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The Shipbuilding Industry

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SHIPBUILDING 2013

ABSTRACT: One of history's important lessons is that whoever commands the sea commands the trade; whoever commands the trade of the world commands the riches of the world, and consequently the world itself. Our nation's national and economic security demands that we protect the sea lines of communication for the global transportation of energy and goods. The sea power theorist Alfred Thayer Mahan posited that in order for a nation to be strong, it needs to possess enough sea power to use and control the seas against any threats. His theory remains relevant today. To achieve the strength advocated by Mahan requires both an adequate domestic commercial fleet as well as a strong Navy. The availability of both commercial and military vessels to populate those fleets depends completely on a collaborative effort between industry and government to provide a capable industrial base.

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PLACES VISITED

Domestic:

Aker Philadelphia Shipyard (Philadelphia, PA)
Austal USA (Mobile, AL)
General Dynamics, Bath Iron Works (Bath, ME)
Bollinger Shipyard (Lockport, LA)
Carnival Corporation (Miami, FL)
General Dynamics, Electric Boat (Quonset Point, RI)
Huntington Ingalls Industries (Pascagoula, MS)
General Dynamics, National Steel and Shipbuilding Company (San Diego, CA)
North American Shipbuilding (La Rose, LA)
Sayres & Associates (Washington, DC)
United States Coast Guard Yard (Curtis Bay, MD)
United States Naval Base San Diego (San Diego, CA)
VT Halter Marine (Pascagoula, MS)

International:

None

INTRODUCTION

The strength and prosperity of the United States is built on a maritime foundation. Native Americans settled the shorelines of lakes, rivers, and seacoasts and traveled inland waterways.[1] The first European settlers traveled to North America by ship, and in the 19th and 20th centuries millions of immigrants entered the United States by sea through iconic ports of entry such as Ellis Island.[2] For the first three centuries of European occupation of North America, over 90% of the new settlers lived within 20 miles of navigable waters—a situation that changed with the coming of the railroad in the early 19th century.[3]

The maritime industry remains a substantial force in the US economy. As described in a publication by the Asia Pacific Economic Conference, 48% of the value of US international trade was transported by sea in 2008. Furthermore, in 2008 the maritime transport industry contributed $30.9 billion to US gross domestic product (GDP) and employed over 250,000 people. Of that population, 40% work in ship repair and shipbuilding, with the remaining split between 25% in transportation, and 33% in port services.[4] Yet, even with the significant value of this industry to the US economy, commercial US shipbuilding accounts for only one percent of world's commercial shipbuilding output.

After its peak during World War II, US shipbuilding witnessed a contraction, reducing profitability for the industry and hampering its ability to produce affordable vessels for military and commercial markets. The deregulation of the 1970s reduced government subsidies to the industry, that, when coupled with increased international competition, created an environment where shipbuilding companies could not manufacture profitable products. This in turn led many to abandon shipbuilding altogether, reducing US capacity. Furthermore, the significant capital required for shipbuilding deters potential entrants to the industry, continuing to limit the number of US shipyards. One life buoy for the industry stems from the Merchant Marine Act of 1920 (otherwise known as the Jones Act)'s requirement that shipping companies utilize US-built vessels for domestic waterborne trade. But the requirements of the Jones Act do not compensate for a small market or encourage elimination of commercial shipbuilding inefficiencies. As a consequence, the price of US-built ships remains higher than those built by other shipbuilding nations. In an effort to curb costs, some operators reduced operations. Subsequently, the US shipbuilding industry witnessed a continual decline in the number of shipyards, with the number totaling 628 in 2012. [5]

Over the next five years, the industry expects to witness a continuing decline in the number of shipyards, largely due to consolidation and growing competition from overseas players, especially from Korea and Japan.[6] One may also attribute this decline to the slow rate of recovery of the global economy from the recession of 2008, leading to a decrease in the orders for new vessels. With such a decrease, there exists overcapacity within world ship production, with yards possessing 50 percent more capacity than the current demand for commercial vessels of more than 1,000 metric tons.[7] What this means for the US shipbuilding industry is that the limited demand for both international and Jones Act shipping drives a lack of new commercial shipbuilding programs for several more years.[8] The only industry bright spot is the building of Offshore Support

Vessels (OSVs), concentrated along the Gulf Coast of southern Louisiana and Alabama that directly and indirectly contributed $2.6 billion and $3.5 billion per year to the economy.[9]

However, the military sector keeps the US shipbuilding industry afloat, and indeed dominates domestic shipbuilding, as evidenced by the chart in Annex 1. Two major players, Huntington Ingalls Industries (formerly Northrop Grumman Shipbuilding) and General Dynamics, together hold 67.9% of industry market share.[10] These two operate six shipyards producing the majority of military vessels: Newport News, Avondale, and Ingalls, together comprising Huntington Ingalls Industries (HII); and Electric Boat, Bath Iron Works, and National Steel and Shipbuilding Company (NASSCO), making up the shipbuilding division of General Dynamics (GD). American subsidiaries of foreign firms comprise a second set of military shipyards: Austal USA, of Australia-based Austal, and Marinette Marine Corporation of the Fincantieri Marine Group in Italy.[11] Of the top six shipyards, only NASSCO successfully competed in the commercial shipbuilding market.[12] This means these yards depend on US Navy construction orders for their continued viability. [13] But the current pace of Navy shipbuilding barely addresses this dependence, failing to provide sufficient workload to preserve the skills and jobs and further weakening an already fragile industrial base. Moreover, such a low procurement rate will also fail to stimulate competition between shipyards, thereby decreasing innovation and increasing cost, further limiting the amount of Navy ship orders.[14]

On the bright side, this low procurement rate provided yards an opportunity to stay viable through stretching out their workload and increasing their repair work. Ship repair constitutes 18% ($3.4 billion) of the total revenue of the U.S. shipbuilding industry.[15] When compared with new construction, ship repair generally experiences a higher margin.[16] In fact, shipbuilders often lower new construction prices in the hopes of securing follow-on long-term ship repair contracts for those new vessels. Yet despite comparatively higher profit margins, ship repair remains a relatively stagnant segment. Low profit margins, coupled with the intense capital investment required initially to enter the business, serve as a significant barrier to entry. For example, a full service integrated ship repair yard requires dry-dock facilities, large piers, electrical/mechanical facilities, cranes, and a wide variety of special tools due to the uniqueness of each repair job. Although technology changed the landscape of competition in the ship repair industry, resulting in drastically reduced docking and lay-up times for repairs, ship repair still requires a significant amount of capital investment and management.

Besides physical capital, both ship repair and new construction require a substantial amount of labor capital. Unlike many labor processes found in new construction, ship repair yard operators cannot automate, necessitating a large labor force. Yards also require a highly skilled and technically competent labor pool to maintain and operate the sophisticated equipment procured to comply with stringent safety and environmental standards.[17]As such, shipbuilding demands an abundant and highly skilled labor force, an asset yards must manage very carefully.

With the environment just described, US shipbuilding industry's viability remains tenuous. In an effort to preserve and improve the long-term viability of the US shipbuilding industry, a critical component of national security, the US Government must change how it collaborates with industry and reform its practices.

NEW CONSTRUCTION, COMMERCIAL

Strengthen the Jones Act to revitalize US commercial shipbuilding

Maritime connections form an enduring thread in US history, weaving together the fabric of American society and integrating the nation's global security and trade needs. In recognition of this importance, Congress passed the Merchant Marine Act of 1920 to protect the US maritime industry, including shipbuilding. This federal statute regulates maritime commerce in US waters and between US ports. With regards to shipbuilding, Section 27 of the law, known as "the Jones Act," stipulates that only ships constructed in the United States may conduct waterborne cabotage (i.e. transport goods between US ports). Additionally, those ships must fly the US flag, possess US citizen ownership, and operate with crews comprised of US citizens.

To gain a sense of the present-day scale of these activities, Jones Act shipping comprised 12% of domestic cargo, including a heavy proportion of bulk commodities such as coal, grain, and natural gas.[18] Furthermore, Jones Act operations include 220 ferry operators based in 41 US states and territories, transporting approximately 90 million passengers annually and generating an estimated $1.35 billion in gross revenue.[19] Indeed, the US Merchant Marine and the US flagged fleet form "the fourth arm of defense."[20] The shipbuilding and ship repair to support Jones Act activities form vital components to national security and the maintenance of a strong navy.[21] The Jones Act thus enhances homeland security, employs valuable skilled laborers while preserving a key industry, and contributes measurably to the US economy in ways that might diminish if the jobs migrated offshore. These concerns about national prestige and national security implications override economic or labor concerns.

Rationale for Jones Act

Advocates of the Jones Act promote protection of the domestic shipbuilding and ship repair base as the legislation's most significant contribution, forming an essential component to retaining the capability and skills to build and repair naval vessels. In other words, protection of the industry forms a national security and military necessity. Even though the most sophisticated US production derives from military ship construction, proponents of the Jones Act contend that maintaining a skilled workforce for commercial ships offers portability between military and commercial maritime applications.[22] A 2011 Lexington Institute study suggests that the presence of a robust domestic commercial ship repair and construction industry also enables US shipyards to even out the work flow between naval and commercial business. This workload leveling helps share the burden of fixed overhead costs.[23] Essentially, advocates of the Jones act consider the costs to shippers and consumers a payment of "insurance" to maintain an industry and a skill set that constitutes a vital pillar to US national security. They argue one should therefore consider the Act a necessary investment to protect America's long-term interests.

Some detractors argue the Act no longer meets its originally intended utility. Yet two emerging markets comprise areas for Jones Act trade to grow and thereby stimulate demand for concurrent growth in shipbuilding. Those new markets are Liquid Natural Gas carriers and transport vessels designed for the Maritime Highway.

Opportunities in Liquid Natural Gas (LNG)

Recent developments in the US energy industry (particularly the future availability of abundant quantities of low-cost natural gas) could drive increased investment in US shipbuilding capabilities. The US Energy Information Administration projects domestic US natural gas production to increase from 23.0 trillion cubic feet in 2011 to 33.1 trillion cubic feet in 2040, a 44% increase.[24] This increase means the market for transporting this gas will expand significantly. For example, in 2012, one analyst noted:

> *"... day rates [to charter] LNG ships in 2010 were US$37,000. Those rates soared to a peak of $160,000 in 2011. And even though they've come down a bit, they'll still likely average around $140,000… possibly even going as high as $200,000 per day.* [25]

These rates signal a burgeoning demand for LNG carriers. The impact of building these highly technical and specialized product carriers in US shipyards could provide a long-needed stimulus in the shipbuilding industry and wean the industry off its heavy reliance on US Navy contracts. While US shipyards could position themselves to satisfy this demand, collaboration with the US government could aid the situation further. By amending the Jones Act such that the Act mandates only US-built and operated ships transport LNG exports, the US government will increase the amount of new orders for US shipbuilders, boosting the industry.

American Maritime Highway

The American Maritime Highway (AMH) serves as a transportation avenue that takes advantage of the thousands of miles of rivers and coastal waters in and around United States territory. The United States Maritime Administration (MARAD) intends the American Maritime Highway to expand "the use of…inland, Great Lakes Saint Lawrence Seaway System, intra-coastal, and coastal waterways for the transportation of freight…and passengers…"[26] The routes of the AMH connect to other domestic surface transportation routes, such as road and rail. AMH shipping thus comprises a new market for Jones Act vessels.

The AMH offers two distinct advantages. First, given the present volume of freight, and the projected growth of that traffic, AMH's ability to circumvent congested land routes and its ability to reduce cargo dwell time at a port pose an enticing benefit of increasing cargo velocity. Furthermore, AMH presents shippers with a mode of transport that presents less danger to the public by shifting the transport of containers carrying hazardous materials onto maritime routes and away from urban and congested areas.[27] Congress recognized this potential when it passed Public Law 110-140, the Energy Independence and Energy Conservation Act of 2007, authorizing the establishment of the AMH and directed the Secretary of Transportation to "establish a short sea transportation program and designate short sea transportation projects to be conducted under the program to mitigate surface congestion."[28] Problems with realizing the benefits of AMH stem from Congress' neglect to appropriate funds specifically for AMH, or even to serve as an advocate.

Recommendation: Strengthen the Jones Act to revitalize US commercial shipbuilding.

Actions to Support the Recommendation

1. Develop a US-flagged LNG product carrier fleet. Expansion of the LNG infrastructure to meet rapidly expanding foreign demand offers a tremendous opportunity for US shipbuilding. The construction of LNG carriers to service this demand could produce significant economic gains to the US economy as a whole, and specifically to the shipbuilding industry.

2. Increase Public Awareness for the American Maritime Highway. Currently, a unified advocacy for AMH does not exist, consequently leading to a distinct lack of public messaging to boost awareness (and consequent stimulation of demand) on the part of the public and freight shippers as to AMH's capability.[29] Congress and the Department of Transportation need to collaborate closely on increasing freight shippers' awareness of AMH's capability and spurring demand for AMH usage.

3. Create subsidies to foster AMH usage. An approach to stimulate AMH use derives from subsidies to jump-start the AMH. Beyond subsidizing the price of cargo carried on the AMH to make AMH a competitive alternative to other surface transportation modes, the government also could direct the majority of its shipments to go by AMH, dispatching items like military cargo and mail onto AMH vessels. Furthermore, the government could also subsidize the equipment for AMH, either the vessels or the infrastructure. Such a move thus might stimulate the demand for AMH that in turn could spur demand to build vessels to support the increased traffic on the AMH.

Once the AMH reaches a level of self-sustainment, the government could then reduce price subsidies and institute usage taxes similar to those on road and air to fund continual infrastructure development, and do so as part of an integrated national plan. That way, the subsidization of AMH infrastructure development as part of a comprehensive transportation plan could energize all intermodal transportation venues. Consequently, the government might increase the capacity and velocity of all the nation's transportation networks, bolstering the underpinnings of the national economy.

NEW CONSTRUCTION, MILITARY

Address flaws in military ship construction process

The Navy's shipbuilding enterprise faces a series of challenges. Those challenges include uncertain force structure requirements, unpredictable future missions, a disconnect between shipyard capacity and currently funded programs, and declining budgets. If the mismatch between the Navy's shipbuilding budget and mission requirements remains unresolved, the Navy must search for ways to improve its entire process for ordering and constructing naval vessels.

Develop/Design/Build Process

Due to their size and complexity, construction of US warships takes a significant amount of time. As an example, the LPD-17 program took 152 months to go from Milestone A to delivery of the first ship. The technical, engineering and construction activities required to take a ship from concept to an operating system (known as "develop/design/build") consume a significant amount of time. To shorten that timeline in order to field ships more rapidly, the Navy often overlaps the development and refinement of requirements and specifications concurrently with the construction process. But as the level of overlap between phases increases, technical, cost and production risks rise dramatically. One of the main reasons for this is design immaturity creates slowdowns either by delaying production or by generating rework as naval architects refine the design. Moreover, in an effort to capture the latest technology, the Navy continually adds new requirements, driving even more changes to the design and further delaying construction to accommodate those changes. As an example of the impact of this behavior, the sheer size of cost overruns incurred on the DDG-1000 class caused the Navy to reduce the projected class size from 32 ships to only three.

The Navy should not continue along this chosen path. It can determine the development phase length, and eliminate overlapping phases. The Navy can also determine the level of technical risk assumed (e.g. how much overlap occurs between design and construction of the lead ship) and the level of prototyping or engineering development model testing. It can also influence the choice of design and manufacturing tools. By eliminating overlaps and stabilizing the design, the Navy could slash dramatically the cost and time involved in vessel production. The cruise ship industry utilizes this approach with great success. The key tenet of this model is cruise ship companies award fixed price construction contracts with 100% of the ship design completed at contract award and with little or no change to the build specifications as construction progresses. To best illustrate the cost involved in changes, shipbuilders often refer to the "1-3-8" principle: something that costs $1 to install or perform during the initial phase of construction costs $3 during the middle phase and $8 after the shipbuilder completes construction. Thus by limiting the amount of changes during the construction phase, one dramatically reduces the overall cost of the end product.

The downside of the no-overlap approach is that it could impose even more time lags and increases the risks associated with technical obsolescence and with changes to the threats driving requirements. The cost-savings gained by this approach, however, offset the extra time needed.

The Navy can manage concerns about technical obsolescence by utilizing the "Flight" concept currently used on the DDG 51 class ships to capture technical improvements in distinct packages managed in distinct phases. This approach might impose more risk on the industrial base because it makes it more difficult to maintain continuity of work. But the Navy can mitigate that issue by collaborating with industry to phase-in this change over a period of time to allow all players to adjust and take advantage of lessons learned.

Supply Chain Stabilization

Another benefit to the no-overlap approach is that the shipbuilder can enhance the supply chain. The supply chain must support the shipbuilding process. In other words, the shipbuilder needs to integrate his suppliers into a cohesive team to deliver the right materials and finished components, at the right time, and in the right quantity to support the manufacturing process. At the same time, the shipbuilder must optimize his supply chain's alignment and performance to drive down costs. When organizing the supply chain, the shipbuilder must also consider the development chain on what materials to purchase, what components to make or buy, who will provide these products, and developing the proper contracts to receive the material.

As one example, HII developed a strong relationship with its supply chain that reduced costs through partnering to meet the production schedule. First, HII instituted lean manufacturing techniques with two dozen suppliers.[30] By using lean manufacturing techniques, HII enjoys the benefits of a pull-based strategy so that the shipbuilder retains the right material on hand for the production schedule.[31] The lean manufacturing technique reduces waste, standardizes processes, and improves quality across a diverse and geographically dispersed supply chain.[32] HII also partnered with BIW to batch order steel from the same vendor for US Navy ships.[33] By risk pooling within the supply chain, both companies aggregated demand, limited the variability of material, and reduced costs through economies of scale to meet the Navy's requirements.[34]

Acquisition Review and Oversight

Given the uniqueness of shipbuilding in general, and military shipbuilding in particular as described above, DoD needs to tailor the acquisition process outlined in Figure 1, Annex. By tailoring the acquisition process, it will ameliorate the cost risk inherent in the ship design and construction process. To accomplish this, and enhance the efficiency of the industry, we recommend adding a shipbuilding annex to DOD directive 5000.1 and concurrent modification of SECNAV 5000.2 instruction as appropriate. A significant change should reconfigure the milestones as shown in Figure 2, Annex 2. Its main function will modify the oversight process to include a Milestone B review prior to lead ship construction and a Milestone C review prior to ship class construction.

Navy Shipbuilding Chain of Command

To accompany the change in regulatory guidance, the Navy must modify the current chain of Responsibility, Authority and Accountability (RAA) for shipbuilding. The chain in its current

form simply is not appropriate and is ambiguous at best. The current structure of the organization chart for shipbuilding , shown at Figure 1, Annex 3, illustrates that the ultimate responsibility falls to the Assistant Secretary of the Navy for Research, Development & Acquisition (ASN RDA). Yet the structure emphasizes the separation of the technical side of shipbuilding from the programmatic side. Naval Sea Systems Command (NAVSEA) manages the technical aspects while Program Executive Officer (PEO) for Ships manages the programmatic aspect in a separate chain. Multiple individual programs overlap, with both System Command commanders and PEOs possessing overlapping responsibility. Both organizations report to the ASN directly, leaving that individual to arbitrate competing issues. This approach can work but is not the most effective, particularly as it demands that the ASN (and his/her supporting staff) maintain a strong grasp of both technical and programmatic issues. The ASN thus often becomes inundated with details and loses focus on the broader objectives.

Instead, there should exist a single "belly-button" both responsible and accountable for a ship, or class of ships, that meets requirements, falls within established cost constraints, and is delivered on schedule. With the current structure, no single person or organization within the ASN RDA command structure does that. By adopting this approach, not only might it streamline the shipbuilding process, it might also give the shipbuilders a single go-to office to provide assistance and answers whenever the need should arise. Figure 2, Annex 3 illustrates a proposed new organizational structure.

Level Loading

Because of the technological complexity, physical size, propulsion plant type, and warfare systems involved in warships, a limited number of US shipyards possess the capability to construct these complex vessels.[35] Given this constraint, the timing and size of ship procurement plays a significant role in maintaining the health of those yards. When one considers those yards also constitute the majority of the US shipbuilding industry as outlined earlier, US Navy ship procurement consequently affects the health of the US shipbuilding industry as a whole.

Under the 2013 shipbuilding plan, shown at Annex 4, the Navy plans on buying a total of 203 non-nuclear ships over the period of 2013-2042, 158 combat ships and 45 logistics support ships.[36] Yet as defense budgets shrink, the Navy must revisit its 30-year shipbuilding plan. The Navy nearly certainly faces a reduction in the number of ships and the sequence of their procurement. The current plan averages out to roughly seven ships per year, peaking at 10 ships a year (twice) and bottoming out at three in 2035. Based on the current DoD budgetary funding levels, challenges, and future constraints, the average of seven ships per year appears unattainable. When one factors in the nearly $1B annual "cost-to-complete" funding that the Navy currently experiences because no entity controls the combination of estimates and actual costs as just discussed, five ships per year seems more realistic.

While the shipyards that service the needs of the Navy's non-nuclear shipbuilding plan will not welcome such a reduction, the Navy should embrace a steady state number of buys per year. Should the Navy need to modify the plan up or down in a given year for a magnitude of reasons, this action should be spelled out well in advance, keeping the number of planned buys steady across the Future Years Defense Program (FYDP). By collaborating with shipyards to level

out the work flow, the Navy will aid shipyards in managing their workforce (both in terms of training and retention) as well as their respective supply chains to manage material ordering and production schedules.

Determination of the number of ships and types of capability

How should the Navy address a criticism that the budget drives the number of ships in its shipbuilding plan, rather than requirements? Simply put, the Navy leadership needs to be honest brokers about its predicament and assess what it needs to accomplish its mission first.

One often hears an argument that by 2020, shipbuilding will decline to a point where both the Navy and the shipbuilding industry as a whole will not recover. [37] In previous downturns of shipbuilding budgets, the Navy possessed a sufficient number of ships to manage the decline. Yet in for this budget reduction, while the Navy decreased the number of ships, it did not address the honest number of ships needed to shield itself from this risk.[38] One school of thought proposes solving this dilemma by increasing the shipbuilding budget to $19B per year, a recommendation supported by the Congressional Budget Office. This funding increase might enable the Navy to procure all the ships outlined in its 30-year plan.[39] But merely throwing money at the problem, particularly given the current budgetary environment, fails to address the accuracy and relevance of the underlying assumptions.

The Brookings scholar, Michael O'Hanlon, proposes one solution: "[o]n balance, the Navy does not need to add 10 percent more vessels to its force structure to carry out current practices and presence. Indeed, it can do well with 10 percent less, or about 260 major ships."[40] To justify this, O'Hanlon advocates for a different basing strategy than we use today: revolving deployments where multiple crews alternate shifts without bringing the vessel back to the US mainland, and basing squadrons of fighter wings in strategic locations around the globe to minimize carrier deployments.

In addition to getting the correct number of ships needed to carry out the Navy's assigned missions, the Navy also needs to acquire the proper fleet mix. For example, some advocate the continuance of the nuclear powered aircraft carrier as the centerpiece of a naval strike group and dissuade against going towards smaller combatants and amphibious ships. [41] But others question the value of aircraft carriers in high threat environments, where mere defense of the carrier consumes too many resources, limiting those assets' availability for other operations.[42] No matter the outcome of these debates, however, the Navy must collaborate with its industry partners to ensure shipbuilding capability and capacity remain intact.

Recommendation: Address flaws in military ship construction process.

Actions to Support the Recommendation

1. Adopt a "no overlap" develop/design/build process. By adopting a "no overlap" develop/design/build process, the Navy will reduce cost and technical risks through the reduction of rework and redesign.

2. Add a shipbuilding annex to the DOD 5000.1 directive and SECNAV 5000.2 instruction as appropriate to better capture the intricacies of modern shipbuilding acquisitions. An acquisition oversight and review process that is unambiguous, consistent and aligns with the shipbuilding process will serve to manage the cost risk inherent in the nature of ship design and construction better. A ship review oversight process that includes a milestone B review prior to lead ship construction and milestone C prior to ship class construction can significantly reduce design rework and consequent cost increases.

3. Re-evaluate and change the ASN RDA organizational chart to ensure that technical and programmatic sides work together. Because a ship is a system of systems, where the technical aspects must remain in lock-step with the programmatic aspects, ASN RDA should re-evaluate and change its organizational chart to ensure the technical and programmatic collaborate instead of compete.

4. The Navy "level load" the shipbuilding plan. It is within the realm of the possible that the Navy can "level load" the shipbuilding plan each year in order to avoid peaks and valleys. To adopt this, the Navy must adopt two significant paradigm shifts. The first comes in the form of a reduction in the 203 combat (large and small) and logistics support ships requested in the 30-year plan to somewhere in the area of 120-150 to keep with the previously discussed four to five ships per year average to meet fiscal constraints. If the Navy does not supply additional funds to the Shipbuilding and Conversion account, it must adjust the maritime portion of the National Security Strategy accordingly (see also action number 5 below). The second paradigm shifts exists in a decrease in the number of shipyards that support the non-nuclear shipbuilding plan, as no shipyard can sustain a low volume of production (one ship per year) and stay in business without charging an exorbitant amount for that ship. Either the government collaborates with these shipyards to expand their product lines into the commercial shipbuilding (such as argued in the commercial shipbuilding section) in order to make up for the reduced workload assignment from the Navy or the yards go out of business.

5. Properly size the Navy to support our National Security Strategy and not the shipbuilding construction budget. The Navy must clearly define the missions fundamental to national security, then derive the number and mix of ships required to execute those missions. The current shipbuilding plan does not appear to present a true assessment, but rather simply appears to continue with the same programs as before.

6. Pursue better collaboration between Navy and other governmental departments. The Navy should pursue, whenever possible, collaboration with other US government agencies that possess expertise in non-military areas. For example, the US Department of Energy conducted a significant amount of work on advanced batteries and battery systems that apply directly to some Navy systems, such as the battery system used to power mini-subs used by special operations forces. The two government entities should collaborate on future propulsion designs for those subs and/or remotely operated surface or undersea vehicles. It is much more efficient, both in

terms of cost and time, for the Navy to leverage an existing government capability than to develop its own technical capability independently.

NAVAL SHIP REPAIR

Strengthen the Industry through Revitalizing the Navy Ship Repair Process

The primary value of a strong domestic ship repair industry is that it promotes national defense by supporting naval combatant ships waging war at sea, enables adequate merchant sealift capacity to project military equipment and supplies overseas, and concurrently supplies critical shipping to support our economy such as such as transport of strategic petroleum reserve oil to refineries.[43] Therefore, as a strategic imperative, the US must possess enough ships available for combat and sealift and, more specifically, possess sufficient ship repair capability to activate and repair them when the need arises.

Additionally, from a purely economic perspective, the government should maintain considerable interest in the health of the ship repair industry because of the significant potential for direct and indirect employment of labor. Unlike shipbuilding, where a growing percentage of shipyards import equipment and materials to minimize costs, ship repair cannot import a labor force to complete needed repairs.

Challenges Faced by the Industry

Operational Issues - Management of a ship repair facility constitutes a complex and difficult undertaking. For example, few routine jobs readily lend themselves to that can be used for productivity measurement. Even recurrent work items like hull cleaning and painting vary greatly with the condition of the underwater hull for each vessel, a task that often becomes clear only after the ship is dry-docked. The workload associated with most repair tasks on any part of the ship varies depending on the material condition of the vessel, adding to the management challenge. This means that repair facilities must retain many workshop skills in house rather than outsourcing them, contributing to a facility's costs.

Unstable order book – Stability in the order book forms a critical component to shipyard planning but often proves unattainable. The ship repair industry does not possess solid benchmarks as it makes critical decisions on people and facilities and attempts to procure needed capital.[44] In the US, where the Navy and Coast Guard represent a majority of the ship repair market, the lack of long term planning coupled with a chaotic federal budget process results considerable fluctuation in ship repair and maintenance plans. For example, recent cycles of continuing resolutions for the budget drove numerous cancellations or deferrals of Navy maintenance. This in turn meant shipyards laid off skilled technicians and engineers since the yards could not rely upon steady revenue to retain those personnel. Upon the restoration of full funding to the budget, the sea services activate those maintenance contracts with short notice and with an expectation of timely completion of work. Yet, one cannot easily replace the skill associated with technicians and engineer, particularly in a short period of time, leading yards unable to meet the services' demand.[45] Attempts by the government to smooth out fluctuations in the scheduling of work using contracting strategies like Multi-Ship Multi Option (MSMO) contracts to provide predictable work

to shipyards proved less successful than intended because significant fluctuations in the funding available ruined the predictability of work executed over the life of the contract.

The Choice to Transition Business Lines – Many shipyard owners also face the dilemma of what to do with underused facilities because of the unstable order book explained above. Some large yards take on smaller repair jobs to augment new build projects and retain the ability to convert back to pure shipbuilding in a period of new construction boom. For example in 2012, NASSCO in San Diego diversified into ship repair from primarily new construction by acquiring a division of Earle Industries in Norfolk and Jacksonville. NASSCO completed a move to extend the reach of their ship maintenance and repair operations into two key East Coast naval ports enhancing their ability to deliver services more cost effectively.[46]

By making this sort of shift between shipbuilding and repair, companies look for opportunities to protect themselves against fluctuations, particularly those in government-related work. The obvious similarities in workforce skills and facility requirements make these moves cost effective. However, it is worth pointing out there exist notable differences in management and business practices between a major shipbuilder and a quick turn ship repair facility. Short timelines, flexibility, and workload uncertainty hallmark ship repair unlike the regimented shipbuilding industry where economies of scale and long lead time issues dominate. Regardless, there exist positive aspects for the health of the industry for yards that do move between shipbuilding and ship repair. Most prominent among them is the improved availability to meet expansions or contractions of new building demand in the future.

Impact of the Navy on the Industry –Several laws and policies dictate how the Navy can accomplish depot level maintenance. 10 USC 2466 require that at least half of all Navy maintenance work be performed at a public depot (known as the "*50/50 rule"*), 10 USC 2464 requires that the public shipyards maintain some core maintenance capabilities for all of the existing ship weapon systems, and Navy policy requires that depot maintenance be performed in a ship's homeport when possible. These requirements lead to award of the majority of contracts for maintenance and repair to one of the four public yards. There is no competition for the assignment of Navy contracts to their own public shipyards. The Navy allocates work to one of the public yards based on available capacity. If public yards do not possess an internal capacity for repairs at a given time, the Navy releases the work for open competition amongst the private sector. The Navy intends to keep the government yards operating at, or near, capacity to take advantage of the availability of government employees on salary and other sunk costs in facilities and overhead. As a result, one encounters a much higher percentage than the minimum 50% of the work going to Navy shipyards, in some cases the estimated percentage of work rises as high as 70%. This large volume of business funneled to the public yards without competition from the private sector causes detrimental effects on the entire ship repair industry by retaining capacity. While that capacity serves as insurance in a crisis when the US government might need to expand shipbuilding rapidly, given the industry's current excess capacity, the government needs to collaborate with industry to strike a balance between crisis reserve and excess infrastructure.

Internal Challenges for Navy Ship Repair

The tendency to focus on ship construction vice ship repair, the acquisition reform initiatives of the 1990s, the consolidation of organic maintenance and training infrastructure, and the Global War on Terrorism operations tempo (OPTEMPO) all resulted in the degradation of the

Navy's surface force material readiness from 2000 to 2010.[47] This resulted in significant material readiness issues after a ten year period. In an effort to improve this situation, US Navy leadership took three decisive steps by establishing the Surface Maintenance Engineering Planning Program (SURFMEPP), designating a Commander Navy Regional Maintenance Center (CNRMC), and implementing the Multi-Ship Multi-Option (MSMO) acquisition strategy.

The establishment of SURFMEPP, the designation of a CRMC, and the implementation of MSMO acquisition strategy comprise large steps forward in improving the Navy's surface force material readiness infrastructure. However, significant shortfalls of skilled and experienced labor along with reductions in funding for billets at these staffs serves to restrict their effectiveness.

Recommendation: Strengthen the Industry through Revitalizing the Navy Ship Repair Process.

Actions to Support the Recommendation

1. Fully fund Navy and Coast Guard maintenance backlogs. Both the ship repair industry and the sea services could benefit greatly from a renewed emphasis on fully funding the surface vessel maintenance accounts. For example, the Navy states it maintains approximately a $400 million backlog of unfunded required ship maintenance at any given time. The common practice of taxing maintenance accounts for new ship construction funding or even for other non-vessel related needs in times of budget uncertainty generates detrimental effects on the ship repair industry. As an example, a cumulative shift of $100 million from the ship maintenance account to shipbuilding might fund only 10% of a new DDG-51. By continuing to transfer funds from maintenance into procurement, policymakers essentially signal the belief that one new ship hull (or actually even less than one hull) outweighs the introduction of widespread inefficiency and unsafe material condition into the entire surface ship maintenance program.[48]

More importantly, given the previous recommendation to eliminate overlaps between phases of new ship construction that might engender a delay in construction between the first and subsequent ships, the Navy could collaborate with yards to take advantage of the backlogged repair work. In this manner, yards keep their workforces and facilities gainfully employed. Moreover, this also satisfies the recommendation to "level-load" work in shipyards, providing them stability and predictability necessary to retain skilled workers, make capital investments, improve process efficiency, and so on.

2. Give more naval ship repair to private shipyards**.** The Navy should direct more of its maintenance and repair work to the private ship repair yards. A reduction in the workload of public shipyards or even the closure of one of them might increase the volume of government work done in private shipyards. The "50/50 Rule" could allow for this as long as the minimum 50% threshold is not breached. From an economic point of view this makes sense because the public yards do not perform new ship construction but currently perform almost 70 percent (by dollar value of contracts) of the naval ship repair work.

Intentionally directing more work to the private sector also contributes to the preservation of that capability. In an era of shrinking new construction budgets and reduced naval ship fleets, the nation's shipyards will begin to rely more on ship repair as a business line or at least as a diversification between lulls in new ship orders. The government must collaborate with private

yards to balance the detrimental effects of continuing to lock out these commercial yards from many depot level maintenance contracts in favor of public yards with retention of ship repair capability. The cold truth is that any private ship repair yard that goes out of business will not come back resulting in long term loss of new shipbuilding capability and increased cost burden for those that remain.[49]

3. Collaborate with industry to fill vacancies in the Navy's Surface Force material readiness infrastructure temporarily with commercial ship repair labor. The newly created Surface Maintenance Engineering Planning Program (SURFMEPP) forms a critical piece of the improved Navy ship maintenance infrastructure but it remains significantly undermanned.[50] To date, only 183 personnel fill SURFMEPP billets, out of 241 the 241 required. Moreover, future Navy budget forecasts for 2014 and out do not support attainment of the 241 requirement.[51] Given the mission of SURFMEPP is based on classes of ship, integrating the existing undermanned workforce with a contractor team pulled from a specific Multi-Ship/Multi-Option (MSMO)class contractor makes sense. For example, many of the ship repair firms performing MSMO contract work in the Norfolk region attained significant maintenance knowledge about their respective class of ship. The Navy should contract with these firms to take advantage of their expertise to support the SURFMEPP vacancies in the short term until budgets support to fund the billets fully. The MSMO contracted personnel should not execute inherently governmental functions associated with Integrated Class Maintenance Planning (ICMP) but rather provide near term technical support to the civilian and military staff. Such a relationship currently exists in the DDG Integrated Planning Yard Services in Bath, Maine. There, SUPSHIP personnel, Bath Iron Works (BIW) personnel, and Aegis combat systems personnel work together to solve problems in support of fleet operated destroyers.[52]

Finally, it is important to note that re-establishing organic maintenance capability is critical to the Navy and critical to national security. Though the aforementioned recommendation leans heavily on contractor support, this comprises only the initial stages as the Navy grows organic capability and continues to support current maintenance requirements of the fleet. The Navy must balance and manage contracted maintenance and organic support as such support underpins the health of the ship repair industry as a whole.

WORKFORCE

Address shipbuilding skills gap and future workforce development

The overarching trends in the manufacturing industry provide insight regarding the current skills gap and future workforce development needs of the shipbuilding industry. In general, the US faces a decline in low and medium skilled US manufacturing jobs while high skilled manufacturing professions and manufacturing productivity continues to rise. From the 38-year period from1972-2010, manufacturing output more than doubled while manufacturing jobs fell by about 7.5-8 million jobs.[53] Technological change and heightened global competition serve to mask the restructuring of the manufacturing workforce. Put simply, the integration of digital design, information technology, and data driven synthetic production technology involving robotics and automation drives creation of professional manufacturing jobs, and displaces the low and medium skilled manufacturing, as shown in Annex 5. [54]

Dispelling Myths

The recent US recession, as measured by a decline in GDP growth and growing unemployment is sometimes blamed for the loss of manufacturing jobs, but a large portion of the manufacturing jobs left well before the 2008 recession occurred. The tipping point for US manufacturing job loss occurred roughly in the 1998 timeframe. More often than not, US leaders and politicians blame the loss of low skilled US manufacturing jobs on globalization, foreign competition, and manufactured-goods trade deficits. One recent study attributed one-quarter of the decline in US manufacturing employment over the period 1990–2007 to Chinese imports.[55] However, China also experienced a steady decline in its manufacturing workforce since 1996 despite the availability of inexpensive labor.[56] The same declining trend experienced domestically appears to hold true internationally. When analyzed comprehensively, these trends provide powerful implications regarding the changed nature of manufacturing. Craft-based manufacturing methods driven by the shop-floor once produced customized products, like US Navy ships. Now, however, synthetic production methods that collaboratively couples human craft with automation-centric data-intensive digital design supplant that technique.

The Rise of the Advanced Manufacturing Industry

From 2009-2011, the manufacturing industry contributed more than 25 percent growth in GDP adding roughly 500,000 new jobs between the beginning of 2010 and the end of 2012.[57] The National Association of Manufacturers estimates that today, manufacturing directly employs nearly 12 million Americans (9% of the workforce) and accounts for 12.2% of the US GDP.[58] Future trends project job growth in the manufacturing sector as a result of the US gaining a competitive advantaged by "unlocking of abundant supplies of domestic energy."[59] The wages offered in manufacturing are respectable with an average annual salary of $77,060 in 2011 including pay and benefits.[60] Despite the upswing in high skilled advanced manufacturing trends, the manufacturing industry and defense industrial base find themselves hampered by skilled workforce shortages. Today, 600,000 manufacturing jobs remain unfilled because manufacturers cannot find workers with the skills needed for the modern manufacturing workplace.[61]

With the acceleration of the information age, and the concurrent rise of information workers, the growth of the middle class forced America's youth to change their job expectations. A recent study by MIT's Dr. Erik Brnjolfsson revealed approximately 70% of America's current workers works in an information related field.[62] Fewer and fewer available entry-level employees enter the manufacturing profession. Moreover, as fewer workers enter manufacturing (and shipbuilding), the average age of the shipbuilder increases, creating numerous workforce challenges in the shipbuilding industry. In fact, several shipbuilding companies in the Gulf Coast region mentioned the continuous loss of their apprentices to each other, or to the oil industry as an on-going problem. This phenomenon is systematic of the larger manufacturing sector as a whole. As reported by Harold Sirkin, Bloomberg Analyst, "Demographics are working against us. The average age of a highly skilled US manufacturing working is 56. Now is the time to train the next generation."[63]

In conclusion, the current skills gap and future workforce development needs in the shipbuilding industry are systematic of a larger problem. There is a lack of *national emphasis* to develop an advanced manufacturing workforce. This workforce, knowledgeable in *synthetic production methods*, forms the cornerstone of America's ability to produce innovative, advanced technology products.

Managing Perceptions (Mamas Don't Let Your Babies Grow Up To Be Shipbuilders; Let 'Em Be Doctors And Lawyers And Such)[64]

The perceptions of parents, teachers, mentors, community leaders, peers, culture, and societal messaging profoundly influence the career decisions of the next generation workforce. Overall, the shipbuilding industry, as well as overall manufacturing, suffers from a perception problem. Despite the demand growth in high skilled manufacturing jobs brought about through advanced manufacturing restructuring, the industry "continues to have a reputation for employing those with lesser educational attainment" based on the results of the US Census Bureau microdata sample and American Community Survey (ACS) conducted between 2000 and 2007.[65] The indelible impression of a limiting and unfulfilling career steers prospective candidates away from careers in manufacturing. As Bruce Katz, a vice president at the Brookings Institution points out, "We still think about manufacturing in the US as yesterday's economy as opposed to the *vanguard of innovation in our economy*." However, manufacturing accounts for "9% of jobs, 11% of GDP, 35% of engineers, 68% of private R&D, and 90% of our patents. We may be the only economy to *decouple production and innovation*."[66]

Additionally, the US secondary education system steers less-academically inclined students towards manufacturing development programs while driving technically skilled students away from manufacturing at a time when the demand for high skill jobs synthetic manufacturing is in demand. As Jay Timmons, President and CEO the National Association of Manufacturers explains, "We have created an education system that is almost completely divorced from the economy at large. The only way to address this monumental challenge and support the economic recovery is to align education, economic development, workforce and business agendas to work in concert and develop the talent necessary for success in the global economy."[67]

Recommendation: Address shipbuilding skills gap and future workforce development.

Actions to Support the Recommendation

1. Conduct a sustained public relations campaign that highlights advanced manufacturing professions as the vanguard of American innovation. Change the national narrative based on cohesive campaign that provides a comprehensive assessment of the growing advanced manufacturing sector as described herein. Demonstrate to thrift-minded families that advanced manufacturing careers are rewarding and sustainable. Design motivational strategies that encourage young people to build their human capital in ways conducive to the needs of the strong and sustainable technology-based advanced manufacturing economy needed to realize product innovation. Distinguish the advanced manufacturing profession from traditional blue collar jobs and laborers of the 20th century. Focus on synthetic production methods that blend computer-aided design, engineering, production planning, and advanced manufacturing methodologies to realize technological innovative products that give the US competitive edge to compete in the global market place.

One proposed approach is to expand Science/Technology/Engineering/Mathematics (STEM, representing advanced technology fields) to include advanced manufacturing (STEMM) that appropriately couples advance technology with product innovation. The manufacturing industry is technology-driven and requires a strong STEM foundation. "STEM occupations are projected to grow by 17.0 percent from 2008 to 2018, compared to 9.8 percent growth for non-STEM occupations." The advance manufacturing workforce works collaboratively with the STEM workforce to develop manufacturing technology to support new growth opportunities and deliver customized and innovative products. The United States should add additional funding, grants and scholarships to assist individuals pursuing STEMM manufacturing careers. This is an actionable requirement for the Office of Science and Technology Policy (OSTP) Committee on STEM (CoSTEM).

2. Develop a national education reform to align Department of Education K-12 goals with a national skills development needs. Our educational system needs to prepare the labor force to succeed in the technology fueled advanced manufacturing industry and the shipbuilding industry in particular. As technology races ahead, it will continue to leave less skilled manufacturing workers behind unless the education systems greatly improves their prospects by reforming education at all levels. In a data driven society, both unskilled and skilled laborers will require basic math and data-rich management skills to function in a knowledge-based synthetic manufacturing environment. Unfortunately, to a large extent, the K-12 education bias portrays manufacturing as a career of last resort at a time when our nation need technically skilled students entering advanced manufacturing fields. This is an actionable requirement for the Department of Education, following the aforementioned STEMM model.

3. Develop a program that couples a nationally accredited degree with professional occupational skills. The needs of industrial providers and regional economies largely drive today's apprenticeship programs, rather than the broader national strategic objective of becoming a global hub for advanced manufacturing that produces technologically sophisticated products. The unintended consequence of regionally-certified and industry specific apprenticeship programs is a limitation of the candidate pool, further exacerbating the shortage of domestic high skilled

manufacturing workforce. An effort to tackle the skills crisis requires national leadership to match the needs of the US economy better to respond to domestic and global market opportunities now and into the future. A national accreditation program that couples a degree with a skill might encourage greater participation of prospective candidates. For example, STEM fields typically offer a degree (such as a bachelor of science) with a skill (such as chemistry, engineering, or mathematics). A national accreditation program that couples a degree with professional occupational skills provides a foundation for stable, transferable, and universally recognized employment. This is an actionable requirement for the OSTP CoSTEM.

4. Take advantage of domestic and global labor pools to fill near term workforce gaps. There are unfilled manufacturing positions primarily due to skills mismatch. Domestically, 18-34 year olds account for half of the US unemployment population creating a domestic labor pool. To take advantage of this labor pool in the near term, the United States must recruit nationally and offer community college training, relocation incentives and subsidies for qualified candidates willing to move. At the same time, the immigrant population remains a viable source for manufacturing labor as tens of thousands of people seek work inside the United States. As such, the United States must find a way to fast-track immigration and citizenship of qualified candidates who excel in advanced manufacturing occupations. This is an actionable requirement for the OSTP CoSTEM.

INTERNATIONAL PERSPECTIVES

SHIPBUILDING: A MALAYSIAN PERSPECTIVE

Malaysia regards herself as a maritime nation based on her substantial long coast line and by virtue of the fact 600 nautical miles of water separate the nation's two. Due to her strategic location, Malaysia's ports received many port visits from some of the approximately 50 thousands ships that transit annually through the Malacca Straits[68] and more than 95% of Malaysia's trade is carried by seaborne transport. However, this high reliance on waterborne transport of goods to and from the country is not commensurate with the state of the national shipbuilding industry, an industry that finds itself unable to support the Malaysian national security policy of self-reliance effectively. Government agencies and maritime industries must leave their silo-like outlook and instead understand the importance of working together.

One area lies with domestic trade. To protect domestic traders, the government put in place a policy in 1980 that declares only ships flying the Malaysian flag may operate or transport goods between ports within the country, much like the Jones Act in the United States.[69] Unlike the Jones Act, however, Malaysia's Cabotage Policy also allows foreign merchant ships to operate between domestic ports. As one example, foreign owners of off-shore support vessels (OSVs) register these vessels with the Malaysia International Shipping Registry (MISR), affording them the opportunity to operate these foreign OSVs legally in Malaysia.[70] This exception means that 85% of Malaysia's trade is carried in whole or part by foreign-flagged ships.[71] This directly translates into a loss of revenues to the Malaysian government due to the out flow of potential tax revenue to other countries. Given the state of the domestic Malaysian shipbuilding industry, however, it is not surprising shipping companies turn to foreign ships.

Malaysia's shipbuilding industry cannot meet the demand for vessels due to the inability of shipyards to produce affordable ships. High labor costs, inefficient construction and repair methods, and lack of contemporary technical know-how prevent local shipyards from producing ships at a quantity and cost desired by shipping companies. Additionally, since relatively small, family-operated businesses operate the majority of shipyards in Malaysia, they find themselves unable to take advantage of economies of scope and scale offered by larger yards.

Malaysia also faces other domestic constraints. Material used to build ships is much more expensive since it is produced and procured locally. Shortages in domestic steel production, coupled with Malaysia's liberalization of foreign direct investment, results in the importation of cheaper steel products and consequent monopolization of the market by foreign firms. The Malaysian government did attempt to protect the domestic steel industry from this threat by imposing import tariffs and other restrictions, an action that resulted in the establishment of privately-owned Megasteels in 1994. However, in 2010, the company finally succumbed to cash flow issues, steep competition from other competitors abroad, and dumping of imported steel in the Malaysian domestic market.[72] Moreover, these restrictions on imported steel drive up the cost of raw materials imported by Malaysian steel-makers, forcing the overall cost of Malaysian-produced steel 65% to 70% higher than that of competitors.[73]

On another front, the discovery of oil wells in the early 1990s led to a change in Malaysian government shipbuilding policy. The government introduced the "Third Industrial Master Plan (IMP3) 2006 to 2020" in August 2006[74] to strengthen the capacity and capability of the shipbuilding and ship repair industry sector.[75] The IMP3 produced positive results within the shipbuilding industry, as evidenced by the $2.35 billion in revenues in 2011, providing employment for 20,000 workers in shipyards and associated activities.[76] In concert with the Malaysian's government initiatives outlined in the Malaysia Shipbuilding/Ship Repairing Strategic Plan 2020 (SBSR 2020), the industry targets the construction of medium-size vessels (below 120m in length, especially offshore support vessels (OSV)) with a goal of capturing a sizeable share of global shipbuilding market, ship repair and offshore oil and gas industry repair market in the region.[77] But the presence of foreign OSV operators alongside Malaysian-owned OSVs in domestic oil explorations (recall the discussion about the MISR) resulted in an OSV glut, driving down the chartered rates for the OSVs from local ship owners. This in turn resulted in low demand for OSVs from local ship owners due to market saturation.

To succeed in the future, shipyards, steel mills, government agencies, local finance institutions, oil industry, and local ship owners all must cooperate. For example, with regard to the cabotage policy, the Malaysian government should take steps to make it impossible for foreign vessels to operate services within Malaysian waters. This might protect the domestic OSV industry in oil exploration as well as domestic shipping. In turn, this might spark demand for domestically built vessels, especially if the cost of those vessels decreased due to the financial incentives given by the government to the steel industry. On the subject of steel, domestic steel mills could create joint ventures with foreign steel companies to capitalize on those companies' expertise and scale. The Malaysian government could pave the way for such a joint venture by providing more trade incentives to make the domestic steel mills more appealing to a foreign company. Locally-produced steel could be cheaper, possibly stimulating demand that could, in turn, make ships less expensive. Since the shipbuilding industry is important for the growth of trade and economic

development in Malaysia, all stakeholders in the shipbuilding industry, public and private, must close ranks to support local shipyards and stimulate the development of the industry. In so doing, they will bolster the country's self-reliance and consequently improve national security.

SHIPBUILDING: A POLISH PERSPECTIVE

Poland is a proud maritime nation, with a sea-going history dating back to the fifteenth century. However, instability in Poland's shipbuilding industry today is preventing it from continuing this heritage. Today, Poland maintains three major shipyards: Gdynia Shipyard Joint-Stock Company, Szczecin Shipyard New Ltd., and Gdańsk Shipyard. Despite exporting nearly 90% of their production to other countries (mostly to Warsaw Pact nations during the Cold War years), these yards all experienced significant difficulty due to poor management, a rise in the global price of steel, and disadvantageous contracts for ship manufacture signed in US dollars but that failed to account and compensate for currency fluctuations. The Polish government, recognizing the importance of a national shipbuilding capacity, recently embarked on a revitalization program, but inefficiencies within the Ministry of National Defense serve to inhibit this program. Nevertheless, the maintenance of naval shipbuilding capability in Poland is not just a matter of choice or state pride; it is also a matter of national security.

In 2006, the Polish government accepted a "Strategy for the Shipbuilding Industry in Poland in the Years 2006-2010" that states: "The shipbuilding sector is a strategic sector of the Polish economy. Polish shipyards are indeed a convenient area to boost the economic competitiveness of the Polish economy and to implement the macroeconomic assumptions that the European Union enshrined in of the Lisbon Strategy in 2000 - especially with regard to boosting the competitiveness of EU countries against the United States and Asian countries."[78] Thus the Polish government accepted an economic goal focused on the restructuring and privatization of the main Polish shipyards to make them ready to act on the global market. Concurrently, in accepting these goals, the government underscored the social necessity of halting the decline in jobs quantity in the regions of shipyard activities by fostering the development of small and medium enterprises as well as by inhibiting the outflow of highly qualified workers. By boosting the shipbuilding sector of the economy, the Polish government seeks to create conditions for overall sustainable economic growth, not only with shipbuilding efficiency, but also through the beneficial multiplier effect such growth might create in the nation as a whole.

Yet in order to fulfill the goals outlined, the Polish government needs to be able to put action behind its words, especially as it pertains to maintaining the technical efficiency and modernization of the Navy's fleet. Despite years of experience in the construction of warships, particularly minesweepers, landing craft and submarine chasers that other nations purchased to outfit their navies, the three main Polish shipyards find themselves hampered in building modern warships. For example, the yards undertook construction of German-designed corvettes, but took eight years to build the same vessel German yards built in three. The primary cause of the delays stemmed from unstable financing by the Ministry of National Defense. The Ministry allocated only a small portion of the necessary funds each year, causing the work to extend over several years. This serves as but one example of how the Ministry hinders implementation of the government's goal of revitalizing and modernizing the Polish shipbuilding industry.

There exist several other examples of how the inefficiency and lack of consistency within the Ministry impedes attainment of the overall goal. The lack of consistency in the implementation of the planned projects through constantly changing decisions and an overly complicated process of formulating tactical-technical assumptions and operational requirements led to many disputes at different levels of decision-making process. The Department of Armaments Policy (now the Armament Inspectorate) undertakes its own review, then often denies, assumptions and decisions formulated at Navy Headquarters, further delaying or even halting the progress of the work. An inflexible defense financial policy does not allow for the transfer of financial resources planned for the coming years. Moreover, Polish involvement in the wars in Iraq and Afghanistan caused the redirection of funds towards Land and Air Forces, effectively pushing plans to build more ships into the background.

The most egregious example of how government inefficiency stifled modernization at Polish shipyards stems from the delays imposed by government bureaucracy. For example, delays in approving the privatization of the largest Polish shipyards in Gdynia, Gdańsk, and Szczecin lasted so long that the yards filed for bankruptcy and began the sell-off their property. Only through the formation of a consortium between the Naval Shipyard in Gdynia and the Northern Shipyard in Gdansk was the Polish government able to stop the dissolution of the country's trained technical workforce. Yet the continued delays in funding for the corvette construction program mentioned above nearly led to a second bankruptcy of the shipyards since they undertook significant financial risk by investing in modern production lines and workforce training.

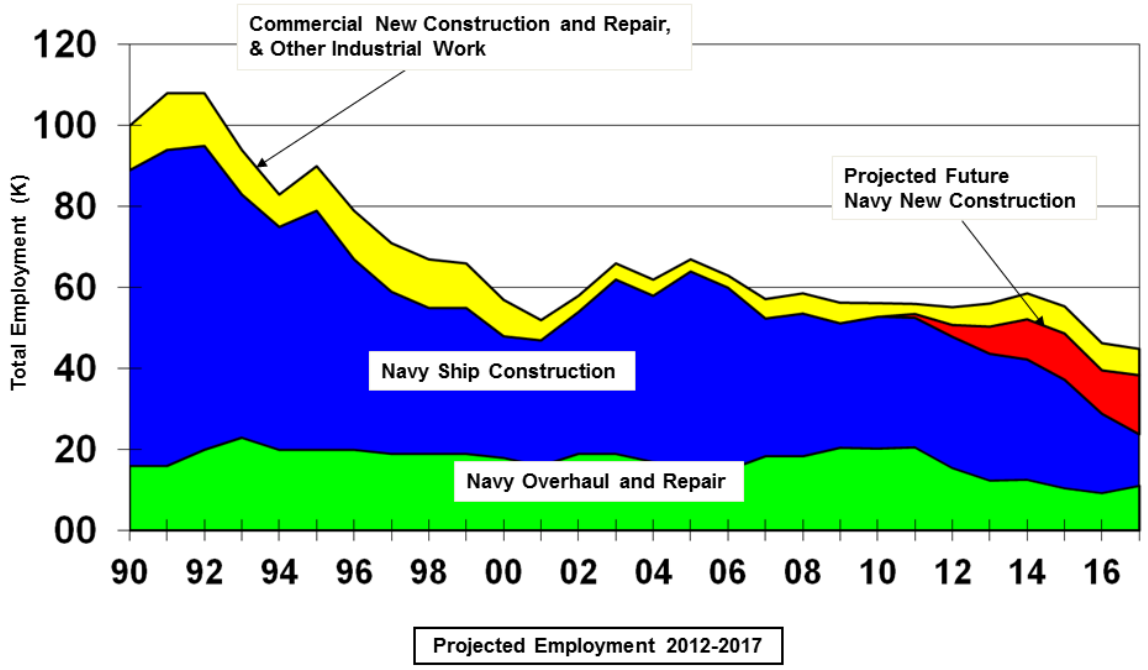
This lack of progress towards the construction of new warships and revitalization of shipyards in Poland permits one to conclude that consecutive governments failed to understand the importance of shipbuilding capacity not only towards Navy modernization, but also towards overall defense and health of the nation. In ignoring the development of the Navy, one offers an invitation to those countries who wish to use military force over sea lines of communication to achieve political goals. For example, the invasion of the Poland, carried out by the Swedish fleet in the seventeenth century, largely became possible because Poland did not appreciate the importance of a strong and healthy maritime industry. Thus the country did not possess its own navy, one that could effectively deter potential aggressors. Thus the ability to build ships in Poland, particularly warships, serves as an integral part of the defense system of the state.

CONCLUSION

The limited amount of commercial shipbuilding orders, coupled with turbulence and reductions in US military shipbuilding, create a tenuous environment for the viability of US shipbuilders. But there exist numerous methods to improve the situation. By reforming its own procurement methods, and collaborating with industry, the US government can stimulate such an improvement. For example, the government could take advantage of the burgeoning demand for LNG and American Maritime Highway trade to strengthen the Jones Act such that orders for US-built vessels increase. Given the dominance of the military shipbuilding sector, the government could adopt several approaches that make its acquisition process more efficient and that work together with shipyards to provide cost-effective warships. Collaboration with the repair side of the industry could yield efficiencies and inject stability into the industry. The US government should also bear in mind that none of these could occur without simultaneous development of the workforce needed to carry out shipbuilding and repair. Moreover, the concerns outlined in this paper do not apply solely to the United States, as witnessed in observations about foreign shipbuilding. All of this demonstrates the importance of a healthy shipbuilding industry on national security. To return to the words of Alfred Thayer Mahan, "*If sea power be really based upon a peaceful and extensive commerce, aptitude for commercial pursuits must be a distinguishing feature of the nations that have it one time or another been great upon the sea. History almost without exception affirms that this is true*."[79]

APPENDIX

ANNEX 1



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ANNEX 2

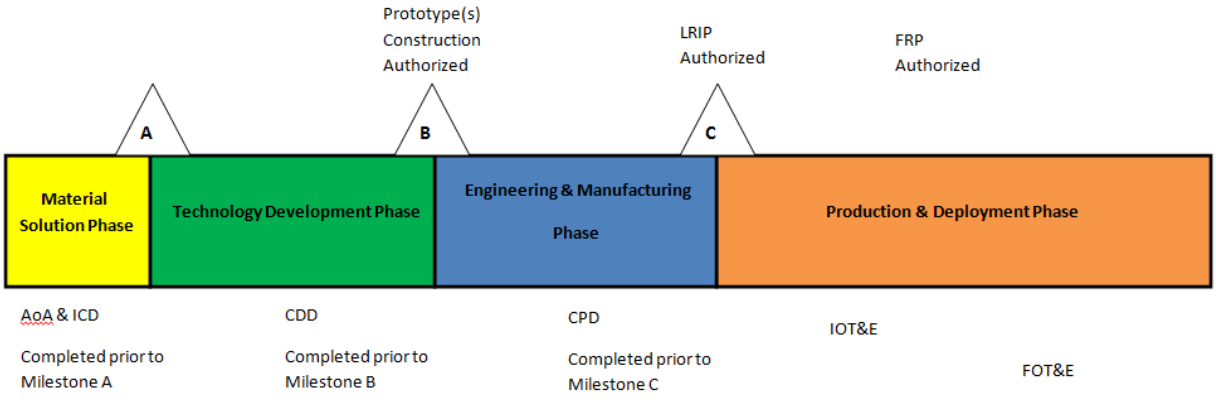


Figure 1
Current DoD 5000.1 process

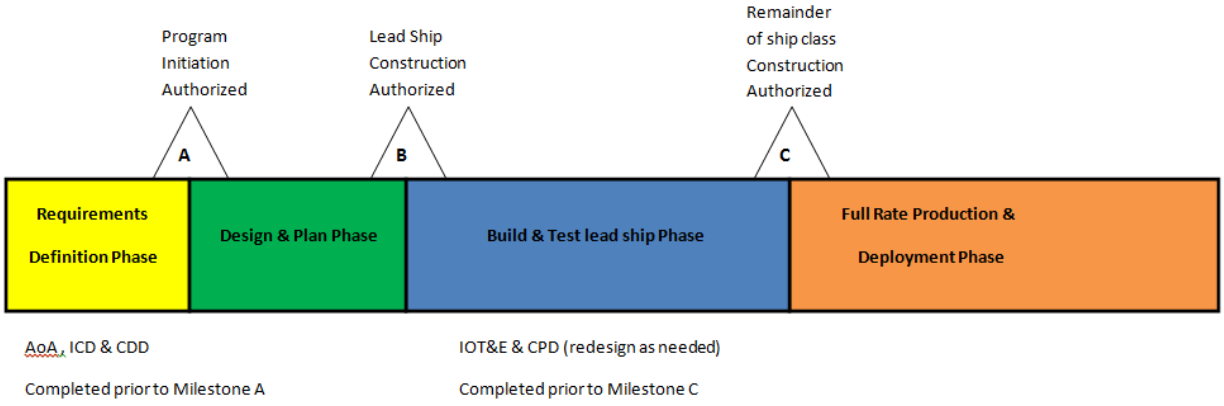


Figure 2
Proposed New DoD 5000.1 shipbuilding process

ANNEX 3

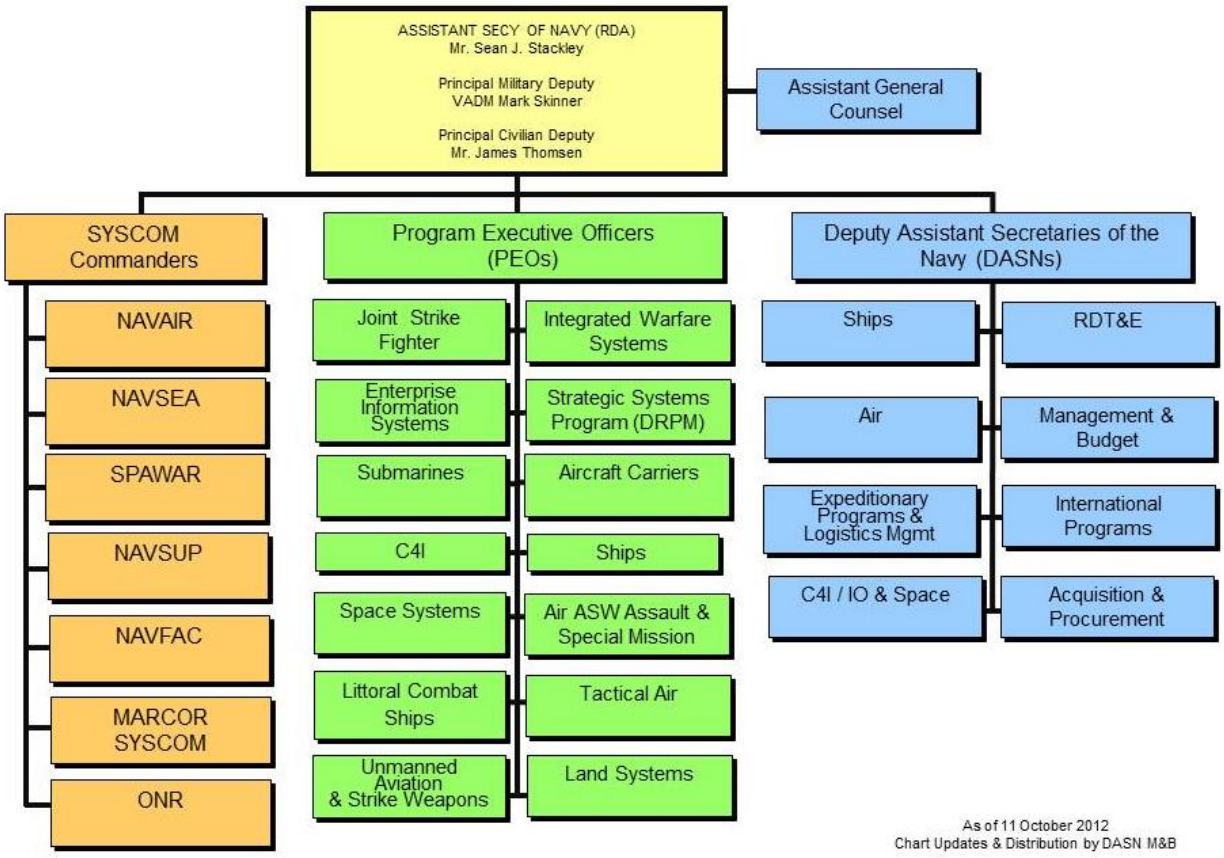


Figure 1
Current ASN RDA Organizational Chart

ANNEX 3

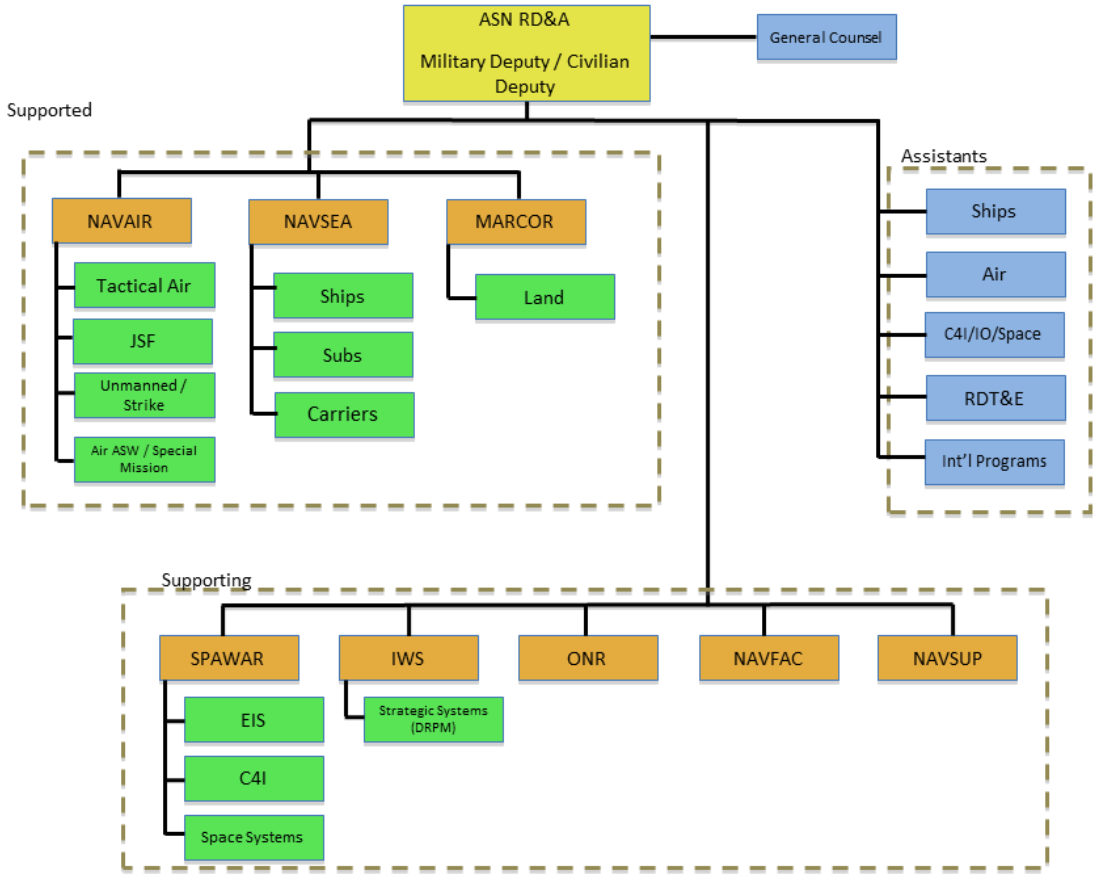
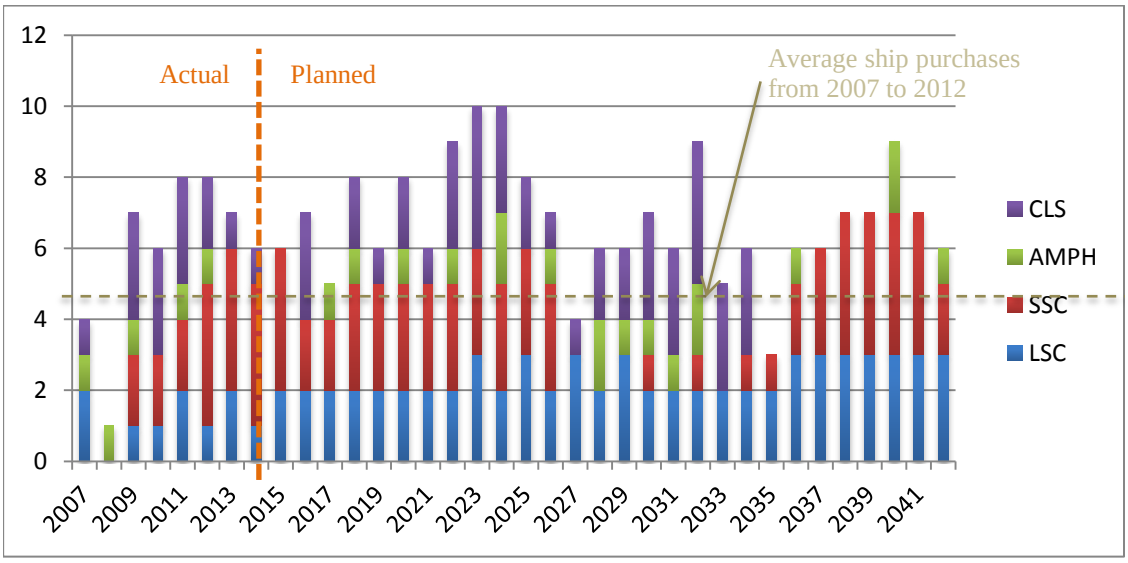


Figure 2
Proposed ASN RDA Chain of Command

ANNEX 4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Actual
Planned
Average ship purchases
from 2007 to 2012
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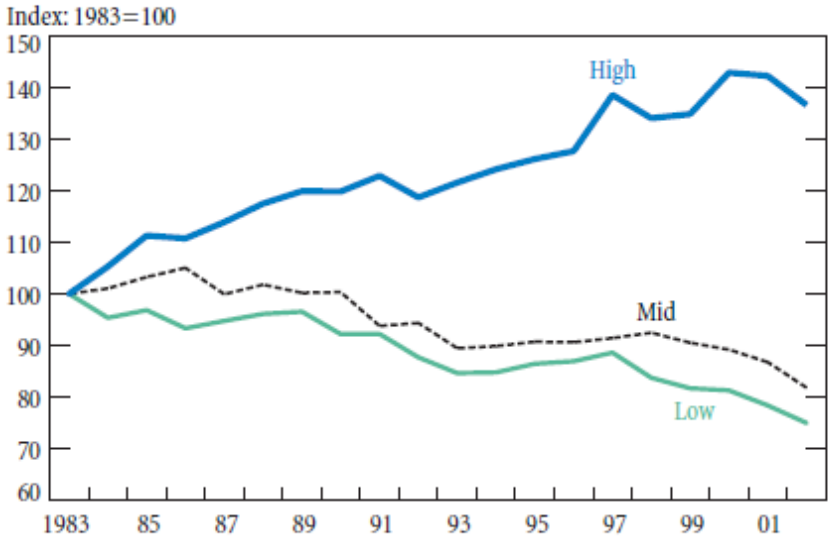
ANNEX 5

Manufacturing Employment by Skill Group, 1983 to 2002



Source: U.S. Bureau of the Census, Current Population Survey.

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ENDNOTES

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[2] Ibid.

[3] John Hankey, interview by author, 26 March 2013.

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