards construct smaller naval and commercial vessels such as assault landing craft, coastal

patrol craft, ocean going tugboats, ferries, barges, and the future US Navy Littoral Combat Ship. There are a number of smaller depot level repair yards located in the main fleet concentration centers of Norfolk, VA and San Diego, CA. These yards are totally reliant on US Navy overhaul and repair contracts for their livelihood.

Shipyards, which employ thousands of skilled workers and have huge investments in infrastructure, are the largest but not the only element in the total system of ship construction. Material and equipment suppliers set the overall economic reality of the final cost of the vessel. Raw plate steel and everything from the propulsion engines to the galley range must be acquired through secondary suppliers. It is this total system which comprises the shipbuilding industry.

CURRENT CONDITIONS

In looking at the current condition of the shipbuilding industry, it is helpful to start by analyzing the large commercial vessel market and the naval vessel market separately. As evident throughout this report, these industries are interrelated in many important ways.

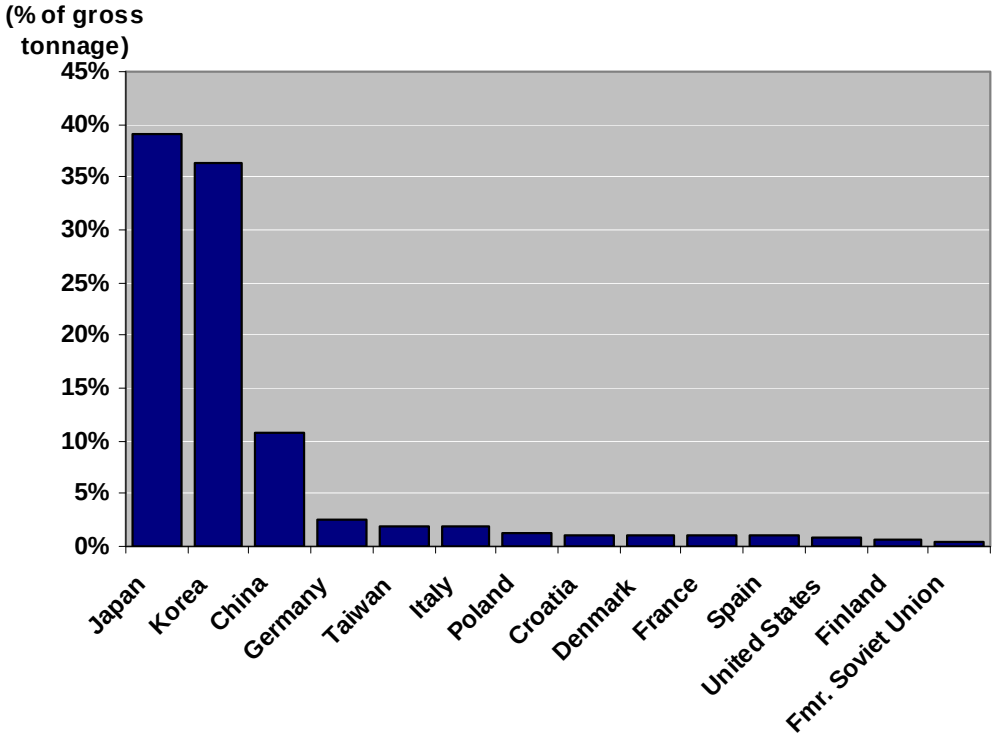
Commercial Shipbuilding Market

Prior to the 1980s, US shipbuilders produced nearly 100 commercial ships each year. In the early 1980s, President Reagan eliminated subsidies for commercial shipbuilding as other countries were increasing theirs. Orders for commercial ships dropped to zero in the mid 1980s and have averaged just seven ships per year since then.[1]

During this same period, the shipbuilding industries in Japan, South Korea, and China emerged to become the worldwide market leaders in commercial shipbuilding. They achieved their status by building highly productive, state-of-the-art manufacturing and assembly plants subsidized by their respective governments. While the Asian shipbuilders were gaining their dominance, the US shipbuilding industry focused more on the buildup of the Navy's fleet. By the middle of the 1990s, when the US Navy's buildup slowed, the Asian shipyards were producing over 50 percent of the world's commercial shipping tonnage at a fraction of the cost of European and American builders.[2]

By the end of 2003, the Far East shipbuilders had increased their market share to 88.2 percent of the world commercial shipping tonnage. Japan, Korea, and China rank first, second, and third with 39.1, 36.3, and 10.8 percent of world shipbuilding deliveries, respectively. As depicted the figure below, American shipbuilding fell to 12th place with approximately 0.9 percent share of the new construction market.[3]

The US industry did not feel the impact of the loss of commercial sales until the US Navy buildup started to decline following the end of the Cold War.[4] This left the US shipbuilding industry with only two customers: the US Navy and commercial buyers needing ships built for the Jones Act fleet.



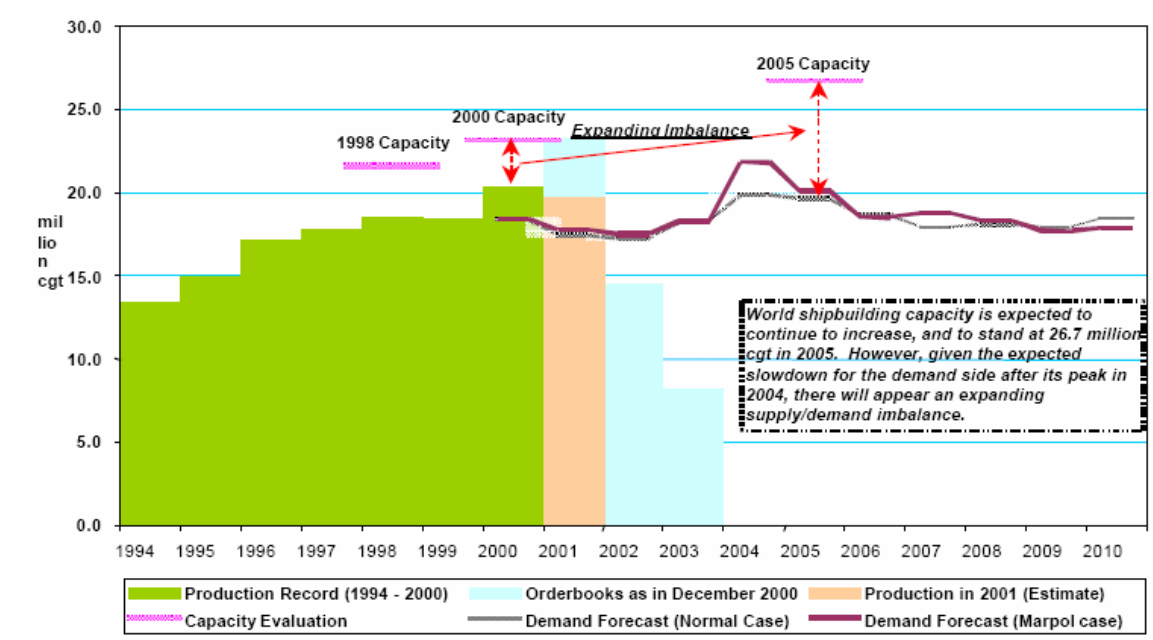
Date Source: Department of Transportation Maritime Administration

In the past decade, this US industry averaged just seventeen commercial and naval ships each year. Because the shipyards now had to spread fixed costs and plant overhead among fewer ships, the overall cost of US built ships increased. This loss of competitive advantage resulted in mergers and closures of major shipyards. It also affected the secondary US suppliers of subcomponents because of the fewer number of specialty items needed to build ships. These suppliers either went out of business or refocused their efforts on other markets. The remaining US suppliers raised their prices following lower demands and higher unit costs. Foreign suppliers emerged to supplant domestic firms as providers of innovative components such as specialized steel shapes that improve productivity and reduce structural weight, and slow speed diesel engines.[5] Because of the low demand and significant litigation risk in the US market, these foreign suppliers can now charge US shipbuilders two to three times what they charge European or Asian shipbuilders for the exact same components. The cost growth is exacerbated by the increasing global competition, driven by the growth of Asian construction, for key critical ship material (steel, titanium) and supplies.

Overcapacity in Worldwide Commercial Tonnage

According to the Organization of Economic Cooperation and Development (OECD), "the shipbuilding market is in imbalance due to an increasing surplus of shipbuilding capacity."[6] The report (see figure below) highlights the roughly seven million gross ton overcapacity in 2005, due in large part to the Asian shipbuilding industry. South Korean, Japanese, and Chinese shipyards continue to grow, further exacerbating the problem. China is presently building the world's largest shipyard. Planned completion of the yard is in 2015, at which time China will likely overtake South

Korea as the world's largest producer of ships.[7] However, all of this new capacity in excess of the current surplus tonnage prediction could cause the international market to collapse.



Source: OECD

Naval Shipbuilding

In recent years, six yards, owned by two large corporations, Northrop Grumman and General Dynamics, have been responsible for the construction of the US Navy's major warships. These are:

- General Dynamics (GD)/Bath Iron Works (BIW) of Bath, ME
- GD/Electric Boat (EB) of Groton, CT and Quonset Point, RI
- GD/National Steel and Shipbuilding Company (NASSCO) of San Diego, CA
- Northrop Grumman (NG)/Avondale Shipyards, New Orleans, LA
- NG/Ingalls Shipbuilding of Pascagoula, MS, and
- NG/Newport News Shipbuilding (NGNN) of Newport News, VA

The table below describes the maximum production capacity of the above yards for a particular class of ship. As stated in the 1996 Congressional Research Study Report, caution must be exercised when using this table to judge the comparative capacities of the yards. A shipyard that is listed as being able to build a given number of large, complex ships may have more capacity than a yard that is listed as being able to build a larger number of smaller ships.[8]

Yard	Maximum capacity: Number of ships completed per year
GD/BIW	3.5 Arleigh Burke (DDG-51) class destroyers
GD/EB	3 nuclear-powered attack submarines (SSNs)[a]
GD/NASSCO	4 or 5 Supply (AOE-6) class underway replenishment ships or 5 or 6 Watson (TAKR-310) class sealift ships[b]
NG/Avondale	4 Harpers Ferry (LSD-49) class amphibious ships
NG/Ingalls	11 DDG-51 class destroyers *or* 8 DDG-51 class destroyers + 1 Wasp (LHD-1) class amphibious ship
NGNN	4 SSNs[c] + 1 nuclear-powered aircraft carrier (CVN)

Source: CRS Report 96-785 F, *Navy Major Shipbuilding Programs and Shipbuilders: Issues and Options for Congress*, op cit. Table 2 on page 28. GD = General Dynamics, NG = Northrop Grumman.
a Capacity of EB's Land-Level Submarine Construction Facility (LLSCF). Additional submarines could be built in EB's older inclined building ways.
b These ships are also known as Large, Medium-Speed Ro/Ro (Roll-on/Roll-off) ships (LMSRs).

CHALLENGES

Ship Requirements and Ship Orders

In February of 2005, Admiral Vernon Clark, the Chief of Naval Operations, outlined the force structure requirements of the US Navy before the Senate Armed Services Committee. In that testimony, ADM Clark estimated the future requirement for US Navy ships to be in the range of 243 to 325 ships. In explaining the estimate, ADM Clark noted, "The ultimate requirement….will be shaped by the potential of emerging technologies, the amount of forward basing, and innovative manning concepts…"

To build and sustain the fleet envisioned by ADM Clark and documented in the recently released thirty year shipbuilding plan, the US Navy would need to procure eight to ten ships and submarines per year. The President's budget submittal to the Congress for FY 2006 requests only four ships. This, and other changes to planned shipbuilding rates, puts pressure on the unit costs due to the increased overhead cost and excess capacity in the workforce which was planned for a higher build rate.

The US Navy and the private shipbuilders are reaching the point where significant industrial base decisions must be made. Maintaining all the current private shipyards in the face of low ship orders can only be maintained at enormous cost. Even with productivity improvements being made by the large shipyards (described in an attached essay), the economic reality requires more ship orders to lower unit cost. If those orders do not come, the government and the shipbuilders need to decide which yards should remain open to support construction needs. The danger to the national security strategy in this scenario is simple; lost industrial capacity can not be replaced easily, if at all.

The challenges in the commercial market are even more dramatic. US domestic commercial shipbuilding capacity pales in comparison to the Asian industry. The enormity of the Asian shipyards is staggering. Shipyards in Japan, South Korea, and

China are operating near full capacity, with orders filling their books for the next five years. The Asian shipyards no longer need subsidies from their governments to be competitive in the world market, the economies of scale and the interlocking secondary supply chain have given the Asian yards the ability to deliver a 40,000 gross weight ton bulk cargo ship for one hundred million dollars less than an American shipyard can produce the exact same vessel. One US shipbuilder noted that a Korean shipyard can deliver a completed ship for the cost a US yard pays just for the steel.

The challenge to America shipbuilders in this market is massive. To be competitive, American shipbuilders would need access to equipment and material supply chains at globally competitive prices. Due to low construction numbers, American shipbuilders do not currently enjoy this access. An American shipbuilder then has to compete with Asian labor rates which are significantly less than American rates. Finally, Asian shipyards are more modern and more efficient than their American counterparts.

Labor Force Challenges

Labor is the major cost driver of ships, reflecting 30% of the total ship construction cost. The average age of an American shipbuilder is between 48 to 52 years, compared with the average age of a shipyard worker in China or Italy, who is in the low to mid 30's. Most American shipyard workers entered and learned their trade during a period when the US was still building a large number of ships per year at all the major shipyards. This group also provided the bulk of the skilled force which participated in the Reagan administration's buildup of the fleet in the 1980's. Unfortunately, the reverse of that buildup at the end of the cold war forced the major shipyards to downsize, consolidate, and more importantly, reduce hiring. These historical trends in ship construction have led to a workforce that is older and getting ready to retire. Younger workers have not had the opportunity to hone their shipbuilding skills as their older counterparts did. While many yards conduct apprenticeship programs, it can take up to five years to become truly proficient. Lack of throughput at the yards reduces the learning curve for these new workers, slowing learning and increasing associated cost of supervision, training and rework. As an example of the skill set for an American ship-fitter and a Korean ship-fitter: an American worker hired by a major commercial yard in the US three years ago has had the opportunity to participate in the construction of five to six ships; his Korean counterpart hired on the same day by the major commercial yard in South Korea has had the opportunity to participate in the construction of up to one hundred and eighty ships. While there is no question regarding the dedication of either worker to his craft, the South Korean worker has been afforded the opportunity, because of the reality of throughput, to master his craft in a much shorter time. The skill sets required by the shipbuilding industry, including structural welding, ship-fitting, material installation, and electrical and electronic system integration, require continued practice. American workers are at a considerable disadvantage in this area. The key labor skills of metal work and welding require long apprenticeships, yet are easily transferable to other areas of the economy: construction of buildings or other steel-based manufacturing. Thus it is difficult to obtain workers, expensive to train them to be proficient, and difficult to keep experienced workers in a competitive economy.

Secondary Supply Challenges

As was stated earlier, the overall cost of a ship is directly linked to the ability of the shipbuilder to procure, at competitive global rates, all the equipment and material needed for construction. During this study of the shipbuilding industry, a recurring theme in skyrocketing delivery price was the cost of material and equipment. While this issue meets the classic economic textbook example of a demand v. cost curve, the implications for survival of the industry are huge. The prosperous foreign yards have integrated their supply chains with their core operations because of the economies of scale they enjoy in construction orders. The US is attempting to improve supplier management through development of supply chain integration via the internet or physical geographical zones. Yet, the range of components and competitive suppliers in no way matches global resources.

Government Management of the Industrial Base

The US has a long tradition of maintaining the military industrial capacity of the country in the private business market. This model has served the country well from the time of the revolution up through the end of the last century. The challenge of private ownership of the major military construction yards today is their almost total reliance on naval orders for their very existence. Only two of the large six yards have any commercial interest at all, and that interest is small.

Much has been written and discussed concerning competition among the various private yards to guarantee the best price and highest quality to the government. The reality of the industry today is that there is very limited competition in contract orders. The specialization of the shipyards based on ship type, Congressional influence, and industrial base concerns has led to the awarding of contracts to keep multiple shipyards open rather than on the basis of best value for the government. This method of maintaining private firms in business has significant cost implications.

The most stable structure of the domestic industry, given the current reality, would be shipyards which are diversified in naval and commercial construction and able to shift their workforce between projects to maintain a steady workload. This nominal efficient shipyard would operate near full capacity to reduce overhead cost and spread infrastructure improvement costs. An organization which produces both naval and commercial vessels, attempting to utilize all existing capacity, provides the greatest resource utilization and lowest unit cost.

In the international community, the government owns or directly subsidizes industrial concerns to meet and protect capacity. The US free market paradigm would not support direct ownership; however, the Government must recognize its role in maintaining capacity. The solution set is simple; increase throughput or pay the enormous cost of inactivity to maintain the industrial base necessary for national security. Efficiency can be improved by increasing direct procurement of military ships, or increasing commercial output via either direct subsidies or incentives.

OUTLOOK

The outlook for the shipbuilding industry in the US is unclear. What is clear is that major governmental decisions concerning the industrial base must be made very

soon. No national decision will in fact be a decision to allow the industrial shipbuilding base to continue in its current state of crisis and decline.

Adding to the uncertainty of the industrial base is the uncertainty of the future shape of the US Navy. The Seabasing concept, covered in more depth in an attached essay, is a concept but not a program of record. The types of vessels that would make up the seabase are not all well defined. While there are many concepts, no decision on the way ahead has been made adding to the risk shipbuilders must take if they wish to make capital investments to compete for a portion of Seabasing construction.

In addition to the Seabasing concept, the US Navy's continued transformation from a deep water force to a combination deep water and littoral force adds risk to the shipbuilder. The US Navy's planned Littoral Combat Ship will not be built in one of the large shipyards. As transformation continues, budget pressure may sway decisions in force structure towards more affordable, but less capable US Navy platforms. The US Navy's next generation destroyer, the DD(X) program, also reflects uncertainty as performance requirements and acquisition strategy continues to evolve.

A further cause of instability in the shipbuilding plan is the inability to accurately estimate ship costs and program funds accordingly. Current law mandates full funding of ships in the years of procurement, which becomes increasingly difficult in today's resource constrained environment. The incentive is to provide "affordable" estimates, which can be adjusted in later years, impacts future ship procurements. The possible solution is to allow incremental funding of ships, reducing the resource burden in a particular year, and allowing for smaller out year adjustments.

It is highly improbable that in the face of escalating ship costs and other major national concerns, the US Navy's ship procurement order book will increase to the point that it will become economically feasible for all the current large military shipyards to remain open. It is probable, due to Congressional action, that the US Navy will be forced to continue to spread the limited ship orders over the range of shipbuilders. If this remains our approach, the trade off to sustain industrial base capacity will be the dramatically increased cost of each vessel.

The commercial shipbuilding sector gets significantly less attention than the naval shipbuilding sector, but is just as vital to the national security. Commercial ships not only guarantee access to vital transportation capability, but provide industrial base sustainment and a surge capability for ship construction. They supplement the shipbuilding industry with trained personnel, maritime engineering experience and an existing supply base. The outlook for our commercial yards is dire. As discussed earlier, the Jones Act fleet is such a small market for large commercial vessels that the build rate to replace Jones Act vessels is minimal. To make the commercial market viable the government would have to play a key role. Without subsidies it is virtually impossible to compete with the Asian shipyards. If the Jones Act were repealed, commercial ship construction in the US would cease. There is no other economic reality than that. No domestic commercial shipbuilding industry would mean that in a very few years the US would be completely dependent on foreign owned and flagged vessels for the transport of all sea commerce into and out of the country.

CONCLUSION

In conclusion, our study found that the tremendous advantage the US enjoys in naval power directly supports our national security through global power projection and maintaining freedom of the seas. Our ability to build large, highly capable naval ships is a vital part of our naval superiority and is therefore inexorably linked to our national security. The US must maintain it lead in naval power by protecting its domestic shipbuilding industry.

It is our conclusion that the number one issue facing the American military shipbuilder today is the uncertainty in future orders for ship construction. The year to year fluctuation in the projected naval order book adds uncertainty for the shipbuilder wanting to invest in capital and labor improvement, and adds cost to the vessels actually being delivered. This fluctuation is exacerbated when the US Navy cancels entire ship classes or severely limits procurement of vessels that have been programs of record, programs which the shipbuilders have used to make labor and capital investment decisions.

We feel it is imperative for the Navy to identify the force of the future and commit to a stable procurement plan to implement that force. The concept of Seabasing must mature at least to the point where the major yards can invest in the infrastructure necessary to build the force. In this area, we also conclude that the requirement for full funding of naval vessels in the year of authorization hampers the ability of the Navy and the industry to maintain a steady shipbuilding plan. It is apparent to us that the US Navy shipbuilding program is often used as a "bill payer" for other DoD priorities. In addition to the reality that the money is not obligated in the year of funding, the temptation to use the US Navy shipbuilding account to pay current year expenses is greater if significant procurement dollars are available to pay the full cost of individual ships.

While we are convinced the nation must maintain sufficient shipbuilding capacity to allow for surge in national emergencies, we feel that the current and projected naval order book does not support the capacity being carried by the six largest shipyards. Restructuring of the industrial base is necessary. This restructuring may entail the politically difficult decision to allow some yards to close, but if the naval order book does not increase and the restructuring does not occur, unit cost will continue to skyrocket out of proportion to the value to the nation of the vessel.

We found that US shipbuilders cannot compete in the global commercial market, particularly against the Asian shipbuilding industry. The reasons for our lack of competitiveness include labor rates, yard efficiencies, and increased cost to American shipbuilders due to low production rates. American shipbuilders do not benefit from an integrated secondary supply chain that the Asian shipyards enjoy. This extra cost for equipment and material combined with higher labor rates and excess infrastructure make it unlikely that purely market forces would allow American shipbuilders to regain a competitive posture against the global industry in the foreseeable future.

As a result, and since we believe that the ability for the nation to build and maintain a US flagged fleet is in the national interest, we also believe it is in the interest of the DoD for US shipbuilders to maintain a construction capability for commercial vessels. Doing so allows shipbuilders to spread overhead and infrastructure costs and provides another tool to increase the stability and retain the skills of the labor force. We recommend that the Congress and appropriate executive agencies (including the

Departments of Commerce and Transportation) seek innovative ways to incentivize the demand for Jones Act ships. We also recommend the DoD become a strong partner in this area, to include advocacy, favorable policies and regulations, and perhaps even application of resources when appropriate.

We began this report by describing this industry as an industry in crisis. Throughout the report we attempted to explain why we have come to that conclusion. This crisis has solution sets; the question is which of the possible solutions should be chosen by the DoD and the Congress. We feel that the most efficient and viable option for the industrial base is to restructure the shipbuilding industry to eliminate some excess capacity, re-vitalize the commercial shipbuilding industry and commit to a stable naval build rate. This re-structuring will not be easy; it will require significant political will. The future of the shipbuilding industry depends on its success.

ESSAYS ON MAJOR ISSUES

Implications of SeaBasing for the Shipbuilding Industry

Editors Note: This essay discussing Sea Basing was prepared based on information available before May 2005. Therefore it does not take into account decisions made and discussed in open literature after May 2005 or reflect the significant progress made after that time.

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The US Navy and US Marine Corps have adopted "Sea Power 21" as the vision for power projection, littoral access and operational flexibility in the future. The vision has three pillars, Sea Strike, Sea Shield and Sea Basing. Sea Strike and Sea Shield are logical evolutions of the current strike and defense missions performed by naval forces. The Sea Base, however, is a revolutionary departure from current logistics and support concepts. The Navy calls Sea Basing "a scaleable aggregation of distributed and networked platforms that provides for the assembly, equipping, support, and sustainment of offensive and defensive power projection forces from the sea, without reliance on land bases…." In short, it "will be a launch pad from which expeditionary forces enter areas of operations, and then will serve as the principal source of support and sustainment for those forces." The structure of the Sea Base will change with time, expanding, contracting and altering its makeup based on the phase of the campaign and the needs of the forces it is expected to support. It may remain the sole source of support and sustainment throughout the campaign, or until ports and airheads have been secured and adequately defended. The Sea Base is expected to provide the traditional advantages enjoyed by forces afloat — independence, mobility, and security—while offering a solution to reduce the political and military barriers faced in accessing shores worldwide. The purpose of this essay is to examine the capabilities and challenges of the US shipbuilding industry in building the Sea Base.

Current plans project that the Sea Base vision will become a reality in some form by 2020. As such, this means that amphibious, logistics and support ships under construction and in design today must be part of the concept. While the Sea Base vision

has been communicated across the community, there is a lack of fidelity in the vision that is necessary to move it from concept to reality. As one member of the industry recently stated, "we all know what Sea Basing is, but none of us knows what a sea base is." As a result, concepts vary within the US Navy and US Marine Corps, other branches of service, the shipbuilding industry and oversight agencies. Some concepts present an integrated and functioning Sea Base complete with logistics platforms, service and transfer vehicles (vessels and airborne platforms), and ship-to-shore and long-range waterborne connectors, all operating in conjunction with the Sea Strike and Sea Shield forces. Among these concepts, some present an evolutionary approach, built on the foundation of current and planned amphibious, combat and support vessels in the US Navy's shipbuilding program. Others present more advanced concepts, using "clean sheet" designs for vessels with advanced capabilities, some of which are not part of US Navy's current shipbuilding plan. Other Sea Base concepts are not integrated solutions at all, but focus instead on individual ships or capabilities, and describe how they will be an integral part of a future Sea Base, without describing the nature of the Sea Base it is intended to support.

The lack of fidelity and requirements definition in the Sea Base concept, even at a basic level, is the first and foremost challenge the shipbuilding industry faces in working with the DoD, hampering attempts to develop and assess the capabilities of the Sea Base in the future. Congressional research and oversight agencies have identified this shortcoming and expressed frustration that the lack of definition does not allow for adequate budget analysis, mission assessment and oversight, making it difficult to project the types and numbers of platforms required to fully implement the concept. Further, as the design phase begins on the next generation of amphibious, logistics and support ships, lack of adequate definition in the concept means Sea Base capabilities may not be properly incorporated into the design and construction of new vessels like the Amphibious Assault Ship – Replacement (LHA-R), Maritime Prepositioning Force (Future) [MPF(F)] ships, and Littoral Combat Ship (LCS). It also delays focus on other vessels required to support the concept like the high speed watercraft—intertheater and ship-to-shore connectors—which means they may not be ready to support the Sea Base in its early form, fifteen years in the future.

In spite of the lack of definition in the concept and requirements needed for a full assessment, it is still possible to examine the readiness of the shipbuilding industry to support the construction requirements of the Sea Base as it is currently understood and to draw some conclusions. There are several factors to consider.

The first is the issue of capacity; is the annual construction rate of the US shipyards sufficient to meet the requirements of the Sea Base. Based on an assessment of the "Big Six" shipyards that build vessels for the US Navy today, there is more than enough capacity to support the construction of all conceptualized Sea Base platforms, from modified legacy hulls to advanced designed concepts. This conclusion is supported by Congressional Research Service analysis as well. The US Navy has at present put forth 250 and 330 ship fleet proposals before Congress. The projected aggregate build rate to achieve and sustain this level is 7 to 10 ships per year, assuming 35 year service lives for the ships. If ship service lives are reduced to 30 years, the aggregate rate is 9 to 12 ships per year.[9] The current production rate of the "Big Six" is approximately 23 ships per year, not including submarines. While it is not clear that all platforms for a

fully implemented Sea Base concept are accounted for in the 250 to 330 fleet proposals, a significant portion of the platforms are accounted for and there is substantial margin above the 9 to 12 ship annual construction rate to support additional Sea Basing construction requirements.

Because there is significant overcapacity in the shipbuilding industry today, the possibility of further contraction in the shipbuilding base is a valid topic of discussion. Given the current level of overcapacity and margin in the annual shipbuilding rate, it is reasonable to project that sufficient capacity will still be available to meet Sea Base and other fleet construction requirements, if further contraction of the shipbuilding base occurs, provided a mix of shipyards remains that is able to build the appropriate classes and numbers of ships. A more complete analysis is not possible without more fidelity in the Sea Base concept.

The third challenge facing shipyards in their quest to meet Sea Base construction needs is the preservation and advancement of shipyard capabilities. This challenge has several facets. The first is the availability of an adequate labor pool—in numbers, skills and experience. US shipyard owners regularly remark that the most difficult part of sustaining and reconstituting the shipbuilding base is the labor force. Skilled, talented labor (vocational and professional) is difficult to retain in times of reduced construction, and trained and talented workers require years of experience to become fully effective. If the ship construction rate must increase to support seabasing requirements, the availability of a skilled and experienced labor pool may be the limiting factor, especially if the ship construction rate continues in its decline before Sea Base- focused construction begins.

An additional aspect of shipyard capabilities is the ability, or lack thereof, to make smart and timely choices on technology insertion, process improvements, and capital and other investments to improve production efficiency, reduce costs and replace obsolete or worn out capital equipment. That opportunity exists now to insert new technology and process improvements into US shipyards as they prepare for the next generation vessels, but the current fiscal environment and instability in the US Navy shipbuilding program make the expenditures politically difficult for the US Navy to promote and financially irresponsible for the shipbuilding firms to pursue.

A further challenge facing the US shipbuilding industry as it prepares to implement the Sea Base vision is its lack of experience with new design concepts and technologies that will be required to fully implement the Sea Base vision. There are many areas in which this lack of experience is a concern. One is ship design. US shipyards have a tremendous amount of expertise in the design and construction of conventional, ocean-going, monohull vessels. While ships of this type will be required, there is also a need for high-speed watercraft, including shallow draft ship-to-shore connectors, transfer vessels within the Sea Base and intertheater lift platforms to rapidly deliver materiel from CONUS to theaters worldwide. Beyond that, significant work remains to be done in the ability to offload supplies, cargo and combat units at sea in high sea states and advanced warehousing, handling and storage techniques aboard Sea Base platforms. These are a few of the concepts and technologies that require further development and an experience base within the US shipbuilding industry.

The final issue in the ability to take Sea Basing from concept to reality is financial, in this case, the cost of construction of the substantial number of platforms

required to field a viable Sea Base. Again, it is impossible to provide exact estimates without numbers and types of Sea Base platforms, but historical data and extrapolations are informative. According to Congressional Budget Office analysis, the number of amphibious and support ships in the US Navy's current plan would require more funds as a percentage of the shipbuilding budget than these types of ships have enjoyed in more than twenty years, and as stated earlier, it is not clear that the current plan completely reflects Sea Basing needs. Beyond that, the current shipbuilding budget as a whole does not support the current new construction needs projected by the US Navy.[10] The implications of these data are clear. Regardless of the current status of US shipyards—the capacity and capability—to meet Sea Basing construction needs, projected shipbuilding budgets will not support the required level of construction, and therefore are unlikely to provide for valuable technology development, concept exploration, process improvement or recapitalization required to prepare the ships and shipyards for construction.

In conclusion, it is clear that the US shipbuilding industry today is capable of meeting the needs of the DoD in providing a Sea Base capability in the future. It is not, however, without challenges. The Sea Base concept requires significant definition soon, investment is required to preserve and advance the capabilities of the shipyards, and an infusion of funds into the US Navy's shipbuilding program is required if the concept is truly expected to become a reality by 2020.

Cabotage Laws

CDR William A. Ebbs, USN

"All politics is local."
Rep "Tip" O'Neil (D-Mass)
Speaker of the House

The great statesman from Massachusetts had it just about right. At the end of the day, all politics *is* local. It takes vision and courage for an elected representative to vote for a measure that may have long term national value but has negative short term local impact. This essay addresses the current status of regulatory action affecting the shipbuilding industry; discusses the historical foundations of the regulation, and offers suggestions for improvement in statutory regulations which may allow more competitive and economical operations of the nation's shipyards.

Any paper devoted to the regulation of shipping in the US must begin with a discussion of the cabotage laws. A cabotage law is a regulation that protects a domestic service from foreign competition. In the case of shipping the cabotage law of concern is commonly referred to as the "Jones Act," named after Senator Wesley L. Jones of Washington State. The Act was passed in 1920 and aimed at protecting American shipping interests from foreign competition. The law prohibits transport of merchandise "in any other vessel than a vessel built and documented under the laws of the US and owned by persons who are citizens of the US." A similar cabotage law, the Passenger Vessel Services Act of 1886, requires essentially the same for passenger ships. To go from one US port to another without an intermediate stop in a foreign port, the vessel must be built, flagged, crewed, and owned by American citizens. Violation of this law could result in seizure of the ships cargo by the government.

As with many legislative initiatives, there are unforeseen consequences to the original intent of the Congress. The defenders of the Jones Act make their case (strongly) that the Act protects US jobs and national security by maintaining a ready fleet capable of surging war materials overseas when needed. That fleet is gone; in fact President George H.W. Bush suspended the Jones Act during the 1990 Persian Gulf War to facilitate the movement of supplies between US ports prior to overseas transport. The "Jones Act Fleet," a term used to describe ships that carry merchandise between US ports, has dwindled to the point that at present there is not one cargo ship of greater than 1,000 GWT operating on the Atlantic coast.

The hard facts are that this country does not have a commercial shipbuilding industry. We have a handful of shipyards that build ships exclusively for the Jones Act trade, but the world market share of commercial shipbuilding is significantly less than one percent, essentially non-existent. Domestic shipyards are incapable of competing in the global shipbuilding market for reasons that are documented in other portions of this report. Disregarding ship and barge construction for service on inland waterways and the Great Lakes, the market for Jones Act vessels is limited. There is essentially no market on the East Coast for Jones Act commercial carriers because of the ability to move cargo overland via trucking or rail (as an aside, this significantly hinders American businesses who must compete with foreign suppliers of bulk cargo items who do not have to pay the increased costs of using Jones Act vessels). On the West Coast the Jones Act trade is limited to vessels supplying the Alaska and Hawaii markets.

It is difficult for an entire domestic industry to sustain itself on the handful of vessels necessary for the Alaska and Hawaii trade. Much of the Jones Act fleet on the West Coast will be in need of replacement in the next few years. However, orders for replacement vessels are not being placed at the rate necessary to maintain the fleet. One possibility for this is a business decision by ship owners to run their vessels to the very end of useful life, while waiting for relief from the protectionist aspects of the Jones Act. This tactic may in fact be a good one (from a business aspect) since tremendous political pressure could be applied on the Congress when the fleet has declined to an unacceptable level. Ship owners, given relief from the Jones Act, could quickly buy ships on the international market at a fraction of the cost of domestic supply.

This essay does not recommend repeal of the Jones Act. Doing so would immediately cause the closure of the remaining domestic commercial shipbuilders. I believe that the national security depends on a robust shipbuilding industry and that that industry can not be limited to only warships being built for the US Navy. Having said that, the Jones Act is highly flawed and may itself be the cause for the lack of competitiveness of the domestic shipbuilding industry. When an industry is given blanket protection from the government the need for innovation and efficiency is removed. Without the need for American shipbuilders to be conscious of the world market and changing shipbuilding methods, the world passed them by. An excellent example of this drive to innovation and efficiency is seen currently in some (not all) of our military shipbuilders who, with declining shipbuilding orders, have worked extraordinarily hard to increase efficiency by system wide process improvement.

The national security demands the maintenance of a shipbuilding industrial base. The Jones Act is barely able to maintain the commercial industry. The time has come for the government, in partnership with domestic shipbuilders, to enact bold legislation

aimed at returning the American shipbuilder to international competitiveness. There are a few ways that this may occur. The government could offer direct subsidy to shipyards, or American ship owners, for purchasing American made ships. Significant capital investment could be made available for modernization of our domestic shipyards to allow for the most efficient construction methods to be employed. Direct or indirect subsidy for secondary suppliers is essential until the build rate reaches a point where it is economical for secondary suppliers to offer the best price for material.

The Jones Act should be amended to eliminate the requirement for American crews to operate vessels of the Jones Act fleet. This requirement adds anywhere from five to ten thousand dollars per day to the operating costs for the ship owner (costs which are passed along to the residents of Hawaii and Alaska). Amending the Jones Act of this provision could improve the attractiveness of reinvesting in the Jones Act fleet. While this recommendation will not be supported by American labor interests, the need to maintain a commercial industrial base may override the small labor market interests.

Bold and significant government effort is needed in the shipbuilding industry to maintain our industrial capacity to build warships and to have a modern cargo fleet capable of the logistics requirements for any future overseas conflict. Warship costs have increased to a point where the Congress is not going to fund the fleet the US Navy needs to carry us into the middle of this century. When the entire infrastructure of a shipyard is carried by the one or two vessels being built for the US Navy, the cost of those vessels become enormous. With a strong commercial build program, the infrastructure costs are spread over a larger ship population.

In summary, the status quo is not capable of maintaining the American shipbuilding industry and the American shipbuilding industry is crucial to our national security. The Department of Defense, along with the Departments of Transportation and Commerce must develop strategies to make the purchase of US built commercial vessels attractive in the global marketplace.

Industry Stability

CDR Hugh D. Wetherald, USN

The US Navy has experienced seemingly unconstrained growth in the cost of building of its ships in recent years and there are a number of contributing factors. As the DoD and Congress attempt to determine the root cause of the explosive cost growth, they often overlook the most fundamental reason. Independent of the specific shipbuilder or type of ship, the current low build rates coupled with the tremendous volatility of the US Navy shipbuilding plan itself are the major contributing factors. Until the US Navy develops a long-term, firm shipbuilding strategy and we increase the build rate to properly utilize the industrial base, we will not get control of cost growth. To do this, the US Navy must develop a long term strategy and commit to it over a long period of time. Only in this way will we be able stabilize the shipbuilding industrial base and get control of the cost growth we are experiencing.

The Naval shipbuilding plan changes every year causing deep reverberations felt throughout the shipbuilding industry. US Naval shipbuilders are private corporations, producing a product for the US Navy. The US Navy in turn signs contracts for their products and pays for those products as set forth in the contracts, and it is the

shipbuilder's responsibility to sign a contract in which their company makes a profit. The costs of the shipbuilder, including overhead, are passed directly to the US Navy through the prices set for the ships they build.

After years of low build rates through which the major shipbuilders have been struggling for survival, the individual companies have weakened financially and are less able to weather the volatile shifts in the US Navy shipbuilding plan. As long as the country desires to maintain the present industrial base, it must also be willing to pay the increased costs associated with constantly modifying the shipbuilding plans.

These annual perturbations in the US Navy shipbuilding plan are one of the most significant factors the shipbuilders face. These constant fluctuations have far reaching implications to the shipbuilders and their impacts are far more significant than just affecting the profitability of the company. They directly impact the level of the workforce, the ability of the shipbuilder to plan investments in infrastructure and efficiencies, contracts for material and most significantly, contracts with labor. Without the ability to plan year to year, the companies are in a reactionary mode, unable to make long term commitments.

There is agreement through the industry that a shipbuilder's workforce is its most important asset, and when combined with the yard's infrastructure and manufacturing process make up the most significant components in the shipbuilding process. When the number of ships a shipyard is contracted to build in a particular year is reduced in that year's budget, the yard is forced to make a near year reduction in its workforce commensurate with the reduction in contracted ships due to the fact that there is no other work to shift the workforce too. Shipbuilding is a highly technical and perishable skill with few industries in which those skills can be transferred. When a worker is laid off, the chances of the yard being able to rehire that employee are remote as laid off shipbuilders generally have to move on to a new career or leave the area. Likewise, when a yard must increase its workforce, it is tremendously difficult to attract skilled labor, and it must be grown from within. In this vein, it is extremely expensive for a shipbuilder to suffer workforce fluctuations as the US Navy workload shifts year to year. Additionally, the inability of a shipbuilder to commit to long term workforce levels puts it at a significant disadvantage when negotiating with labor unions. The unions, in an effort to create job stability for their members, want commitments from the shipbuilder and the shipbuilder is unable to commit to a stable workload and thus a stable workforce level. This in turn places upward pressure on wages and other costs related to manpower. An additional effect of this instability on the workforce is that it translates to a difficulty in a shipbuilder's ability to attract high quality employees. The average age of a Newport News shipbuilder is 52 and rising. The shipbuilders will do everything in their power to either slow work or bring it forward in order to maintain their workforce; however, all of this represents a loss in efficiency and the US Navy in the end pays the bill.

The second area which significantly impacts the shipbuilders is the effect of the lack of a stable workload on their ability to plan infrastructure investment. This is significant in so far as the US Navy demands that US shipbuilders become as efficient as foreign shipbuilders, yet the US Navy is not allowing the US shipbuilders to do so. Once again, the inability for the shipyard to plan ahead has negative impact. If a particular yard is planning on two destroyers the following year, for example, and only gets one or none because the US Navy decided to reduce the number of destroyers procured that

year, the shipbuilder does not have the cash flow required to make planned investments or to pay for investments already made. More significant than yearly fluctuations though is the wholesale cancellation of major programs after just a few hulls. This issue has impacted all of the major shipbuilding programs over the past few years. Each year, the US Navy has thrown out the arguments of the preceding year pertaining to why we needed the ships we were requesting in the numbers we were requesting them, in favor of new arguments to fit completely different numbers and ship types. The root of the problem is that this happens each year as the US Navy changes direction and focus, and in each of these cases, the impact at the yards is significant.

At the core of the difficulty in stabilizing the US Navy Shipbuilding Plan from year to year is the US Navy's difficulty in determining a long term strategy for force structure and what kind of ships it needs. While this is a difficult topic, the US Navy's force structure estimates have varied from 250-375 ships over the past two years with radically different mixes of ships required.[8] It is impossible for industry to react to these widely differing force structures or posture themselves to design and build the ships the US Navy needs.

US Navy shipbuilding has experienced explosive cost growth in the building of its ships over the past several years. The reasons for this cost growth are many, to include, labor rates, manufacturing inefficiencies, and the spread of overhead over ever fewer ships. Invariably, these increasing cost factors can all be traced back to the highly volatile nature of the US Navy shipbuilding plan as it winds its way through the steps of approval each year. Until the US Navy, DoD and Congress can agree on a stable, justifiable long term strategy for Naval Force Structure and shipbuilding strategy, and commit to a long term investment stream, the shipbuilders will not be able to operate in a healthy business environment. Anything less will continue to drive the entire industry well into insolvency and will result the continued exponential growth in the cost of the ships being built. The overall result will amount to a direct subsidy as the industry remains afloat through indirect payments in the form of high prices as it operates below the level of viable economic activity.

Productivity in Shipbuilding

Col Michael G. Archuleta, USAF

Increasing productivity is one way to help keep costs down. The shipbuilding industry increases productivity by incorporating process enhancements, through modernization, or by a combination of both. Process improvements include any changes that affect employee training, quality control and manufacturing flow. The major shipyards are continually looking for smart process improvements. For instance, one yard fosters a "culture of continuous improvement" by encouraging employees to participate in process improvement teams. As a result, over 85 percent of that shipyard's employees had a hand in increasing productivity and improving working conditions last year. As part of the solution to making things better, the employee recommendations made the workplace safer, streamlined routine electronic and mechanical fabrication steps, and developed new methods for welding and manufacturing very large, cumbersome components. Some of the shipyards conduct apprentice programs that train cadres of employees in the application and management of one or two skill sets such as

fitting or welding. At Bath Iron Works, process improvements in the manufacturing of hull sections combined with experience from building the first five Arleigh Burke destroyers enabled the total labor hours per ship to drop 20 percent on construction of the sixth hull.[9]

The industry also relies on modernization to enable a smaller workforce to produce more ships. In the past few years, two technological enhancements greatly improved the US shipbuilding industry. First, computer-aided three-dimensional design, analytical, and manufacturing tools enable greater accuracy, precision and speed in all aspects of ship construction. Second is the advent of modular construction. This enhancement allows the shipyards to fit and modify more subsystems in environmentally controlled buildings, improving productivity by up to 75 percent compared with the time needed for fitting or modifying subsystems outdoors.[10] Modular construction also allows the shipyards to be more flexible to changing US Navy requirements.

The US Navy supports modernization in the shipbuilding industry through its Manufacturing Technology (MANTECH) Program. In 2003, the US Navy established the Center for Naval Shipbuilding Technology (CNST), in Charleston, SC, to oversee the shipbuilding portion of MANTECH. CNST manages development and implementation of manufacturing technology solutions for naval ship production, repair and maintenance requirements. It also facilitates transfer of the developed manufacturing technologies to the US shipbuilding industry.[11] CNST is currently overseeing 11 projects related to the design, manufacture and assembly of ships and quality assurance of the entire process.[12] The two most recent projects are productivity enhancements for welding operations. One is a process improvement for shipyard efficiency that will reduce the propensity for over-welding. The second is a technology improvement that introduces a new hybrid laser/gas metal arc welding system that reduces cost saving by eliminating the need for multiple weld passes.[13]

There is a drawback to increased productivity. Although these enhancements can reduce the amount of labor hours, there comes a point of diminishing returns where too much productivity becomes detrimental to a shipyard. When productivity attains a level intended for higher throughput, lower annual production schedules (like the current one) of only one ship per yard could lead to significant downtime between ships. If the downtime is too long, the more skilled workforce may seek employment elsewhere or the shipyards may resort to layoffs. Regardless, this results in a less skilled workforce working in an unstable environment when construction on the next ship begins.

Market Competitiveness

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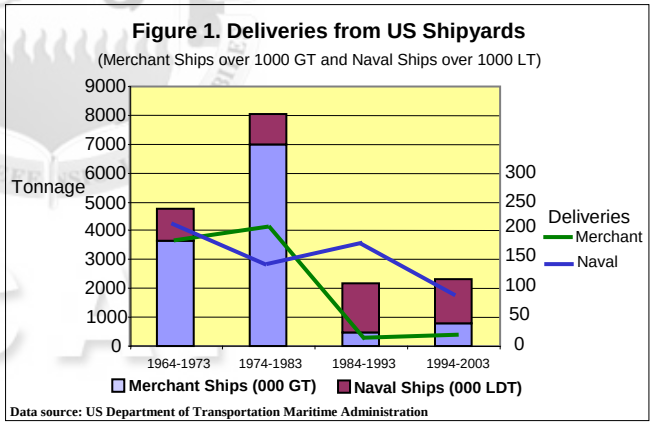
Commercial ship transportation is a critical global resource. The commercial shipbuilding industry in the US has declined dramatically over the last thirty years. While the global demand for commercial shipping remains strong, the ability of domestic shipbuilders to compete in the global market has declined precipitously. Government regulations and subsidy termination did much to create a difficult environment for the shipbuilders along with causing supply costs to grow dramatically. As the market demanded less from American producers' valuable economies of scale, worker skills and

capital investment decreased exasperating the industry's decline. Foreign producers in Korea, China, and Europe rapidly absorbed market share as their competitive advantage over American producers grew. Today the only viable domestic commercial shipbuilding activities exist to service shipping needs created by government regulation. While free market activities exist within the market created by those regulations, domestic commercial shipbuilding would have ceased minus the restrictions of the Jones Act. A lack of competitiveness in the commercial shipbuilding industry in the US has resulted in a captive market created by regulation and significant investment and policy changes would be required to attempt to return the industry to a globally competitive posture.

The 1980's ushered in a significant shift in domestic shipbuilding production. The Reagan Administration's focus on the "evil empire" and the defeat of communism brought an ambitious shipbuilding initiative toward achieving a 600-ship Navy and in doing so cast a pall on the commercial shipbuilding industry. In its first year in office, the administration "won repeal of the "construction differential subsidy", a program designed to bolster the competitiveness of the US industry in the global market for commercial vessels…effectively destroying the commercial shipbuilding industry in the US."[14] While US ship owners continued to receive Operating Differential Subsidies (ODS) designed to offset the higher costs of shipping on US flagged vessels, construction-direct subsidies (CDS) for domestic shipbuilding ended.

During the Clinton Administration, the ODS program also met with revision. ODS subsidies once provided in varying amounts based on operating costs were transitioned to fixed annual amounts under the Maritime Security Program (MSP).

Domestic shipyards, as depicted in Figure 1, once produced predominantly merchant vessels over 1,000 gross tons prior to the Reagan years but then transitioned to naval ship construction following the end of construction subsidies. Today, few domestic shipbuilders producing large ocean going merchant vessels and compete only under the protectionism of the Jones Act.



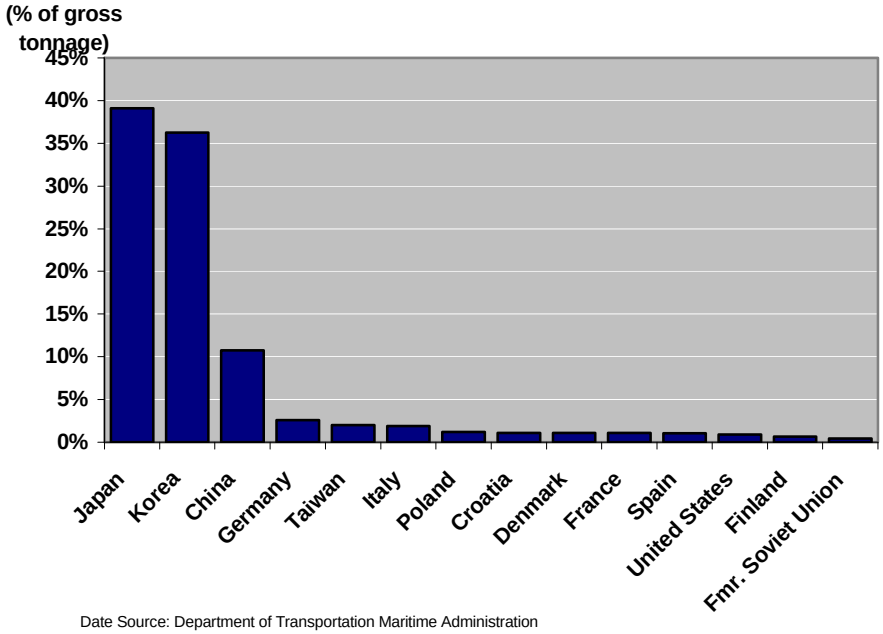
Competition in the Global Market

The US commercial shipbuilding industry is no longer competitive in the global market, particularly in large vessels - over 1,000 gross tons. There are numerous reasons for the lack of competitiveness, including the emergence of foreign government subsidized shipbuilders, unfair trade practices, and a conscience shift among domestic shipbuilders toward naval ship construction.

In the past twenty-five years, Far East shipbuilders consisting of Japan, Korea, China, and Taiwan, have cornered the global market in large ship construction. In 1981, Japan controlled 61.2 percent of the market, followed by Germany (7.7%), Korea (6.8%), Spain (5.7%), and France (3.7%) for new ship deliveries. Despite being supported by $208 million dollars in direct government shipbuilding construction subsidies[15] under the Merchant Marine Act of 1936, the US only ranked 6th with 2.6 percent of the market. By the end of 2003, the Far East shipbuilders increased their

market share from 70.5 percent twenty-two years earlier to 88.2 percent - Japan, Korea, and China ranked first, second, and third with 39.1, 36.3, and 10.8 percent of world shipbuilding deliveries, respectively. As depicted in Figure 2, American shipbuilding fell to 12th place with approximately 0.9 percent share of the new construction market.[16]

Figure 2. World Shipbuilding Deliveries in 2003



Date Source: Department of Transportation Maritime Administration

The growth of foreign commercial shipbuilders was also driven by the construction of modern facilities and production tools. Much of these were directly financed by government funds and provide distinct productivity advantages over older American yards. The costs sunk in the facilities are not included in the selling price of the ships produced. A large portion of fixed costs are discounted and do not contribute to the total cost of the ship. This provides foreign producers a price advantage from the start as well as modern facilities that enhance productivity.

Commercial shipbuilding in the US has recovered very slightly from the lows of the late 1980s.[17] As in any declining industry the production slowdown fuels greater problems brought on by a loss of economies of scale and loss of skilled workers. Economies of scale in shipbuilding occur when series ships are built that allow efficiency growth from subsequent ships built in the series.[18] Foreign producers have profited from this concept as they produce standard classes of ships. Foreign producers have developed efficiencies that result in a similar class of ship that sells for one-third the price of a similar American product. Continuous production maintains a gainfully employed skilled workforce that learns with each ship. The domestic producers have limited orders so throughput is tenuous resulting in fluctuating workforce needs. Workers face employment insecurity and seek more stable employment. The loss of skilled workers results in a regressing learning curve and lower productivity. The domestic industry has shrunk to such a level that skilled workers often cannot stay gainfully employed in the industry.

Commercial shipbuilding in the US is a limited resource. In our developed economy heavy industries like shipbuilding find it difficult, if not impossible to compete globally. Yet, we still need to maintain the shipbuilding capability for security reasons and it does provide some economic input. Although a resource that does contribute to our economy, the cost to reenter that global market far exceeds benefit. Domestic shipbuilding has undergone radical changes in the last forty years. American producers cannot compete globally and are locked in the domestic market where they will remain without significant investment and government policy changes.

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