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Industry Report

"Maritime Industry Support for National Security"

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SEA DOMAIN 2020

ABSTRACT: As the U.S. continues to mitigate ongoing concerns with budget constraints and the evolving strategic environment, U.S. policies must likewise adapt. As the U.S. experiences budget constraints amid changing national security requirements, the relationship of maritime dominance and national power must be evaluated. The primary outcome of this industry study is the acknowledgement that unchanged policy or lack of reform will impede America's global naval dominance and further erode our maritime competitiveness. This industry paper focuses on the policies the USG should implement to ensure sea/maritime capabilities necessary to support U.S. National Security. This report emphasizes outcomes that maintain and sustain the current Naval fleet, leverage global resources, and invest in the future. These outcomes are considered through four primary lenses: shipbuilding capabilities, human capital limitations, infrastructure observations, and realignment of sustainment investment. The paper presents numerous recommendations, while offering a consolidated list and providing four main options for consideration.

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Introduction

"The strategic environment continues to be more dynamic, increasing in its uncertainty and sophistication. The proliferation of modern technologies, along with the erosion of the competitive advantage in areas where we have long enjoyed relative superiority, contest our ability to influence and create a great range of challenges for a globally responsive force." **Honorable James F. Geurts, Assistant Secretary of the Navy for Research, Development, and Acquisition.[1]**

The United States has long enjoyed the freedom to dominate oceans around the world. This advantage has enabled the United States to transport goods in support of national security initiatives, but not without challenges. The U.S. military strategy relies on American sealift capabilities to transport military troops and material abroad in support of contingency operations.[2] The fundamental components are shipbuilding and sustainment in support of both the American economy and global trade in times of peace and military operations in times of war.

Throughout history, diplomacy and trade between nations have relied on a merchant fleet to ensure trade. Vital to economic well-being, nations ratified various practices to encourage the growth and sustainment of national merchant marines.[3] These practices have included "subsidies, cargo preference schemes, tax advantages, low-interest loans, and loan guarantees, as well as laws reserving certain subsidies and cargoes to domestically constructed ships."[4] The United States continues to struggle with the adoption of new policies and initiatives to reform the maritime industry in support of military readiness, surge, and mobilization requirements to execute the NSS. This paper will focus on four aspects of the maritime industry: current status of American shipbuilding, absence of resource investments in human capital, observations of domestic/international infrastructure, and the lack of readiness/sustainment. The problem we are trying to resolve: **What policies should the USG implement to ensure sea/maritime capabilities necessary to support U.S. National Security?** The ultimate goal of this paper is to sustain the current Naval force structure, leverage global resources, and invest in the future. These goals enable the U.S. to identify potential policies that address the current concerns faced in the sea domain.

America's strategic situation has changed, as outlined in the 2017 NSS which identifies China as a primary competitor. China's consistent industrialization and innovation have contributed to this dynamic and the outflow of American industrial capacity. U.S. economic posture is such that our industrial base has atrophied, leading to the question: Is our industrial base viable enough to serve the needs of our National Defense and Military? Executive Order 13806: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States* highlights the atrophy of American manufacturing.[5] The accompanying report observes that,

> "…more than 60,000 American factories, key companies, and almost 5 million manufacturing jobs since 2,000 [threaten] to undermine [the United States manufactures'] capacity and capabilities to meet national defense requirements and raises concerns about the health of the manufacturing and defense industrial base. The loss of additional companies, factories, or elements of supply chains could impair domestic capacity to create, maintain, protect, expand, or restore capabilities essential for national security."[6]

According to the 4th quarter manufacturing output index data over time, it appears that the U.S. was on a steady incline until the 2008 recession occurred (see Appendix A).[7] While manufacturing has grown (until 2008, and increasing but not fully recovered since then), the rest of the economy has grown faster. In relative terms, that means manufacturing as a share of Gross Domestic Product (GDP) has fallen. This reduction means U.S. factories are making more products with fewer factories because of higher productivity (see Appendix B).[8]

Reinvigorating the American shipbuilding industrial base is a potential means of contributing to the manufacturing industry growth. However, the U.S. government must measure the need for a robust domestic shipbuilding industry against competing demands for labor in areas that are potentially of more significant value to the nation. America has a broad array of options available to serve its immediate maritime interests. Some might contend that those options negate the need to expand its American shipbuilding capacity any further.

The geopolitical and geo-economic balance of power around the world continues to shift. As great powers vie for control and influence, economies show signs of relative strength and decline. Today, China and Russia are America's principal competitors as the United States shifts from a unipolar moment of relative peace to a period of Great Power Competition.[9] However, of these China is the principal threat. With 1.4 billion people, China is for now the most populous country on earth. One could conceive that a nation's inherent strength relates to its ability to mobilize and harness its people's talents and capacities. Over the last two decades, and with the help of various nations and multilateral bodies, including the United States, China has indeed mobilized its people and economy to tremendous effect. Today, China is the world's second-largest economy, behind the United States, with an estimated GDP of $13.6 trillion (USD).[10] More than 85%, or $11.56 trillion (USD), of total Chinese imports and exports, flows by sea.[11] Accordingly, China has invested in developing its shipbuilding industry and broader maritime footprint. Today, the Chinese shipbuilding industry accounts for 40% of global commercial ship construction.[12]

America is a maritime nation in that U.S. Naval power is employed to preserve the peace and stability of the global order and secure various American and allied economic and trade interests around the world. From an international trade perspective, the U.S. moves 53% of imports and 36% of exports by maritime transportation.[13] The nature and implications of maritime trade, within the context of National Security and Great Power Competition, highlight the magnitude of America's maritime interests and necessitate an equally strong Naval force. The preponderance of American defense-related shipbuilding capacity, because of various legislative efforts, can be characterized as a monopoly/monopsony relationship between the U.S. shipbuilding industry and the U.S. government. America's Navy is 296 ships strong and paired with 624,646 active, civilian, and mobilized reserve personnel who contribute to the service of American maritime interests directly.[14] Beyond America's Navy, however, is a much deeper force and set of authorities, capabilities, and industries that contribute to the stability and maintenance of not only Americans but also the world's maritime interests. The depth and breadth of this family of industries contribute to the innovation within the National Technology Industrial Base (NTIB) and Defense Industrial Base (DIB) more broadly.

The principal federal agency responsible for maintaining security within the boundaries of the U.S. territorial waters is the United States Coast Guard. The United States Coast Guard, including its 243 ships, 1,650[15] small boats, and more than 56,569[16] Active, Reserve, and Civilian members provide for the security of U.S. maritime interests in both territorial seas and inland waterways. The U.S. military operates across international waters and contributes to freedom of

navigation within international waters. The U.S. military protects American interests and supports geopolitical stability more broadly in cooperation with partner nations. Complementing the Navy are the 89 ships of the National Defense Reserve Fleet,[17] including its subset of 46 Ready Reserve Fleet (RRF) ships. Also included are 17 Maritime Prepositioned Force ships within Military Sealift Command.[18] The entirety of the U.S. Navy and the Maritime Administration (MARAD) force structure, the force includes approximately 402 ships – generally Jones Act compliant. Including the vessels operated within the Department of the Army, the maritime force structure increases by around 300 boats to more than 702 vessels.[19] Further adding the United States Coast Guard's ability to integrate with the Department of Defense operations abroad, the number of ships, excluding small craft, also increases to approximately 945 vessels (see Table 1).

Table 1. DoD Maritime Fleet

Organization	# of Ships	Personnel (Active, Reserve, Civilian)
U.S. Navy	296	624,646
National Defense Reserve Fleet	89	
Maritime Prepositioned Force	17	
SUBTOTAL NAVY/MARAD	**402**	
U.S. Coast Guard	243	56,569
TOTAL MARITIME VESSELS	**645**	
U.S. Army	300	
TOTAL VESSELS	**945**	

Beyond the array of capability and capacity of various U.S. governmental assets, a number of other mechanisms can contribute to American or coalition Naval power and capacity. Among them are: America's partners and allies, privateers, contracting, and reflagging. For the purposes of this paper, the contracting and reflagging mechanisms are significant factors. Contracting of salvage ships that support continuing operations such as the case of the USS Fitzgerald. The U.S. Navy contracted the heavy lift vessel MV Transshelf, a Curacao flagged heavy lift vessel, to transport the destroyer to Huntington Ingalls Industries in Pascagoula, Mississippi, following a collision with the Philippine-flagged ACX Crystal June 17, 2017.[20] The USS John S. McCain conducted similar operations in support of damages sustained. Contracting any discrete capability, from tug to heavy lift vessels, oil rigs, and cruise ships are possible. Additionally, the Navy routinely charters vessels (which is a contracting method) for movement of cargo through spot, voyage, time, and bareboat charters.

Another example of an additive ability is the reflagging of specific ships conferring the privilege of American protection. An example of this mechanism is the reflagging of 11 Kuwaiti oil tankers in the Arabian Gulf in March of 1987. Leading up to that point, Iranian air attacks on Persian Gulf shipping targeted Kuwaiti vessels and vessels bound for Kuwaiti ports. Iran sought to retaliate against Kuwait for aiding Iraq during the eight-year war between Iran and Iraq. Kuwait requested aid from the United States to protect its vessels and maritime commerce. America accommodated, reflagging eleven Kuwaiti oil tankers as United States vessels. That reflagging changed the nationality of the ships from Kuwaiti to the U.S., "entitling the tankers to the United States naval protection."[21] All eleven reflagged tankers continued operations in the Persian Gulf escorted by U.S. warships. The reflagging preserved Kuwait's maritime interests and stabilized maritime commerce, including oil and the Middle East. Also, this contributed to the continuity of operations for American forces in the region. While contracting and reflagging vessels offers some

means of increasing the depth of American maritime capability, they presume willing and able partners during potentially exigent circumstances.

The renewal of a Great Power Competition with China along with a number of industrial and economic considerations suggest that America's capability and capacity in the maritime space are insufficient. In consideration of that sense, one approach is to deliberately invest in maritime infrastructure, capability, and capacity to compete with other shipbuilders and derivative industry leaders in China, Japan, and the Republic of Korea.[22] Those three countries constitute 90% of the world's shipbuilding capacity. That investment would also have to address the human capital portion of the maritime industry as it is already under-producing. Increasing domestic shipbuilding and training skilled tradesmen would be a geo-strategic and geo-economic shift that takes decades to achieve. It could also alter the complexion of the American economy and workforce for generations to come.

Current Status of the Industry and Policies

As the world's largest economy, the U.S. participates in a global system where over 90% of world trade moves by water.[23] Domestically, more than 70% of imported tonnage freight moves through American ports, and on American waterways at some point in the journey to the consumer.[24] As the U.S. continues to innovate and dominate the maritime domain, it is imperative that we explore ways to strengthen and modernize our maritime policies, in ways to increase our ability to compete economically and militarily in this new age of great power competition.. One of the central U.S. maritime policy enablers continues to be the U.S. Merchant Marine Act of 1920.

Jones Act Considerations

The purpose of the Jones Act is to assure a vibrant American commercial maritime sector that provides access to global markets that fuel the U.S. economy and provides the means to support the national defense in times of peace, war, or national crisis.[25] Although "80% of the world's coastlines of UN maritime states have cabotage laws" as a means of protecting their maritime security and economic interests, the United States' cabotage regime is widely considered the most restrictive.[26] In the United States, cabotage laws are enshrined in Section 27 of the 1920 Merchant Marine Act, known universally as the Jones Act.

The primary "design of the [Jones Act] is to encourage the development and sustainability of a U.S. flagged fleet [to support shipbuilders and meet the nation's national defense needs] and to protect that fleet from anti-competitive practices by foreign carriers."[27] To accomplish this, the Jones Act requires that all U.S. vessels engaged in coastwise trade (between U.S. points) and registered in the U.S., crewed by at least 75% U.S. citizens, and owned/controlled by at least 75% U.S. citizens.[28] At present, the number of vessels participating in commerce under the provisions of the Jones Act is around 40,000. Of this number, 83% are unpowered and smaller ships (the majority being barges and tugboats) that operate mostly on the network of inland, intra-coastal, and near-coastal waterways.[29]

Despite this large number of Jones Act vessels participating in domestic commerce, the fleet of private "U.S. flag, self-propelled oceangoing vessels" ($\geq$1000 GT) dropped 94% from 1960 to 2019, going from 2,926 vessels to 182 in 2019, of which only 98 are qualified for Jones Act trade.[30] Globalization has driven cargo tonnage up, and the cargo capacity of ships has gone up as well (less U.S. flag ships, more cargo carried by sea). During this period, the world fleet of

oceangoing vessels (≥1000GT) expanded by 276% from 17,317 in 1960 to 47,779 in 2019.[31] This foreign armada of ships now accounts for a large portion of all imported cargo into the United States. In 1960, the U.S. had nearly 3,000 U.S. flagged oceangoing ships (including tankers and LNG carriers) competing in the international trade market.[32] As the ship numbers cratered, the U.S. flagged maritime sector contracted to support the non-contiguous U.S. markets protected by the Jones Act. Critics say this is evidence the Jones Act has failed and is outdated, while supporters use the same statistics to argue that without the Jones Act, the United States would have no U.S. flag oceangoing fleet at all.

The World Economic Forum refers to the Jones Act as the world 's most restrictive example of cabotage law, in large part because of the provision that ships must build in the United States, a provision that very few other countries share. In 1980, MARAD surveyed how many countries around the globe had domestic build requirements. Of the 56 countries surveyed, only Brazil, Egypt, Indonesia, Nigeria, Peru, Spain, and the United States have domestic-build requirements.[33] One common to all these countries is that they do not enforce the build requirements as rigidly as the U.S. In many cases, these countries ignore the implementation where it is in their economic interests to do so. Cabotage restrictions are not uncommon, and in some situations requiring domestic builds is necessary as is the case in the construction of naval vessels. The European Union (EU) permits cabotage, but with exceptions and loopholes. The EU economy as a whole is comparable to the U.S. economy – similar populations, landmass, and GDP. Some of their restrictions are EU-specific, as opposed to national, but those are not dissimilar in practice to U.S.-specific restrictions. Canada also has provisions allowing the use of a foreign-flagged ship if no Canadian equivalent vessel exists, therefore as long as the carrier is not taking business away from a Canadian shipping company.

Exceptions such as the above would enable the United States flexibility in providing the types of vessels needed to address a broader range of national security-related issues (e.g., energy). As an example, there are zero Liquefied Natural Gas (LNG) carriers in the U.S., so it is impossible to transport natural gas from the Gulf Coast to Puerto Rico, which uses natural gas for 1/3 of their power generation. In situations such as this, Americans cannot sell American products to other Americans because there are no U.S. ships to transport the LNG. This situation also applies to liquefied petroleum gas or propane. The United States is the world's largest exporter of propane, and we cannot ship propane to Hawaii because there are no ships in the Jones Act fleet to transport it. Because of this, Hawaii must import propane from West Africa instead of buying American produced products. Many Jones Act complaints arise when it comes to restrictions on trade between the U.S. mainland and non-contiguous areas such as those of Hawaii and Puerto Rico.[34] Although, in 2013, the Government Accountability Office (GAO) reported that it is difficult to isolate the exact extent to which freight rates between the United States and Puerto Rico are affected by the Jones Act.[35] Nonetheless, most economists would agree that the Jones Act distorts the functioning of market forces.[36]

The United States is blessed with access to two of the largest oceans in the world, the Gulf of Mexico, Great Lakes, and a complex internal hydrographic network that reaches into the heart of the country and facilitates transport and trade by maritime means inland.[37] However, it seems that the number of shipyards and their annual production of commercial vessels do not correspond to a country with the characteristics described above. In the 2019 article "Rust Buckets: How the Jones Act Undermines U.S. Shipbuilding and National Security," Colin Grabow highlights that "*today [there are only] four shipyards in the United States … constructing large oceangoing commercial ships*."[38] With only four shipyards operating in the large-size vessel building market

(including tankers) in the United States, it becomes virtually impossible to compete against Asian shipyards as they are larger and more numerous. Also, since there is little production of commercial ships in the U.S., it means that there will be fewer jobs for merchant seafarers and other related specialties (e.g., naval architects and marine engineers).

Under these circumstances, the commitment to national security objectives in the event of a war scenario is comprised of both from the increased capacity of sealift and to mobilize the number of crew necessary to operate the (RRF).[39] According to the U.S. Department of Transportation (DoT), MARAD, the number of ships currently under the RRF program (established since 1976), to support the Department of Defense (DoD) in the sealift effort, is 46 ships[40] of which there is only a single tanker. The RRF is committed to being able to reactivate within 5 to 10 days[41] to support the DoD's wartime mobilization efforts, which were at their peak in World War II. In the post-World War II era, the U.S. shipbuilding industry has gone from building seventy oceangoing commercial ships in the mid-1970s to less than five oceangoing commercial vessels total between 2010 and 2020.[42]

Due to the 'U.S. built' requirement, U.S. shipbuilders enjoy a significant pricing advantage in the Jones Act oceangoing shipbuilding market where a small number of companies build domestically at significantly higher costs as a condition of participating in the protected Jones Act marketplace. As stated earlier, the overwhelming majority of Jones Act vessels are small vessels built and maintained by hundreds[43] of small to medium-sized shipyards.[44] The U.S. produces more than 1,100 inland tank and deck barges annually at this lower end of the shipbuilding scale.[45] At the oceangoing end of the shipbuilding scale, shipyards can be counted on two hands. With over 70% of all shipbuilders' revenue coming from DoD and Coast Guard contracts, a highly specialized market, only three domestic shipyards build oceangoing commercial ships.[46]

It is hard to dispute that the requirement to build Jones Act vessels in the U.S. confers a pricing advantage for U.S. shipbuilders. This system of competition, cooperation, specialization, and diversification across a small group of Jones Act companies (shipyards, carriers) ensures that each of the small numbers of companies wins and the benefits of the oligopoly system distributed to support the continued survival of the system. The system confers significant pricing power to the companies but at a high cost to the consumer.[47] A comparison of container rates for a shipment from either Houston, Philadelphia, and Jacksonville to Puerto Rico was 198% - 293% higher than the same container shipped from Madrid, Spain to Puerto Rico.[48] [49] The extended lifecycle of ships and small number of companies participating in the oceangoing Jones Act market results in fewer ships being built. This low build volume, combined with the relevant shipyards competing for larger defense contracts, drives up build pricing. For a defense shipbuilder like National Steel and Shipbuilding Company (NASSCO) to convert their Navy shipbuilding operations to produce a Jones Act ship requires significant retooling. The results in additional wear and tear on plant and equipment tailored for a specialized and highly technical build quality drives cost. For example, the last oceangoing Jones Act ship built by a 3,100 twenty-foot equivalent units (TEU) container ship built by NASSCO for Tote Maritime for $324 million.[50] In contrast, the newest foreign-built container ships carried 23,000 TEU's and manufactured at an average of $152.4 million each.[51] So, to take 743% less cargo capacity, Tote Maritime paid 213% more for their ship.[52] Because of the cost and market dynamics associated with the Jones Act, these higher-priced, lower cargo yield ships are ill-suited to compete in a global maritime marketplace where the cargo scale is going up while the cost of construction is going down. One can only infer that Tote Maritime prefers the safety and insulation from significant scale competition, which the Jones Act provides, over expansion and growth.

This type of business model has other hidden costs: it hinders us from fully leveraging its vast maritime domain, and programs like America's Marine Highway (AMH) to full national advantage. In their 2009 "Shipbuilder's Assessment of America's Marine Highway," General Dynamics – NASSCO offered some sage advice to Jones Act companies noting that:

> The best way to reduce the cost of a Jones Act ship is to establish the requirements of the marketplace, identify or design a vessel to meet those requirements, and then once the design is complete – produce those vessels in quantities that drive down the "learning curve" toward more affordable unit prices. A [key element] is to identify vessel capacities and speeds that would suit more than one market or route to increase the potential for series production.[53]

Controlling cost is essential if the United States is realizing the dream of an AMH. The commercial freight industry (ship, truck, rail) has to razor-tight profit margins. If the United States cannot bend the cost curve of Jones Act ship construction down, the AMH will continue to be just an authorized, but never a severely appropriated pipe dream.

Recommendations for Moving Forward

Amend the Jones Act to expand the national defense criteria. National defense is too ambiguous and narrow in the Jones Act currently. Achieving energy independence is critical to U.S. national security, yet supporting this goal often requires special Jones Act waivers, even during times of national crisis, which are the circumstances for which the designed law was to help resolve.[54] Expanding the national security aperture broadens the national security waiver criteria to allow for U.S. LNG to be carried to U.S. ports on foreign carriers. This recommendation ensures the protection of interior shipping markets (western River system) from a foreign competition where foreign nationals are not in America's economic or national security interests.[55]

Eliminate the U.S. build requirement from the Jones Act. This requirement limits the purchase of vessels to those built-in U.S. shipyards at costs higher than that of foreign competitors, including allied shipyards.[56] Likewise, require that all Jones Act vessels use U.S. shipyards for all maintenance and repair work (which is not a current Jones Act requirement). Making both modifications would increase the size of the U.S. flag fleet by substantially lowering vessel costs while concurrently increasing U.S. shipyard capacity with this more massive fleet, and allowing American shipyards to compete for commercial ventures, an area of specific interest to industrial and defense stakeholders.[57] Additionally, this would allow Americans to purchase American LNG and other tankers from foreign builders and subsequently reflag them[58] (the U.S. currently has no LNG carriers to domestic service markets).[59]

Limited Human Capital Investments

A critical factor for sustaining and improving the American maritime industry is human capital. Whether aboard ships or in the shipyards that build and repair the American Merchant Marine vessels, the workforce is aging, and there are significant challenges to recruiting young men and women to work in the maritime industry. When the military is gearing up for Great Power Competition, it is vital to address the human capital challenge. Without increasing the maritime

workforce, the United States is unlikely to be able to build and sustain a 355-ship Navy or man the sealift required to deploy the military in the event of a conflict. The government will have to take action to help recruit and sustain the maritime workforce of the future.

Challenges

In 2016, the U.S. Navy conducted a force structure assessment, identifying the need for a 355-ship fleet to maintain maritime power projection against "the ever-evolving and increasingly complex maritime security threats."[60] If the Navy moves toward the 355-ship fleet, it will encounter the limits of the capacity that shipyards can handle, due in part to the workforce's limitations.

The current shipbuilding workforce will be unable to process an increased workload due to a lack of incoming skilled workers and an aging workforce. The past cycles of military ship construction drove the current workforce demographics. During the Reagan administration, when shipbuilding was increasing, the government alone employed over 58,000 personnel in public shipyards.[61] Following the end of the Cold War, amid the military drawdown, five government shipyards were closed, and employment fell to 22,000 as public shipyards focused on ship maintenance. Private shipyards began to receive construction contracts. From a broader perspective, the number of laborers employed in shipbuilding today compared to those employed by the end of WWII has declined by approximately 79% compared to only 9% of those employed in manufacturing (see Appendix C, Charts 1 and 2). However, despite the smaller pool of employees, productivity is increasing has continued to rise, even after the recession in 2008 (see Appendix C, Chart 3).[62] Unfortunately, the reduction of employees led to an excess of workers, which in turn reduced the need for recruiting and training new personnel for an extended period. Currently, the workforce shows a "bathtub effect," which occurs when an "organization has many staff with little experience (as defined by years on the job), many staff with much experience, and [limited] staff between these levels."[63]

However, the civilian workforce has deteriorated of experience within this period for public shipyards (see Appendix D). Up to 47% of the workforce has less than ten years of experience, which reflects the challenging need to sustain a skilled workforce amongst an aging labor pool.[64] One may argue that this would present a challenge even in an era of steady-state fleet size; it is a much more significant challenge when the military is seeking to increase its naval force structure by 17% to a 355-ship fleet, resulting in the largest apportionment of the 945 vessels (see Table 1). The Congressional Research Service estimated in 2017 that this would require a 40% increase in the workforce.[65] Increasing the workforce by this percentage, over the next five to ten years, will challenge the shipbuilding industry in terms of training, certifying, and developing the skills of employees while also maintaining product quality and workflow efficiency. As the percentage of experiences tradesmen reach the end of their careers, the industry will challenge to keep certified instructors to train the increasing number of apprentices.

The United States Merchant Marine Fleet, and in particular the government's Ready Reserve Fleet, faces similar workforce challenges. The Ready Reserve Fleet is one of the primary tools for deploying large numbers of ground forces and sustaining operations in the event of significant military conflict. Most of the temporary workforce is civilian mariners, which is similar

to military reservists. The Maritime Administration (MARAD), which is responsible for the Ready Reserve Fleet, estimates that there are currently about 12,000 civilian mariners in the United States Merchant Marine.[66] There remains a shortage of about 1,800 civilian mariners to staff the Ready Reserve Fleet ships adequately. In September 2019, MARAD tested its ability to activate the Ready Reserve Fleet rapidly. However, most of the attention was on ship readiness rather than significant crew mobilization challenges for the ten-day exercise, which had noticeable effects on commercial shipping.[67] For this event, MARAD only deployed 40% of the Ready Reserve Fleet. One could argue that the shortages in the mariner crews for the remaining ships were sufficient to sustain an open-ended, long-term mission such as wartime mobilization. In numerous interviews, Rear Admiral (retired) Mark Buzby, the Maritime Administrator, has noted the problems presented by the shortage of American citizen mariners.

Shipyards and the U.S. Merchant Marine face significant challenges in recruiting personnel. The shipbuilding industry "is concentrated in a relatively small number of coastal states, with the top five states accounting for 63% of all private employment in the shipbuilding and repairing industry."[68] The Merchant Marine largely relies on the United States Merchant Marine Academy and six state-level academies that graduate a combined 1,100 students a year for Officer level personnel.[69] None of the industry has been particularly successful in recruiting mariners from outside of their immediate geographic areas. One likely challenge is cultural. Even though both shipyard workers and mariners make reasonable wages, there is a bias in the American educational system against blue-collar work, with an emphasis on college attendance over trade schools. Additionally, recruiting Americans in this merchant marine occupation has some challenges.[70] This career field generally lacks many amenities, such as high-speed internet, that are considered essential by the American populace and require extended time away from friends and family.[71]

One potential solution is to increase the wages in these fields; in theory, if the jobs paid more, then more people would be attracted to these career fields. However, maritime companies, particularly within the maritime freight sector, face significant pressure to keep wages flat. Wages account for 10% of industry revenue. Increasing wages would further narrow company profit margins, making the maritime freight industry even less appealing for new entrants. Additionally, buyers retain much of the power in the maritime sector due to the size and financial leverage of the large corporations that import and vast export large freight amounts. Because of buyer sensitivity to shipping costs, players must compete on freight rates and efficiency, including the speed of transport and delivery of the undamaged product. While the supply of American merchant mariners remains low, demand is also decreasing as freight industry operators plan for labor costs to decrease at a rate of 0.7% per year as newer ships, requiring fewer operators, enter service.[72] The decreasing size of the U.S. maritime fleet and the introduction of industrial automation further compounds the reduced demand for labor. Unmanned technology may offer some relief for mariner shortages as the technology now exists to operate ships remotely. It will likely be a decade or more before this technology matures, and vessels become a large part of the commercial services.

Shipyards have also faced similar challenges. The wages for shipyards have nominally increased for decades. Although the industry has kept up with inflation, real wages have remained stagnant and are significantly below the GDP per capita growth. If static wages remain, a wider gap will ensue and contribute to the decline of economic progression for shipyard laborers

(Appendix E).[73] Likewise, when shipyards receive additional demand, the pressure is not to "fill job orders but to operate with the lower pay rates."[74] This environment creates a lack of incentive to accelerate wage increases. Employing robotic technology may increase production capacity at shipyards and ultimately fill labor gaps in lower-skilled tasks. However, to keep operational costs constrained, naval shipyards may be reliant on government customers to fund these enhancements and, therefore, slower to adopt and invest in innovative technologies.

Policy Recommendations

As the educational requirements for officer equivalent merchant marines, who receive formal, college-based education at one of seven U.S. maritime academies, or attend a Reserve Officer Training Corps (ROTC) program. One suggestion is for MARAD to seek additional funding for the Student Incentive Payment (SIP) Program. Currently, SIP provides tuition assistance of up to $32,000 across four years of a college education.[75] Instead, MARAD should increase funding so that tuition assistance and allowances are equivalent to the various military ROTC or college loan payback programs to attract more young people to the merchant marine. Even with emerging unmanned technologies, experienced operators will be a constraining factor requiring the industry to innovate and grow.

Additionally, Congress should enact legislation that would allow trained foreign mariners to gain American citizenship through service in the Merchant Marine. The military has created the precedent for this type of program. While technology may eventually reduce the number of required personnel, in the short term, the fastest way to increase the pool of qualified mariners would be to recruit experienced staff from trusted ally and partner nations. Like the military program, this would require a minimum number of years of service in the Merchant Marine in exchange for American citizenship. Applicants would clearly need to be screened and receive background checks, but the mechanisms for these types of actions mostly exist already and would only need to be adapted to this program. Once screened, applicants would become "green card" holders and would subsequently receive citizenship after a set number of years of service in the Merchant Marine. These individuals would count towards the Jones Act's requirement that 75% of the crew be American citizens. MARAD would be responsible for determining the number of mariners required on an annual basis so that this would be a limited program based on American needs and interests.

The Maritime Administration should also provide grants for autonomous technology research that would support the operation of uncrewed vessels within U.S. waterways. Crewless ships in international waters have long raised concerns related to piracy and human trafficking. However, the development of this technology for use within domestic waters provides an opportunity to test the technology, reduce manning requirements, and support further technological innovation. As part of this initiative, the Maritime Administration should commit to building the replacement ships for the Ready Reserve Fleet using unmanned technologies given that the Navy has successfully demonstrated the capabilities required.

On the shipyard side, the government must improve the predictability of work for private shipyards, potentially using Artificial Intelligence technology and adjusting its acquisition strategy. In a Navy's Report to Congress on the Long-Range Plan for Maintenance and Modernization of Naval Vessels for Fiscal Year 2020, NAVSEA identified initiatives to address

the stability of work in the shipyards.[76] Industry advised NAVSEA that fluctuations in workload and the unpredictability of awards were preventing shipyards from hiring additional employees without some level of commitment or guarantee of work.[77] The boom and bust nature of shipbuilding has created an "imbalance that favored limited shipbuilding over readiness, resulting in lapses in maintenance and operational proficiency."[78] There is little incentive for private shipbuilders to make long term investments in the workforce if there is no reasonable certainty of long-term increased workload. The Navy is adjusting its acquisition strategy to address these concerns, while still meeting the Navy's needs.

The government should also pursue re-opening a new government shipyard. While the Navy is working to improve its existing shipyards, it is unlikely that it will be adequate to support the 355-ship fleet. A new government-owned shipyard would be less vulnerable to the business cycle. It may be better able to incorporate patriotism as a factor in the recruiting process and to access communities outside of those traditionally associated with shipbuilding.

Each of these policy recommendations creates additional costs for the government. In an ideal world, there would be clear recommendations for offsetting cuts to other areas, or these problems could be solved by private industry without government intervention. However, the post-Cold War era's experience at least is that the private sector will not solve this problem on its own and that the underfunding of the Maritime Administration has at least contributed to the decline in readiness of the Merchant Marine.

Domestic/International Infrastructure

Since its inception, the U.S. maritime industry and its associated infrastructure – ports, piers, dry docks, and related equipment like cranes, lift systems, and so on – have played a fundamental role in the nation's success. Commercial and government-operated shipbuilding and repair industries in 2017 contributed about $60 billion to the U.S. economy.[79] The U.S. Defense Maritime Industrial Base enables the United States to build, provision, and maintain the world's largest Navy. Construction and repair yards provide vital support to preserving U.S. sea power as they ensure the national capacity to expand or recapitalize naval and commercial assets.

However, the current infrastructure is simply not adequate to meet even the present-day needs of the Navy. This infrastructure depletion is a key reason the shipbuilding industry today is ill-prepared to undergo a surge or mobilization. As the National Defense Industrial Association (NDIA)[80] has highlighted, the United States currently has only seven major shipyards, so competition within the shipbuilding industry – encompassing construction, repair, and maintenance of ships – is low. The Navy depends on a limited number of suppliers, and for aircraft carriers only on one. There has been a consequent dearth of investment in maintaining and modernizing infrastructure due to a lack of competitiveness within the U.S. shipbuilding industry. Furthermore, as pointed out by a RAND study[81] and echoed during a recent online conference at National Defense University (NDU),[82] due to the unpredictability of the industry suppliers have not invested in the necessary infrastructure and innovation.

In this era of Great Power Competition, we need to remember that maritime power spans commercial interests and national defense. A robust commercial maritime industry will thereby contribute to national security. Over the past decade, China has championed this approach, emerging as a considerable global naval power fueled simultaneously by interrelated economic drivers and national strategic imperatives. As previously discussed, China has invested heavily in

its domestic shipbuilding infrastructure and is building and acquiring control over ports around the globe through state-owned industries while also expanding its naval presence to secure its sea lines of communications.

One challenge is maintaining commercial and naval maritime superiority. The United States must develop a comprehensive, "whole-of-society" maritime strategy that encompasses the defense and commercial industry as one interwoven entity. Officials must adopt new policies to incentivize maritime infrastructure recapitalization,[83] which would regain capability and capacity for current and future needs.[84] The United States must also work with allies to maintain unlimited access to ports and maintenance facilities overseas, and develop new access arrangements. The following paragraphs will recommend policies the United States Government (USG) should take to address these imperatives.

Policy Recommendations

Domestically, the marine highway has the potential for cost-effective expansion as well as maintenance savings for land-based infrastructure. As there are already thousands of miles of uncongested capacity, we must promote use of the marine highway. For a modest investment of $5 million per port, uncongested ports could increase throughput to much larger ships, including roll-on-roll-off (RoRo) ships. However, a more significant investment of $50 million would be sufficient to create an east coast liner loop regular service to relieve congestion on the Interstate 95 corridor.[85] In 2040 it's projected that the I-95 highway will experience an increase of miles traveled by 70%; such volume increases are not physically or environmentally feasible, and studies indicated the I-95 corridor would require $15 to $19 billion per year for sustainment.[86] Recommendation: Invest in the national marine highway through port development and an east coast liner loop service.

The marine highway has the potential to provide intrinsic benefit to national defense by aiding in sealift capability. American sealift capability relies on an interwoven system of prepositioned ships, surge ships, and sustainment ships.[87] The average age of the fleet of vessels making up military sealift command and the MARAD sealift fleet is 44 years.[88] In addition to this, the Voluntary Intermodal Sealift Agreement (VISA) program is used to effectively place commercial ships on retainer for use by the U.S. government in time of need on short notice; the VISA program accounts for approximately 300 ships.[89] This fleet of ships, making up the ready reserve fleet, is expensive to maintain in a retainer status and provides dual-use to the marine highway. Aging ships and low readiness lead to a need for recapitalization of the fleet.

Although national defense usage and marine highway usage are not entirely the same, they do provide meaningful overlap that results in positive outcomes for both DoD and MARAD. DoD and MARAD should align the ready reserve fleet's dual usage criteria to the marine highway and national defense needs. The focus on high- and medium-speed RoRos would suffice for use along the U.S. coastlines to fulfill the DoD requirements of speed, range, and cargo handling. The same ships and crews transiting the marine highway could then be relied upon for mobilization. Studies further indicate the cost of creating these ships would likely still be less than the current expenses of keeping ships on retainer.[90] The primary national defense aspects needed would then be accomplished while bolstering the maritime transportation industry. Recommendation: Align dual usage criteria for shipping along the marine highway with national defense needs, specifically RoRos for sealift capacity.

This marine highway would require integration with the inland highways (such as waterways, channels, rails, and roads) and their associated infrastructure (e.g., ports, airports, connection hubs) to satisfy current and future needs. However, the maritime commerce transportation system spreads among several federal agencies, including the U.S. Department of Transportation (DOT), the U.S. Coast Guard, and the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration (NOAA), and also among state and local entities. These responsibilities are highly dispersed, decentralized, and not well coordinated.[91]

The consequences of federal agencies' unwillingness for change could further hinder progress. Improved coordination will, in turn, also enhance emergency preparedness and port security and resilience, as well as ports' ability to manage most effectively the future increased throughput associated with the marine highway. The organizational element that could lead this coordination effort is the Department of Transportation, which will become the focal point also to promote infrastructure improvements. As Kurt Nagle, the CEO of the American Association of Port Authorities (AAPA) argued in 2018, U.S. port operations have increased significantly.[92] Further, he estimated $66 billion of investment for the next decade "to enable our seaports to efficiently handle their expected cargo volumes, continue providing dramatic economic and jobs impacts, and enhance America's international competitiveness."[93] Recommendation: Designate and fund the Department of Transportation as the lead agency for developing the marine highway and associated infrastructure.

There are several avenues to fund and support this effort. Taxes and tax credits represent fiscal policy options for the federal government to incentivize the marine highway expansion and associated infrastructure improvement. The harbor maintenance tax is a directly levied tax on importers and domestic shippers of 12.5% on the value of the imported cargo – these fees are held in the harbor maintenance trust fund. Since the establishment of the harbor maintenance trust fund in 1986, it has collected more than it has appropriated for services, leading to just shy of $10 billion sitting idle in the U.S. Treasury as of summer 2019.[94] In this area, the U.S. government should take two actions. First, Congress should fully unleash the use of the trust fund by appropriating the full amount held in the trust fund at any time for harbor maintenance; this would avoid funds sitting idle and provide for the investment of approximately $34 billion over the next decade in the infrastructure of national ports and harbors without any increase to current taxes.[95] The government could also introduce mileage-based tax credits that would be specific to the most critical marine highway corridors which have the potential to most significantly impact the overall labor force and convergence of defense and commercial needs. Marine highway grants should continue via the "Notice of Funding Opportunity for America's Marine Highway Projects" method. However, MARAD, which administers the grants, should streamline the approval process for designation of marine highway projects. Recommendations: Fully appropriate funds from the harbor maintenance trust fund; introduce mileage-based tax credits for marine highway usage; streamline marine highway grants process.

Another policy proposal to restore the capacity and effectiveness of domestic and international maritime infrastructure is to establish a Public-Private Partnership (PPP) to improve the share of total public and private investments in the United States and abroad. In particular, in 2017, investments (both public and private) in transportation infrastructure and equipment in the United States reached almost $413 billion, which represents 14% of total expenditure. This partnership would result in two positive effects: the first is an increase of PPP investment, and the second is an increase in the resilience of transportation system infrastructure, which is vital since maritime infrastructure is vulnerable to disruptions due to extreme weather conditions,

cybersecurity, and international piracy.[96] Many companies and government agencies are investing in improving the resiliency of the whole system; for example, by creating alternate routes to avoid travel blockages in extreme weather conditions.[97]

The increase of private investment in both domestic and allied infrastructure could influence support through government policies. Federal agencies would contribute by paying part of the realization of new ports and facilities or by granting loans with no interest for the first period and low rates for the remaining time. Internationally, the newly-inaugurated U.S. International Development Finance Corporation (DFC) is a useful public-private vehicle for increasing U.S. foreign direct investment in ports, particularly in the developing world. Still, the U.S. government should increase the DFC's $60 billion exposure cap. Domestically, the government may acquire part of a property and the right to use ports, dry docks, and other facilities with priority for the maintenance of military ships. In particular, as highlighted in Naval Sea Systems Command (NAVSEA's) Long-Range Plan for Maintenance and Modernization, something must be done to mitigate the lack of accelerated investment in maritime infrastructure.[98] Recommendation: Increase PPPs in port infrastructure, both domestically and abroad.

To further spur investment in maritime infrastructure, find domestic and international investors and stakeholders, and catalyze innovation, the U.S. government should create a network among domestic and allied experts, centers of excellence, agencies, and representatives of the defense and private sectors. This network will undergird the NSS, which states that the National Security Innovation Base is "a network of knowledge, capabilities, and people."[99] It also "turns ideas into innovations, transforms discoveries into successful commercial products and companies, and protects and enhances the American way of life."[100] This sort of network is yet another sector where new infrastructure is needed to facilitate access to these tech bridges and information exchange, as was noted during the online conference of NavalX held at the NDU on April 2, 2020.[101] Recommendation: Create a network of networks to connect stakeholders and promote investment and innovation in maritime infrastructure.

On the international front, allies and partners could assist U.S. maritime readiness through continued or expanded access to port infrastructure. In peacetime, for instance, allies and partners can continue to provide the U.S. Navy with access to maintenance and repair facilities, provided the United States continues to invest in these relationships. For example, Singapore's Changi Navy Base has established a new maintenance support center for U.S. Littoral Combat Ships (LCS), while Japan hosts the U.S. Navy's Ship Repair Facility and Japan Regional Maintenance Center.

Through lifting the U.S.-build requirement in the Jones Act, the United States should also encourage allies and strategic partners to preserve their current commercial shipbuilding industries and avoid a Chinese monopoly of the industry. South Korea and Japan's combined global market share is now about 47%; while China alone accounts for 45%.[102] Simultaneously, the Departments of Defense and State can also use Foreign Military Sales (FMS) and Funding (FMF), direct commercial sales (DCS), bilateral military cooperation, and rotational visit agreements, and joint exercises to bridge maritime supply chain and infrastructure gaps. Recommendation: Reinforce partnerships overseas to ensure maritime infrastructure access and promote allied shipbuilding industries.

The United States should enhance relations with new partners to develop alternative port infrastructure access, particularly along the maritime commercial routes, where China's influence is growing. This burden-sharing would help foster a collective maritime community of democracies. For instance, India is particularly concerned by China's increasing military presence in the Indian Ocean, particularly its burgeoning relationship with Pakistan, and has taken steps to

improve its military capabilities and commercial partnerships with other littoral states. The United States should seek enhanced cooperation with India, particularly in the maritime sphere, supporting India's military modernization efforts and its greater economic integration throughout the Indo-Pacific and East Africa. Recommendation: Explore new partnerships to enhance maritime cooperation and secure additional access to global ports and maintenance facilities.

Domestic and allied maritime infrastructure plays a vital role in spurring economic growth, prosperity, a high level of readiness, and the ability to surge and mobilize, as underlined by the National Security Strategy. Furthermore, the Secretaries of Commerce, Transportation, and Labor noted in 2016 that "[i]n order to support U.S. competitiveness in a global economy, it is essential that we modernize and maintain our U.S. ports and our maritime transportation system."[103] This paper has proposed several policy recommendations that the United States should take to improve maritime infrastructure domestically and abroad. These may not all be achievable in the near term given fiscal limitations in the post-COVID era. As a priority, however, the U.S. government should incentivize private transportation industry firms to develop and utilize the marine highway and its associated infrastructure. The marine highway can provide public benefit to economic competitiveness while also reinforcing the strategic maritime industry. The United States should also work to solidify access agreements with its allies and partners and negotiate arrangements with new partners such as India, while supporting the commercial and strategic shipbuilding industries of key allied producers. Much of the international effort would be through existing diplomatic means and military partnerships, with limited cost to the U.S. taxpayer, whereas the domestic investment would be offset by fully unleashing the harbor maintenance trust fund as well as maintenance savings on land-based infrastructure.

Readiness/Sustainment Limitations

Along with the need to build a naval fleet to meet the needs of the NSS, the National Defense Strategy, and the National Military Strategy, the U.S. maritime fleet must be sustained to ensure its readiness. As the U.S. defends against adversarial predators during this Great Power Competition – "readiness" is vital to winning conflicts and supporting humanitarian relief efforts. The U.S. must consider improving the process of ship repair, maintenance, modernization, and proper sparing to provide equipment that is operational and suitable for service. Human capital and infrastructure resources have identified several areas of improvement within the sustainment area. Therefore, enduring current maritime workforce attrition levels will lead to the improbability of sustaining a 355-ship Navy. Besides, the marine highway has the potential to provide essential benefits to national defense by aiding in sealift capability.

Sustainment

In December 2019, the Chief of Naval Operations issued Fragmentary Order (FRAGO) 01/2019: A Design For Maintaining Maritime Superiority that called for an Integrated American Naval Power that integrates the Marine Corps and Navy with a focus on warfighting, the warfighter, and the future Navy.[104] This section focuses on warfighting a military fleet that will "be a potent, formidable force that competes around the world every day, deterring those who would challenge us while reassuring our allies and partners."[105] The warfighting objective includes ten tenets; however, this section focuses on the tenet to "improve ship depot-level maintenance and modernization,"[106] which links to the previous discussion of public-private enterprises and

human capital. Under this tenet, the "goal is to improve productivity, reduce lost days through depot availability extensions by 80% in FY20 compared to FY19, and eliminate lost days through depo extensions by the end of FY21."[107]

In response to the FRAGO, NAVSEA developed a plan in February 2020, for expected depot-level maintenance delivery for surface ship maintenance.[108] This plan established three lines of effort to improve on-time delivery; 1) Developing & Sustaining the Industrial Base, 2) Improving the Planning Process & Material Management, and 3) Improving Productivity in Ship Depot Maintenance Execution.[109] Below recommendations provide for the improvement of the planning process and material management and some effects they have on the execution of an availability. Recommendations cover some of the NAVSEA identified measures, as well as additional steps to improve on-time delivery. NAVSEA identified the use of a directive maintenance strategy that encompasses using condition-based maintenance coupled with historical input and data analytics, which leads to the early identification of Long Lead Time Material. Shifting the milestone for the planning process allows for a shipyard contract award 120 days (A-120) before start work. Any availability (A-120), with the long-term goal of an award at A-180, right-sizing the length of availability is sufficient to achieve the work scheduled by updating its Availability Duration Scorecard (ADS) to establish the right period of readiness, and the need to improve the process to acquire material in support of ship availabilities.

Policy Recommendations

In addition to the NAVSEA recommendations, a close review of the processes involved in preparing for and executing ship availabilities must be undertaken for areas to improve their effectiveness. The current methods include multiple organizations with responsibility passing back and forth between these organizations, resulting in no one focused point of accountability. This process consists of the fleet type commander's Port Engineer (PE), several members of NAVSEA, PMS407 and SEA 21, the Regional Maintenance Center's Project Managers (RMC's PMs) and Surface Maintenance Engineering Planning Program, both subordinate activities of NAVSEA, the Principle Acquisition Resource Managers for the modernization efforts, Alteration Installation Teams, the planning yard and third party planners, and the Program Manager's Representatives. Many of these entities must exist due to the functions they perform, but consolidating the PE and PM duty positions would benefit the organization.

The port engineer focuses solely on the ship, including the crew and fleet; whereas, the program manager focuses on the ship, team, and Navy, and manages the schedule, budget, and quality of the work completed. The fleet often feels that the project manager's focus on schedule, budget, and quality overshadows the focus on getting what the ship needs. A contractor, vice Government employee, often fills the port engineer function. Government personnel should occupy this position as the function it performs is inherently governmental, as defined by Federal Acquisition Regulations 7.503.[110] The type commander funds the program manager function, so they already have the fleet's interests as a priority, but they organizationally report to NAVSEA 21 known as SEA 21. SEA 21 has several entities, and they coordinate with fleet customers. This consolidation more closely resembles the structure Military Sealift Command employs and has proven to be especially useful.

Another additional recommendation beyond those presented in NAVSEA's plan is the more disciplined use of Class Standard Work Templates (CSWTs) when preparing availability work packages. The goal of using CSWTs is to ensure work items created at any RMC will be

consistent in content. Unfortunately, not all RMCs use the templates without adjustments, which causes them to lose consistency. Instilling discipline in the RMCs to use the templates as written would provide flexibility to the shipyards and contribute to the successful accomplishment of the work items. While it is the policy of SEA 21 to use the CSWTs without personalization, there are no enforcement ramifications for violating the policy.

In 2018, a GAO report titled "Actions Needed to Address Costly Maintenance Delays Facing the Attack Submarine Fleet" identified that material delays were significant contributors to attack submarines being unable to begin or complete maintenance periods.[111] In 2019, a GAO report titled "Persistent and Substantial Ship and Submarine Delays Hinder Efforts to Rebuild Readiness" found that lack of spares significantly contributed to reduced readiness and maintenance delays. The Navy must improve the posture of spare parts to support the timely completion of maintenance availabilities and improve readiness across the surface fleet.

The Navy's sparing policy has two significant areas that need addressing to achieve a holistic solution of reducing maintenance delays and improving readiness. The first area focuses on ships in the acquisition phase, defined as pre-Outfitting Work Limiting Date (OWLD), the second focuses on ships post-OWLD, and considered in-service. For vessels in the acquisition phase, specific areas of focus include Interim Sparing Support (ISS) and provisioning. For in-service ships, the focus is on the procurement of insurance items. Brief descriptions of these complicated issues with recommendations on approaches to address them follow.

ISS includes spares purchased by a program office to support the period from delivery until the Material Support Date (MSD), three years from initial delivery. During this period, demand patterns established as the ISS are spares used. After MSD is reached, Naval Supply Systems Command (NASVUP) uses the demand data to identify which spares to procure and then sell back to the fleet. The significant problems with ISS are related to funding and execution. NAVSEA Program Offices have not received full funding for ISS[112] and are not adequately establishing requirements for ISS per Navy policy. Acquisition Program Offices currently only submit annual funding requirements for On-Board Repair Parts (OBRPs) and Installation and Check-Out spares (INCOs) (which are materials to support the system build or installation) for new systems. OBRPs are provided to a ship either at delivery, for new construction, or after modernization, for ships in-service. INCOs are stored ashore and used as needed during the install period. After the last system is delivered, NAVSUP is supposed to receive any remaining quantities of shore-based spares purchased by the program office for lifecycle support.

Specific areas where the deviation is occurring from the OPNAVINST 4442.5A are acquisition program offices are not procuring initial supplies to support shore-based spares of material expected to fail and shore-based insurance items where "the impact of not having this material available ashore may jeopardize readiness and or result in increased costs to expedite procurement and transportation to support a work stoppage requisition."[113] In years where Program Offices receive inadequate Other Procurement, Navy (OPN-8) spares funding, modernizations are occurring lacking a full complement of OBRPs, and zero procurements for INCOs and other ISS spares. Program Offices do not currently submit funding requirements to procure initial shore-based spares for initial quantities of items expected to fail or insurance items. The impact is no ISS is sparing to support the platform until an established demand pattern occurs.

The levels of underfunding for the ISS budget vary for NAVSEA Program Offices, excluding spares related to nuclear reactors managed by NAVSEA 08. For programs that receive less than full funding, it leads to reduced operational availability, diminished lethality, cannibalizations, borrowed parts from production, and significant maintenance delays related to contracting for new material. The rationale for the chronic underfunding of these accounts indicates they are not receiving the priority they deserve. Recommend program offices submit requirements for ISS spares and resource sponsors fully fund the accounts. ISS spares should include requirements for; onboard spares, the initial stock of shore-based spares for parts expected to fail, INCOs, and insurance items (items not expected to fail, but would cause a significant delay or loss of capability). Navy policy should amend program offices to use OPN funding under their Total Obligation Authority to make up for any deficiency in OPN-8 funding.

Provisioning errors created in the acquisition window, especially in block buy contracts, are leading to significant issues in sustainment. Specific problems are provisioning that categorizes components as life-of-ship, and lack of technical data with Contractor Furnished Equipment (CFE). The probable reason these issues occur is to reduce the advertised acquisition and sustainment cost projections. For systems designated, life-of-ship technical data requirements are reduced because the item will never be replaced, spares not procured. Logistics support products for CFE (including parts lists, drawings, tech manuals, maintenance procedures, and spares) are procured and provided by a prime vendor to the government. If a prime vendor underbids on a contract or is facing cost overruns in engineering, logistics products for CFE are an area where the government allows prime vendors to deliver inferior quality components. Both life-of-ship errors and a lack of technical data errors result in a lack of spares, diminished readiness, and lengthy delays correcting the problems.

In fixed-price block-buy contracts, provisioning problems can pass from hull to hull through a whole ship class. This process occurs when provisioning problems on the initial hull identified during review and acceptance by the Navy. A shipbuilder will submit the same provisioning package on for all follow-on hulls. When an error is detected, the shipbuilder will insist that the Navy pay additional funds to correct deficiencies because it is out of the scope of the initial fixed-price contract. In instances where program funds provisioned results in results sparing increases will only be allocated to pre-delivery ships because the acquiring program office can only spend Ship Construction, Navy funds on pre-OWLD platforms. Recommend requiring acquisition program offices to complete ship alterations (SHIPALTs) for both new construction and in-service ships. In instances where provisioning corrections increase sparing, it is more cost-effective and efficient for acquisition programs to procure and provide spares to new construction and in-service ships. A solution would be to require that acquisition programs using fixed price block buy contracts include contract language requiring vendors to correct deficient provisioning for CFE up to delivery for the last hull in a block buy.

Once a ship or system passes the MSD, NAVSUP assumes responsibility to support the fleet's spare requirements. NAVSUP utilizes the Navy Working Capital Fund (NWCF), which is a revolving fund and adds a surcharge onto purchases to fund NAVSUP operations. NAVSUP does an excellent job of ensuring that parts that fail regularly are stocked and available for use. NAVSUP does not procure insurance items because demand is low, and it would consume funds used for high demand parts. If NAVSUP were to acquire too many insurance items and not enough

'fast movers,' they would be unable to fund their operations and would have to request additional appropriations. Insurance items provide a critical role in supporting in-service systems because having a single asset in reserve can reduce the impact associated with the long lead times for procuring material. To remedy the issue, recommend a change to policy so that when a life of ship component fails, a review to determine if procuring additional assets to establish an insurance item spare is warranted. Additionally, recommend OPNAV fund a new account to be executed by NAVSUP for purchasing insurance items outside of the NWCF and review annually for adequacy.

In summary, improving sustainment and readiness is required, no matter the ultimate size of the Naval fleet, It requires improving the repair, maintenance, and modernization process through the consolidation of the PM and PE functions since the PM already has the fleet's interests as a priority, and organizationally report to SEA 21. The result in entities involved in ship repair to be under the control of SEA 21. SEA 21 coordinates with customers and fleet disciplined usage of the CSWTs to ensure consistency between the RMCs applications and other various shipyards. Its recommended that full funding be provided to program offices to procure interim support spares, including onboard spares, shore-based parts expected to fail, installation spares, and insurance items. One possible solution is to require program offices to use OPN funding under their Total Obligation Authority to make up for any deficiency in OPN-8.

Additionally, acquisition program offices should be required to complete SHIPALTs for provisioning corrections discovered after OWLD under block buy contracts. Require that ship/system acquisition contracts include a mandatory contract line item to correct deficient provisioning for CFE and limit the use of CFE in acquisition programs. Require in-service program offices to include budget requests for provisioning updates and review annually for sufficiency. Adjust policy so that when a life of ship component fails, a review is performed at NAVSUP to weigh whether to procure an additional asset to establish an insurance item spare. And lastly, research notional funding requirements for insurance items. Establish a fleet funded account for NAVSUP to execute to purchase insurance items and review annually for adequacy.

Recommendations

As the U.S. continues to mitigate ongoing concerns with budget constraints and ever-changing national security requirements, something must change. Unchanged policy or ignored reform could further hinder and challenge American maritime superiority, which the U.S. has held for years. The elements of the NSS must address several critical gaps and seams. Below is a list of options:

Option A: "Quick wins, get it done yesterday."
Option B: "Slow-track, no cost to taxpayers."

Proposed Recommendations	**Options A, B**	**Resources**	**Risks**
Jones Act Modifications - Allow foreign builds	A	- Foreign carriers/builders	- Reduced U.S. production
Human Capital Investment - Military Accessions Vital to National Interest equivalent	A	- Minimal admin costs	- Requires legislative actions

Infrastructure Capitalization - Invest in Marine Highway - Fully unleash harbor maintenance trust fund	B	- $5M port dredging for additional - $34M over ten years	- Sunk costs may not attract desired maritime traffic - Port maintenance cost result in fixed infrastructure
Readiness/Sustainment Efficiency - Reduce lost operational days to zero by improving processes and ensuring appropriate sparing to facilitate timely repairs and maintenance to the Naval fleet	A	- Realign funding spares to offset both scheduled and unscheduled maintenance costs	- Risks would be not having a ready fleet

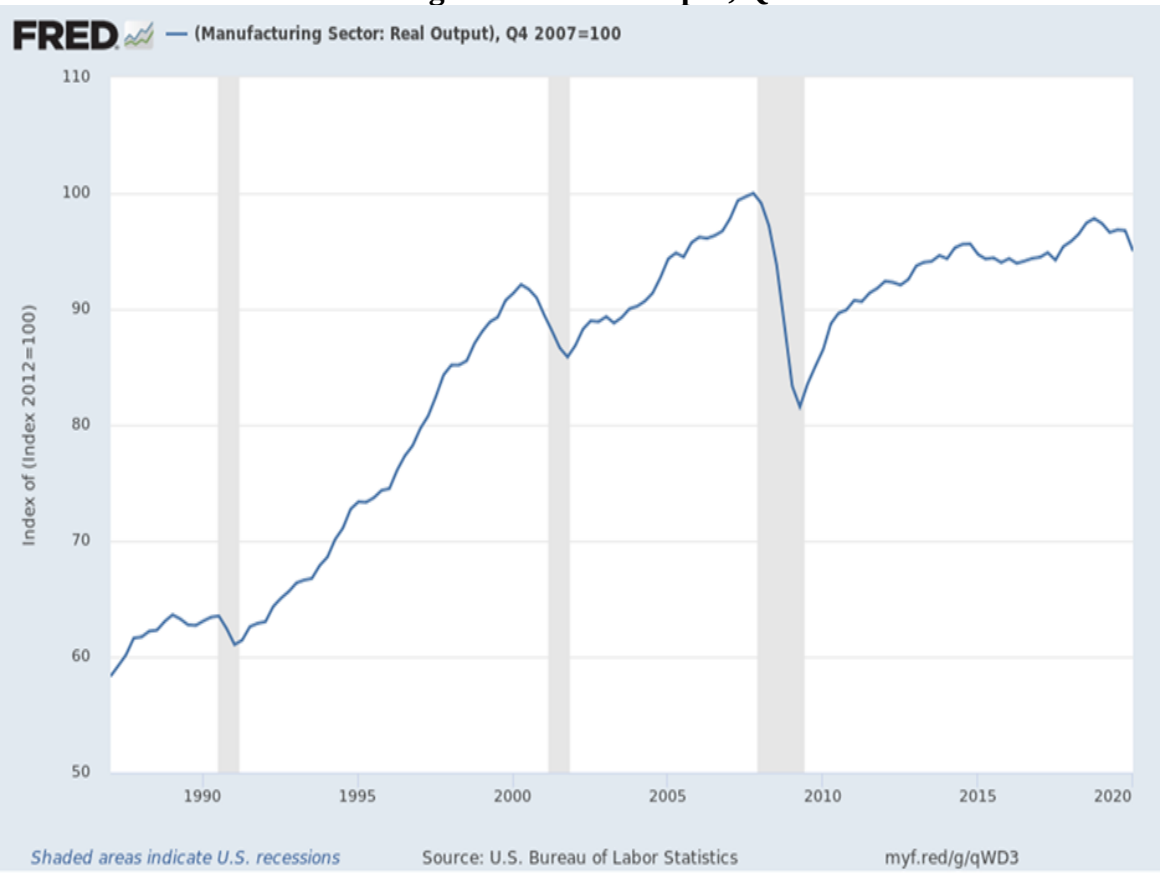
Conclusion

In summary, shipbuilding has been a significant factor in the U.S. economy for decades. Numerous concerns inhibit NSS objectives: one complicated issue is what, if anything, should be done to assist the declining U.S. shipping and shipbuilding industries. Lacking administration support or reform for maritime industries, the capabilities needed to support national security may be unavailable because of the competitive domestic market conditions and foreign competition. This deterioration may eventually harm the capability of the U.S. to surge, mobilize, and deploy troops in times of conflict. The U.S. maritime industries have experienced eras of both countless growth and severe reduction. It appears that many maritime industries today are on a relentless decay. This decline could change course if the government considered amending or abolishing the Jones Act, surge and revamp human capital resources for shipbuilding, repair and crewing ships, advance domestic and international infrastructure, and sustain the current and future naval projections.

American shipbuilding is a significant component of the heavy industry within the United States. The industry builds, maintains, and helps to evolve America's Naval services capabilities and the 945-vessel national fleet outlined above. The depth and breadth of the family of industries are equally significant and contribute to innovation within the NTIB and the DIB more broadly. However, these are not the only resources available to serve the interests of the United States. While there are risks associated with contracting and reflagging, these options offer an ability to increase what America achieves in the maritime domain rapidly. Increasing the scale of American shipbuilding remains an option to boost industrialization of the American economy; however, it is unlikely necessary, unless America wishes to garner a global shipbuilding market share and compete with China and South Korea. The United States will continue to dominate the seas, and these proposed recommendations in this paper make the U.S. more efficient in shipbuilding to improve national security, and enhance processes to produce a more powerful shipbuilding industry.

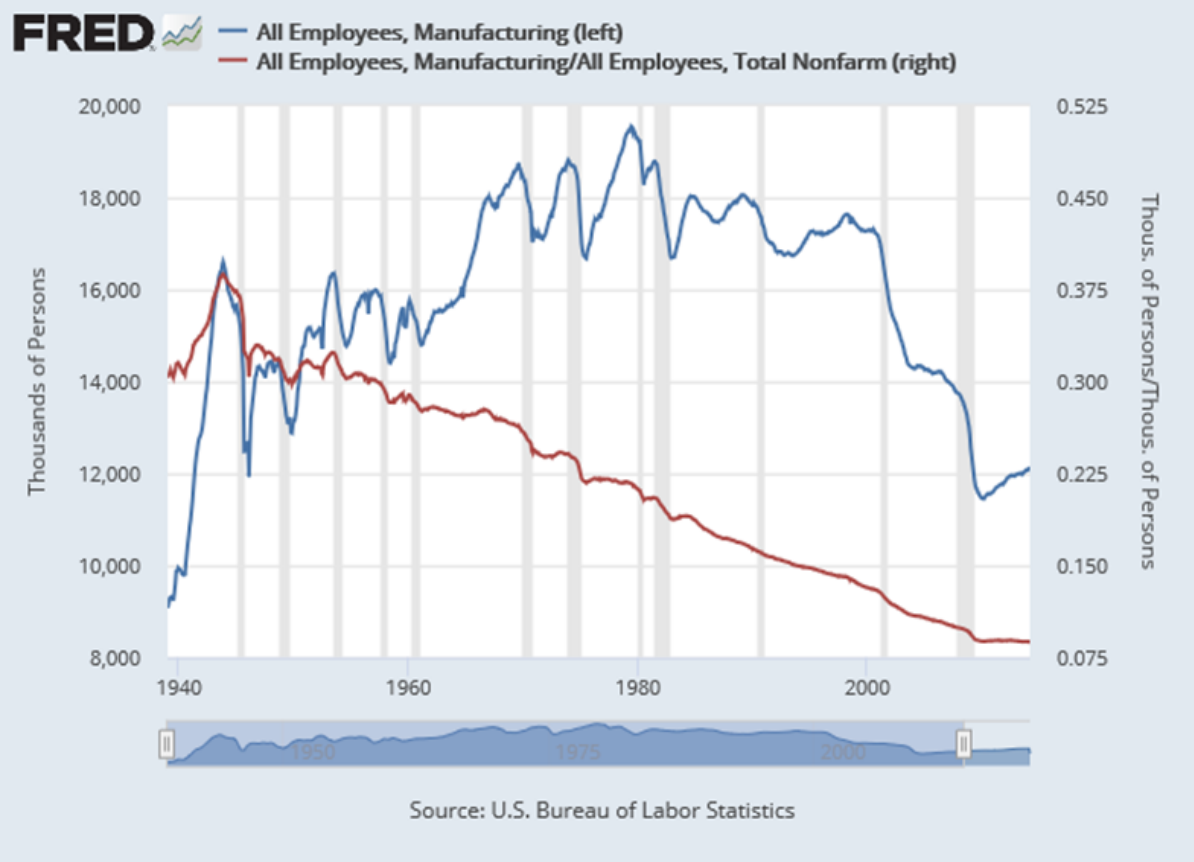
Appendix A.

Manufacturing Sector: Real Output, Q4 2007=100



Appendix B.

The Decline of Manfucaturting



Appendix C.

Chart 1: All Employees, Manufacturing

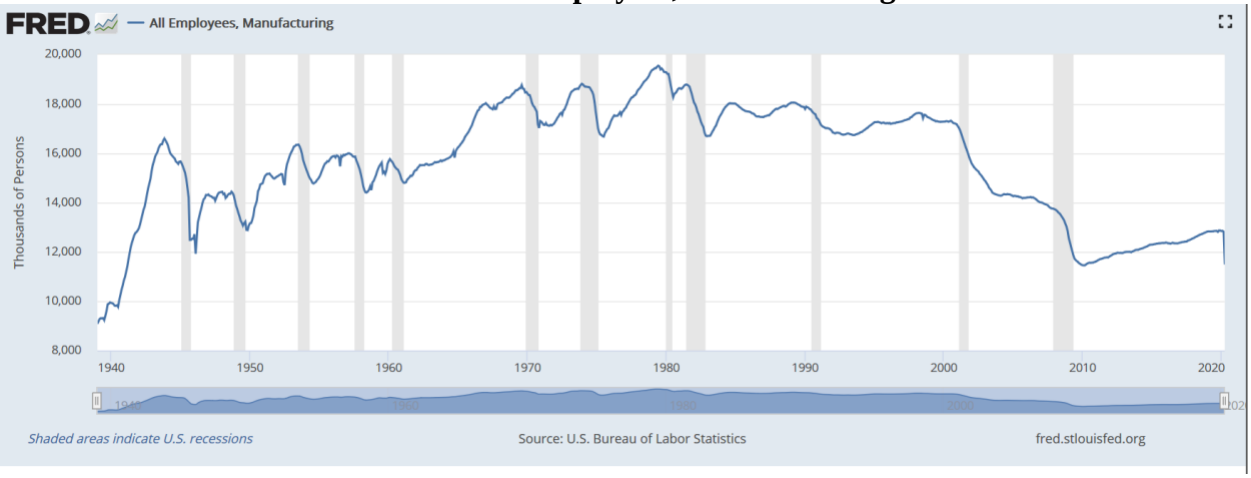
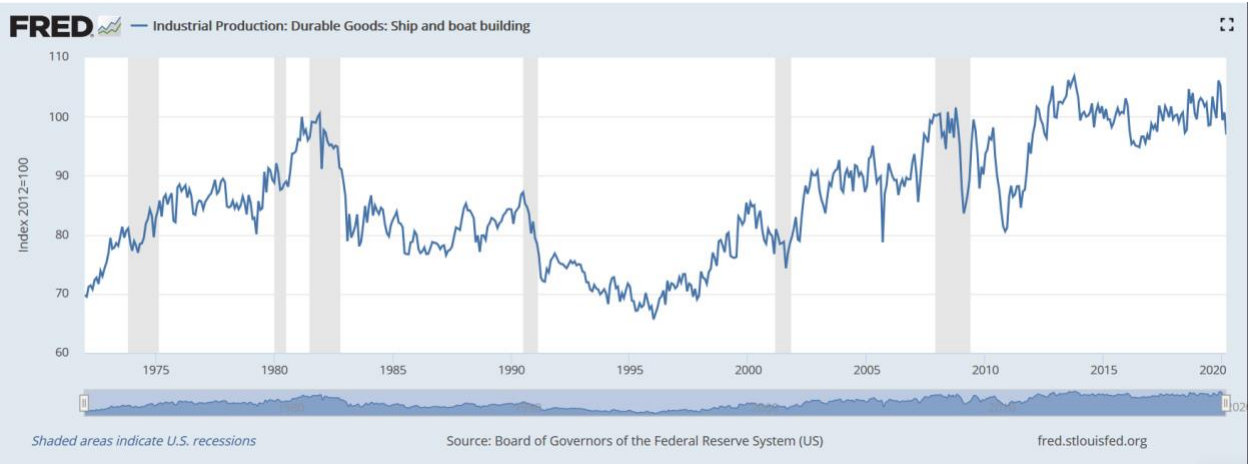


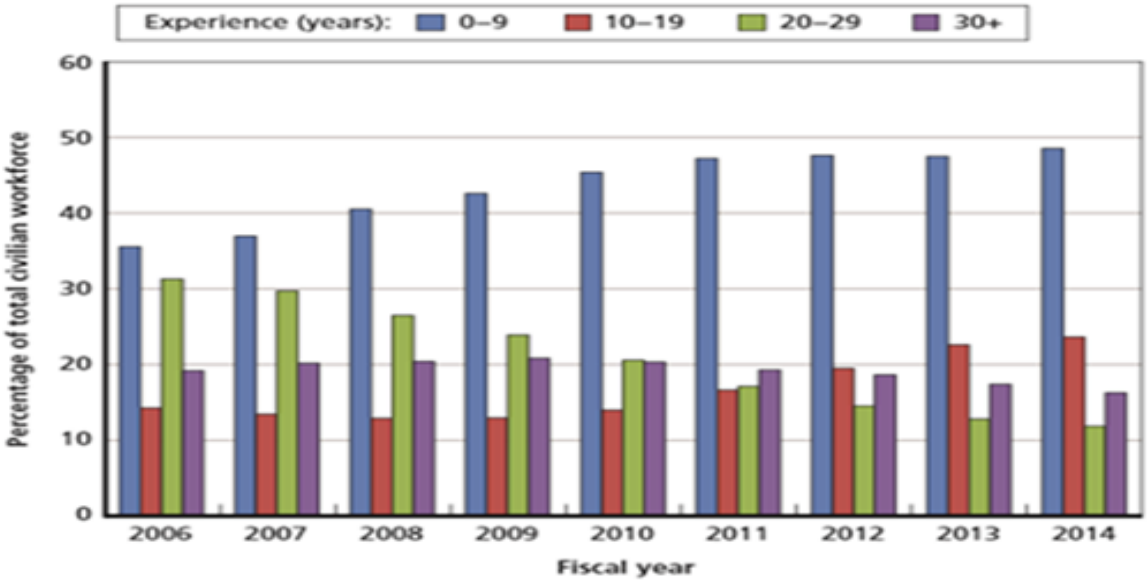
Chart 2: All Employees, Ship and Boat Building

Chart 3: Industrial Production: Durable Goods: Ship and Boat Building



Appendix D.

Civilian Workforce Experience, FYs 2006-2014

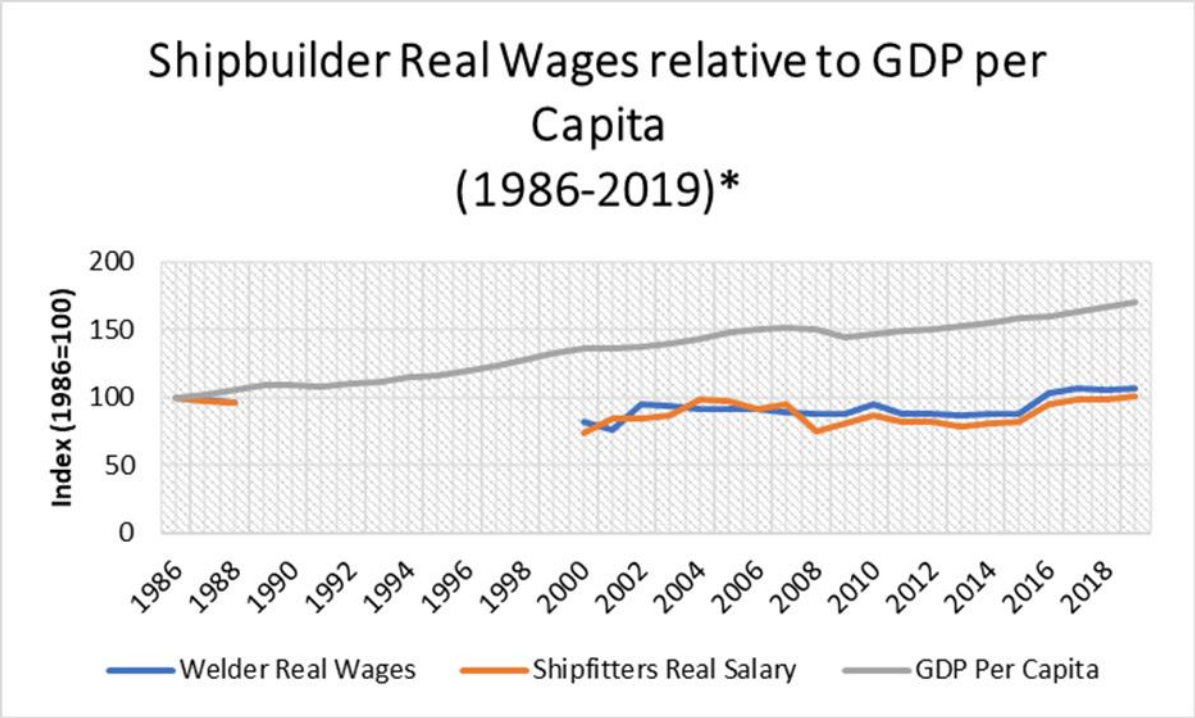


SOURCE: Norfolk Naval Shipyard, 2014; Pearl Harbor Naval Shipyard, 2014; Portsmouth Naval Shipyard, 2014; and Puget Sound Naval Shipyard, 2014.

RAND RR1552-3.1

Appendix E.

Shipbuilder Real Wages Relative to GDP per Capita (1986-2019)*



Due to lack of available data, graphical details are not depicted for years 1988-1995; 1998-1999

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