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From Rusted Hulls to Rising Tides: Revitalizing U.S. Shipbuilding in the Age of Global Competition and Maritime Security

December 2025

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ABSTRACT

The U.S. shipbuilding industry, once a global leader, faces significant challenges from foreign competition, workforce deficiencies, and outdated infrastructure. These issues threaten national security and economic sustainability. This project explores strategies to revitalize the U.S. shipbuilding industry through innovative techniques, including modular design and workforce development, while analyzing the root causes of its decline. By examining global shipbuilding practices, policy impacts, and historical trends, this research aims to provide actionable recommendations to enhance efficiency and competitiveness. The study employs a mixed-methods approach, integrating comparative analysis, policy review, and case studies to address questions about mitigating foreign subsidies, improving production methods, and learning from global leaders. Findings from this research are expected to inform policymakers and industry stakeholders, offering solutions that balance economic goals with national defense priorities.

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF ACRONYMS AND ABBREVIATIONS

AI	Artificial Intelligence
AM	Additive Manufacturing
AR	Augmented Reality
BLS	Bureau of Labor Statistics
CSIC	China Shipbuilding Industry Corporation
CSSC	China State Shipbuilding Corporation
CSIS	Center for Strategic and International Studies
CRS	Congressional Research Service
DfAM	Design for Additive Manufacturing
DoD	Department of Defense
DOE	Department of Energy
ESB	Expeditionary Sea Base
FY	Fiscal Year
GAO	Government Accountability Office
HII	Huntington Ingalls Industries
IoT	Internet of Things
LCS	Littoral Combat Ship
LNG	Liquefied Natural Gas
MARAD	Maritime Administration
MASGA	Make American Shipbuilding Great Again
MIB	Maritime Industrial Base
NDAA	National Defense Authorization Act
NSRP	National Shipbuilding Research Program
PLA	People's Liberation Army
PLAN	People's Liberation Army Navy
PRC	People's Republic of China
R&D	Research and Development
RRF	Ready Reserve Force

RPP	Request for Prototype Proposals
SAE	SAE International
SIB	Submarine Industrial Base (context 1) / Shipyard Infrastructure Bridge (context 2)
SIOP	Shipyard Infrastructure Optimization Program
SRF-JRMC	Ship Repair Facility and Japan Regional Maintenance Center
US	United States
USTR	Office of the U.S. Trade Representative
VR	Virtual Reality
WAAM	Wire Arc Additive Manufacturing

EXECUTIVE SUMMARY

The United States was once the world's undisputed leader in shipbuilding, capable of producing thousands of vessels to meet both wartime and commercial demands. That dominance has since faded. Today, China, South Korea, and Japan operate modern, highly efficient, and strategically coordinated shipbuilding industries that far surpass the United States in scale, technology, and productivity. This decline poses not only economic consequences but also significant national security risks. This study examines the causes of that decline, identifies lessons from global leaders in shipbuilding, and proposes concrete strategies to restore American maritime competitiveness.

The U.S. shipbuilding industry faces a convergence of structural problems—aging infrastructure, workforce shortages, fragmented policy support, and unpredictable demand. These challenges have weakened industrial capacity and made American shipyards less competitive internationally. Compounding these internal issues is the fact that the United States lacks a cohesive national strategy to integrate workforce development, technological innovation, and industrial policy. As a result, the shipbuilding base that underpins both economic resilience and national defense is underperforming at a time when strategic competition, particularly with China, is intensifying.

This research uses a qualitative, comparative approach built around three elements. First, a comprehensive literature review examines government reports (GAO, CRS), industry analyses, and academic studies to define the scope and causes of U.S. shipbuilding decline. Second, a cross-national comparison analyzes shipbuilding practices in China, South Korea, and Japan to identify policies and industrial strategies that have sustained their global leadership. Third, theoretical framework integration applies three analytical lenses—Porter's *Competitive Advantage of Nations*, Systems Innovation Theory, and the National Resilience Framework—to evaluate how nations develop, sustain, and modernize their maritime industrial bases. This combination of data and theory allows for a structured assessment of why the U.S. fell behind and how it might recover.

The key findings of this study reveal that the decline in U.S. shipbuilding is systemic rather than temporary. The U.S. has too few operational shipyards, many of which are outdated. Efforts such as the Shipyard Infrastructure Optimization Program (SIOP) have progressed slowly and lack consistent funding. Workforce shortages remain critical, as skilled trades—welders, fitters, and marine engineers—are aging out faster than they are being replaced. Unlike South Korea, which connects training centers directly to industrial facilities, U.S. workforce programs are fragmented and reactive. Technological modernization is also uneven. Although pilot programs in additive manufacturing and robotics exist, they are not scaled across the enterprise. In contrast, "smart yards" in South Korea employ digital twins, AI-driven logistics, and IoT integration to achieve predictable, high-volume output. Another key differentiator is dual-use integration. Leading nations combine military and commercial shipbuilding within the same ecosystem, ensuring steady workload and cost efficiency. The U.S., however, maintains a rigid separation between the two sectors, leaving its yards dependent on fluctuating defense budgets. Finally, policy coordination is lacking. While U.S. initiatives such as the *Ships for America Act* and Submarine Industrial Base (SIB) investments are valuable, they operate in isolation. Competitor nations treat shipbuilding as an integrated national enterprise that aligns government, industry, and labor priorities.

The study concludes that the United States' shipbuilding challenges stem less from a lack of capability and more from the absence of a unified national framework. America has the technology, industrial expertise, and workforce potential—but not the coordination or predictability needed to sustain them. Other nations view shipbuilding as an instrument of economic growth and national strategy. Until the United States does the same, it will continue to experience cost overruns, production delays, and declining global relevance.

To restore competitiveness, the study proposes a coordinated, multi-layered approach. It recommends establishing a National Maritime Industrial Policy Board, anchored by a White House–level Shipbuilding Coordinator, to unify efforts across the Department of Defense, MARAD, the Department of Commerce, and private industry. It further suggests implementing multi-year procurement contracts to provide predictable demand signals that justify workforce expansion and yard modernization. The study calls for the integration of workforce training with infrastructure investment through regional shipbuilding clusters connected to technical colleges and apprenticeship programs. It also proposes scaling technological modernization by creating a *Shipbuilding Innovation Fund*—modeled after DARPA—to advance digital shipyard technologies such as additive manufacturing, robotics, and digital twins. Additionally, it recommends reforming but preserving the Jones Act, maintaining national security protections while incentivizing cost reduction, allied co-production, and technology transfer. Finally, the study advocates for expanding allied partnerships with South Korea and Japan for co-production, workforce exchange, and shared digital infrastructure standards.

Revitalizing U.S. shipbuilding is not a matter of nostalgia—it is a matter of national resilience. The industrial capacity that once made the United States the "Arsenal of Democracy" still exists; it simply needs alignment, investment, and purpose. Through integrated policy, modern technology, and renewed partnerships, the U.S. can rebuild a maritime industrial base that supports both economic prosperity and strategic security in the decades ahead.

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I. INTRODUCTION

A. PROBLEM STATEMENT

The U.S. shipbuilding industry, once a cornerstone of American industrial and military strength, is struggling to compete in the global market. This decline is particularly evident when comparing the U.S. industry to foreign competitors such as China, which benefits from substantial government subsidies and has outpaced both the military and civilian sector of the United States in ship production by a factor of 230 to 1 (Tang, 2024). As a result, the U.S. shipbuilding sector has seen a reduction in U.S.-flagged vessels and a shrinking number of domestic shipyards, compromising the sustainability of the industry as well as national security. In response, legislative measures such as the "Ships for America Act" have been introduced to promote domestic production and safeguard U.S. maritime interests from both economic and national security threats (Kelly, 2024).

The Eno Center for Transportation notes that these subsidies, which allow peer and adversarial nations to flourish in their shipbuilding efforts, have contributed to job losses and weakened the competitiveness of the U.S. shipbuilding sector (Eno Center for Transportation, 2015). Compounding these external pressures, internal policy constraints such as those imposed by the Merchant Marine Act of 1920, commonly known as the Jones Act, may have inadvertently hindered the industry's ability to modernize and compete in the 21st century (CATO Institute, 2019).

Despite this urgent need, there is a gap in knowledge as well as effort concerning the specific modernization strategies that could benefit U.S. shipbuilding. Existing literature discusses successful modular design and rework reduction strategies implemented by U.S. allies, yet little research has explored how these methods could be adapted within the United States' unique regulatory and economic landscape. A closer examination of these methods could offer valuable insights into potential improvements for domestic shipbuilding practices, particularly regarding affordability and adaptability.

B. RESEARCH OBJECTIVES

This study aims to contribute to the ongoing dialogue on U.S. shipbuilding by analyzing the industry's decline, comparing U.S. capabilities with those of leading shipbuilding nations, and proposing actionable strategies to correct the decline. Furthermore, this study aims to examine whether or not the U.S. can adapt proven international shipbuilding strategies—such as modular design, smart yard integration, and lean manufacturing—to its unique landscape of regulation, economic constraints, and security priorities. The research findings will enable policy recommendations that support workforce development, sustainability, and competitiveness in U.S. shipyards, ultimately enhancing both commercial success and national defense capabilities.

1. Primary Research Question

What are the primary economic and policy-driven factors contributing to the decline of the U.S. shipbuilding industry?

2. Secondary Research Questions

How can the U.S. implement proven strategies, to include modular design and rework reduction, to enhance the competitiveness and sustainability of U.S. shipyards?

What insights can the U.S. shipbuilding industry gain from the practices of leading international competitors, in the form of China and allies, to include Japan and South Korea?

C. METHODOLOGY

This research employs a qualitative methodology, including a comprehensive review of existing literature, policy analysis, and case studies of international shipbuilding practices. By analyzing reports, industry publications, government documents, and expert opinions, the research identifies key factors contributing to the industry's decline and potential strategies for revitalization.

Data is collected from articles, government publications from both the legislative and executive branches, industry analyses both in the public and private sectors, and academic journals. The study also examines legislative documents and policy proposals relevant to the shipbuilding industry.

Comparative analysis is used to examine the practices of leading shipbuilding nations, focusing on how their methods could be adapted within the U.S. context. The final analysis consists of an assessment of current and proposed strategies for industry revitalization.

D. RESEARCH RATIONALE

The decline of the U.S. shipbuilding industry has become a critical national security issue receiving urgent attention from defense officials, legislators, and military commanders. According to U.S. defense officials, China has executed an "unprecedented military buildup" encompassing nuclear, conventional, cyber, and space capabilities (Vergun, 2025). Senior U.S. defense officials also have warned that American industrial capacity must rise to meet the moment. John Noh, Acting Assistant Secretary of Defense for Indo-Pacific Security Affairs, testified before Congress that China's long-term objective is to establish dominance in the Indo-Pacific and ultimately surpass the United States as the leading global power. Noh testified that China's President Xi Jinping has instructed the People's Liberation Army (PLA) to be capable of conducting an operation against Taiwan by 2027 (Vergun, 2025). In response, Noh argued that strengthening the U.S. defense industrial base and rebuilding combat-credible deterrence in the region are essential steps to counter Beijing's trajectory (Vergun, 2025).

Similarly, Admiral Samuel Paparo, commander of U.S. Indo-Pacific Command, underscored China's extraordinary military modernization by citing rapid advances in artificial intelligence (AI), hypersonic missiles, space-based assets, and an aggressive production tempo that now surpasses the United States in air, maritime, and missile capabilities. According to Paparo, the PLA's persistent operations near Taiwan—escalating by 300% in 2024—are not mere posturing, but rehearsals for potential conflict (Vergun, 2025). He warned that these developments present real and serious threats to our homeland, to our allies, and to our partners, underscoring that deterrence remains the highest priority (Vergun, 2025).

This strategic urgency has catalyzed bipartisan legislative efforts focused on revitalizing America's shipbuilding capabilities—efforts that seek to shore up national defense and safeguard long-term economic stability to include the Ships for America Act introduced by Senator Mark Kelly (Kelly, 2024) and the Executive Order from President Donald Trump—Restoring America's Maritime Dominance (Trump, 2025). With China already leading the world in commercial vessel output and aggressively expanding its naval footprint, the United States must contend not just with capability gaps but also with the foundational question of whether its industrial base can meet future demand (Vergun, 2025).

While allied nations such as South Korea and Japan have implemented successful practices to include the use of cobots (collaborative robots), AI, and lean manufacturing, there is limited research on how such methods could be tailored to U.S. shipyards at scale. Much of the public and policy discourse acknowledges the problem but falls short of offering detailed solutions that connect academic research, commercial innovation, and strategic policymaking.

With shipbuilding increasingly in the national spotlight, this study seeks to bridge the divide between insight and implementation. By examining international best practices and aligning them with the structural realities of U.S. industry, this work offers concrete, evidence-based recommendations to catalyze revitalization. The time is ripe—ongoing legislative momentum, growing public awareness, and strategic urgency create a rare window of opportunity to transform American shipbuilding from a vulnerability into a pillar of strength. This study aims to contribute to the effort to ensure that U.S. shipyards can once again support global stability, maritime superiority, and national resilience.

E. LIMITATIONS AND SCOPE

The study is limited by the availability and accessibility of data, particularly regarding proprietary industry information and internal policies of foreign governments, some of which remain inaccessible due to confidentiality and geopolitical constraints. The scope of the research focuses on the U.S. shipbuilding industry, with comparisons drawn primarily to South Korea and other U.S. allies, where information is more readily available.

The study does not delve into classified military shipbuilding programs or sensitive national security details.

F. ORGANIZATION

The study is organized into four chapters. Chapter I introduces the critical challenges driving this research, including the decline of U.S. shipbuilding competitiveness, fragmented industrial policy, and workforce shortages. It also outlines the study's objectives and research questions, explains the methodology used to evaluate global shipbuilding strategies, and clarifies the scope and limitations of the analysis. Chapter I also provides a comprehensive background and overview of the historical context of the U.S. shipbuilding industry, including its apex during World War II and subsequent decline.

Chapter II reviews the historical background and includes a literature review that synthesizes existing research on the challenges facing the industry, including workforce shortages, infrastructure obsolescence, and policy constraints. It also examines strategies for revitalization. Chapter II also presents an analysis of the data collected, comparing U.S. shipbuilding practices with those of leading international competitors.

Chapter III provides a comparative analysis that takes a close look at how the United States compares to leading shipbuilding nations like China, South Korea, and Japan. It explores how each country develops its workforce, modernizes its shipyards, and aligns industry and government efforts—and highlights what lessons the U.S. can learn to strengthen its own shipbuilding base.

Chapter IV summarizes the findings and proposes actionable strategies to enhance the competitiveness of the U.S. shipbuilding industry.

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II. HISTORICAL BACKGROUND, LITERATURE REVIEW, AND THEORETICAL FRAMEWORKS

A. HISTORICAL CONTEXT

The U.S. shipbuilding industry has a storied history dating back to the early days of the nation, playing a pivotal role in economic development and national defense. The U.S. Navy's demand for steel armor and other components arose during the revitalization of the fleet, specifically in the 1880s, as the United States sought to transition from wooden ships to steel-plated, steam-powered warships (Naval History and Heritage Command, 2025). In what was one the first instances of a modern contract between industry and the U.S. military at a large scale, American steel manufacturers played a pivotal role in providing the steel that enabled the U.S. Navy to build "the new steel Navy" in the late 1800s (Naval History and Heritage Command, 2025).

During World War II, the commercial shipbuilding industry as a whole reached its zenith, both in scale and effectiveness, becoming a critical component of the Allied war effort. U.S. shipyards produced thousands of vessels, including the iconic Liberty and Victory ships, which were essential in transporting troops, equipment, and supplies across the globe (U.S. National Park Service , 2024). Designed for rapid construction, Liberty ships served as the backbone of the cargo fleet. These ships were built quickly to meet urgent demands, with some constructed in as little as four days due to innovative assembly-line techniques introduced by industrialist Henry J. Kaiser (National Park Service, 2024). Victory ships, developed later, featured improved speed and cargo capacity, further enhancing the efficiency of military logistics (National Park Service, 2024). These achievements underscored America's unmatched industrial capacity and its ability to mobilize resources on an unprecedented scale. The mass production of ships not only supported the war effort but also set new standards for industrial practices and workforce management. This period marked the height of U.S. shipbuilding, showcasing an unparalleled ability to mobilize industrial capacity. However, as shown in Figure 1, production levels began a prolonged decline in the decades that followed, driven by deindustrialization and the nation's shift from a manufacturing-based to a service-oriented economy. Over the past 40 years, manufacturing employment in the United States has experienced a sharp overall decline as the economy transitioned toward service-oriented industries. Manufacturing employment peaked at 19.6 million workers in June 1979, but by June 2019, this number had fallen to 12.8 million—a reduction of 6.7 million jobs, or 35% (U.S. Bureau of Labor Statistics, 2020). Key sectors such as fabricated metals, machinery, computer and electrical products, and textiles have been among the hardest hit, highlighting the broader challenges faced by the shipbuilding industry (Eno Center for Transportation, 2015). The U.S. commercial fleet has contracted so severely that fewer than 200 U.S.-flag oceangoing ships remain in service, which totals around 1% of America's seaborne trade. This marks a dramatic reversal from the mid-20th century, at a time when U.S.-flagged merchant vessels transported roughly one-third of total global trade (Thompson, 2021). By the 1980s, the number of major U.S. shipyards capable of producing ocean-going vessels had dwindled significantly--today, only a handful of these shipyards remain operational (Congressional Research Service [CRS], 2024). As shown in Figure 1, this decline has reached rock bottom and has remained.

B. DECLINE OF SHIPBUILDING

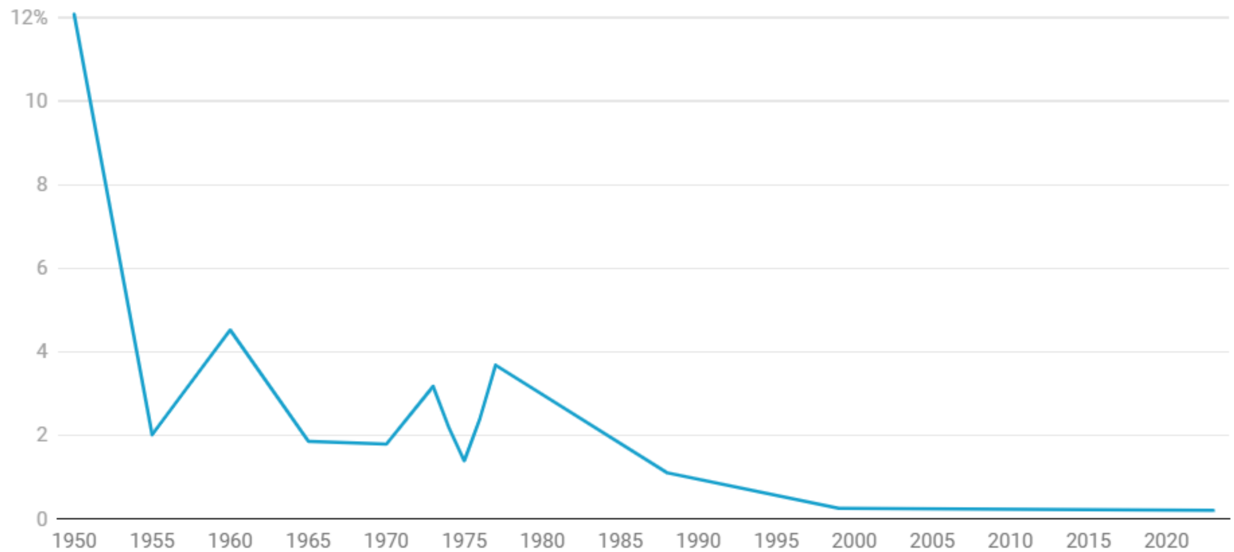


Figure 1. Decline of United States-owned fraction of global new ship tonnage. Source: Potter (2024).

Militarily, the U.S. Navy struggles to match China's rapidly expanding fleet of 350 warships, as American shipyards face reduced funding and closures. This further decline stems from decisions such as the Reagan administration's removal of construction subsidies without reciprocal actions from competitors, which has led to the closure of 14 shipyards since 1970 and a significant loss of jobs (Thompson, 2021). China's dominance in global shipbuilding and its strategic control over key trade routes further exacerbate U.S. vulnerabilities.

C. LITERATURE REVIEW

The decline of U.S. shipbuilding capacity and competitiveness has been widely documented across academic, industry, and government sources. Once a global leader responsible for nearly 5% of worldwide ship production in the 1970s, the United States now accounts for only 0.2% of global output, while China, South Korea, and Japan collectively hold over 90% of the market (Weddle et al., 2024).

1. Workforce and Labor Deficiencies

Workforce attrition has exacerbated these challenges, with private U.S. shipyard employment falling from 180,000 in 1980 to roughly 100,000 by 2010 (U.S. Maritime Administration [MARAD], 2016). The U.S. has struggled to maintain a skilled workforce, and this decline in labor capacity has directly contributed to reduced competitiveness in the shipbuilding sector. In contrast, the leading shipbuilding nations of China, South Korea, and Japan have made significant investments in workforce training and development to support their growing shipbuilding industries.

2. Infrastructure Obsolescence

U.S. shipbuilding suffers from fragmented governance, inconsistent funding, and technological stagnation. Reports from the Government Accountability Office (GAO) detail significant delays and cost overruns in nearly every major naval program, including the Columbia-class ballistic missile submarine and the Ford-class aircraft carrier (GAO, 2024). Aging infrastructure—such as outdated dry docks, facility layouts, and limited capacity—exacerbates these delays. Infrastructure limitations also contribute to frequent production bottlenecks, further hindering U.S. shipbuilding competitiveness (GAO, 2022).

3. Gaps in Technological Integration

While the United States has launched initiatives such as the SIOP and Submarine Industrial Base (SIB) investments, these efforts have been slow, uneven, and narrowly focused on public yards rather than the broader commercial sector (Eckstein, 2024). The technological stagnation in U.S. shipyards contrasts sharply with the high-tech capabilities of international competitors. South Korean shipyards, for instance, consistently deliver high-complexity vessels—including LNG carriers and container ships—on time and within budget by integrating robotics, digital twins, IoT-enabled production tracking, and precision-driven modular construction techniques (Maritime Executive, 2025)..

D. SYNTHESIS OF LITERATURE

The literature converges on the conclusion that U.S. shipbuilding lags behind global competitors across capacity, efficiency, and technological sophistication (CRS, 2024). The Navy's shrinking industrial base increasingly jeopardizes its ability to sustain maritime dominance, particularly in contested regions such as the Indo-Pacific, where China's production scale enables rapid naval force generation (CRS, 2024). The U.S. also relies on foreign-built logistics ships to meet sealift demands, raising operational risks during potential conflicts where foreign-flagged support may be unavailable (CATO Institute, 2024). Three interconnected challenges for the United States emerge repeatedly across the research: workforce shortages, infrastructure obsolescence, and technological stagnation.

First, workforce shortages remain one of the most significant constraints on U.S. shipbuilding capacity. The National Shipbuilding Research Program (NSRP) estimates a shortfall of 20% in skilled labor, compounded by an aging workforce and limited recruitment pipelines for welders, riggers, and marine engineers (Warren et al., 2023). In contrast, to sustain its industrial momentum, South Korea has coupled technological modernization with targeted workforce development initiatives. A leading example is HD Hyundai Heavy Industries' Root Academy Hall, established within the company's Ulsan shipbuilding complex in 2024 as part of the Ministry of Trade, Industry, and Energy's "Root Industry Specialized Complex" program (HD Hyundai Heavy Industries, 2024). The facility spans more than 3,900 square meters and serves as a state-of-the-art training center for shipbuilding's foundational trades—such as welding, casting, and metalworking—while also supporting suppliers located in the surrounding industrial complex. The academy integrates robotics-assisted and VR-based training simulators, including virtual paint training systems that replicate real-world shipyard conditions too hazardous or costly to reproduce physically. These tools allow trainees to gain hands-on experience through immersive, industry-aligned simulations, accelerating skill development and improving workforce safety. The program also offers industry-certified technical pathways, ensuring new entrants quickly meet shipyard operational standards while promoting standardized competency across the supply chain. Complemented by welfare facilities such as fitness centers, rest areas, and health clinics, Root Academy represents a holistic approach to labor retention and skill renewal. As CEO Lee Sang-kyun emphasized at its opening, the academy is designed to “alleviate the difficulties faced by root industries in securing and nurturing skilled workers” (HD Hyundai Heavy Industries, 2024). This initiative illustrates how South Korea’s workforce strategy blends human capital investment and advanced simulation technologies, reinforcing the broader goals of the K-Shipbuilding Super Gap Vision 2040 to sustain a high-skilled, adaptive labor base essential for next-generation shipbuilding.

Second, infrastructure obsolescence directly reduces throughput and productivity. U.S. shipyards continue to operate with outdated layouts, limited dry dock availability, and aging utilities, resulting in schedule delays and cost overruns. Benchmarking studies reveal that South Korean shipyards achieve nearly double the productivity of U.S. facilities due to their investments in modular construction, automated panel lines, and digitized production environments (McKinsey, 2024).

The U.S. shipbuilding industry has begun adopting additive manufacturing (AM) and collaborative robotics (cobotics) to address persistent productivity and supply chain challenges, but progress remains uneven. Through the Maritime Industrial Base Program, Lincoln Electric and General Dynamics Electric Boat are using wire arc additive manufacturing (WAAM) to produce large submarine propulsion components—demonstrating how AM can shorten lead times and strengthen industrial responsiveness (The Maritime Executive, 2025). At the same time, SAE International highlights how AM is reshaping design and qualification standards through Design for Additive Manufacturing (DfAM) frameworks, while cobotics are being introduced to improve worker safety and precision in high-skill tasks (SAE International, 2025). In comparison, Samsung and Mitsubishi shipyards utilize smart yard technologies to include IoT sensors, predictive scheduling, and automated material handling to accelerate delivery times while improving precision (Weber, 2025).

Despite these structural deficiencies, the literature highlights emerging opportunities. Initiatives to include the SIB’s investments in robotics, predictive maintenance, and AI-driven production analytics demonstrate the feasibility of modernizing U.S. shipyards. Proposals for modular design adoption, greater dual-use—tools that are engineered for the commercial world but are also useful for the naval domain integration, and increased allied partnerships represent promising pathways to reverse decades of industrial decline.

E. GAPS IN LITERATURE

While the literature offers extensive analysis of U.S. shipbuilding challenges and foreign advantages, several critical gaps remain that guide this section. It first outlines the absence of practical frameworks for adapting proven global practices to U.S. conditions. It then highlights the need to better align workforce development with infrastructure modernization, followed by a review of policy approaches whose long-term impacts remain unclear. Finally, it examines the limited research on emerging technologies and dual-use innovation that could strengthen both commercial and naval shipbuilding.:

First, there is a lack of U.S.-specific adaptation frameworks for integrating modular construction, lean manufacturing, and smart yard technologies. While Japanese and South Korean models are widely studied, the research rarely addresses regulatory, institutional, and cultural barriers unique to the U.S. defense-industrial base.

Second, workforce development and infrastructure modernization are treated as separate challenges rather than integrated efforts. Articles from Rand Corporation and GAO explore strategies for aligning training pipelines, apprenticeship programs, and vocational academies with concurrent investments in advanced yard layouts and automation systems.

Third, analyses of proposed legislative reforms—such as subsidies, tax credits, or expanded cargo preference laws—often fail to evaluate long-term effects on cost reductions, production schedules, and supply chain resilience.

Finally, there is limited research on dual-use innovation pathways that bridge commercial and naval shipbuilding. Additive manufacturing, collaborative robotics, and AI-supported design tools have demonstrated success in commercial shipyards abroad in countries such as Japan and South Korea.

This study addresses these gaps by developing a U.S.-tailored implementation framework for modularization, proposing integrated workforce-infrastructure solutions, analyzing the long-term effects of policy interventions, and designing dual-use innovation strategies that draw from foreign successes while remaining aligned with American regulatory and institutional contexts.

F. THEORETICAL FRAMEWORKS

This study applies an integrated theoretical framework combining industrial competitiveness, systems innovation, and national resilience theories to analyze global shipbuilding performance and to ground the comparative analysis in Chapter III. Each framework functions as a distinct yet complementary "lens" through which the U.S. shipbuilding sector and its foreign counterparts are evaluated.

1. Porter's Competitive Advantage of Nations (Industrial Competitiveness Model)

Porter's Diamond Model (1990) provides the foundational analytical structure for evaluating why certain nations achieve and sustain competitive advantage in specific industries. The framework's four determinants—factor conditions, demand conditions, related and supporting industries, and firm strategy/structure/rivalry—explain variations in shipbuilding performance across the United States, South Korea, Japan, and China. In Chapter III, this model is operationalized by comparing workforce pipelines (factor conditions), government coordination and subsidies (firm strategy and government role), and technological innovation ecosystems (related industries). The framework clarifies how South Korea, for example, converts integrated workforce and technology systems into long-term industrial advantage, while the U.S. remains hindered by fragmented policies and inconsistent investment cycles.

2. Systems Innovation and Socio-Technical Transition Theory

Drawing from Geels (2002) and related systems-innovation literature, this lens explains why isolated policy fixes—such as robotics adoption or single-yard modernization—are insufficient without whole-system coordination. It emphasizes that industrial transformation emerges from the co-evolution of technology, policy, and social structures. Chapter III applies this framework by examining how South Korea's "smart yard" programs integrate digital twins, AI, and IoT, within synchronized national policies (the K-Shipbuilding Super Gap Vision 2040). The United States, by contrast, illustrates the pitfalls of fragmented innovation efforts lacking systemic coherence. Systems Innovation Theory thus underpins the argument that sustainable shipbuilding modernization requires institutional alignment between government, industry, and workforce ecosystems.

3. National Security and Economic Resilience Framework (Dual-Use Industrial Base Model)

A third analytical lens derives from national security economics and resilience theory, emphasizing the interdependence of commercial and military production capacity. This framework assesses how industrial base strength, dual-use infrastructure, and allied partnerships contribute to strategic readiness. Chapter III applies this model through analysis of programs such as the SIOP, the Submarine Industrial Base (SIB), and allied co-production ventures under the Make American Shipbuilding Great Again (MASGA) initiative. Together, these cases demonstrate that resilience is not solely measured by output but by the adaptability and depth of the industrial ecosystem supporting national defense.

4. Integrated Application.

By triangulating these three perspectives, the study develops a multidimensional understanding of shipbuilding competitiveness. Porter's model identifies structural drivers of national advantage; Systems Innovation Theory explains the processes enabling technological and organizational adaptation; and the National Security/Resilience framework situates these within the broader strategic context of great-power competition. This combined theoretical foundation supports the cross-national comparisons and policy analysis presented in Chapter III, guiding the identification of practical pathways to revitalize the U.S. shipbuilding industrial base.

G. CONCLUSION

The literature establishes a consensus: U.S. shipbuilding is falling behind in productivity, technological sophistication, and strategic capacity while foreign competitors surge ahead through cohesive policy frameworks, vertically integrated infrastructure, and advanced smart yard systems. However, much of the research stops short of offering practical, U.S.-specific implementation strategies.

Reports from GAO and NSRP provide tactical recommendations—such as expanding apprenticeships and funding workforce training—but they rarely integrate these solutions with broader modernization objectives. Similarly, studies from CSIS, CRS, and McKinsey detail the efficiency gains of modular production, AI-assisted scheduling, and dual-use facilities, but they lack a roadmap for translating these practices into the U.S. industrial ecosystem.

Chapter III builds on these findings by comparing U.S. and foreign shipbuilding practices. Chapter 3 also pivots among a variety of extant literature, official data reports, sectoral analyses, and investigative journalism in an examination of inequalities in skill formation, technology adoption, infrastructure development, industrial policy, and production.

Chapter IV presents a unified framework for revitalizing U.S. shipbuilding competitiveness and sustaining strategic maritime dominance.

III. COMPARATIVE ANALYSIS OF U.S. AND FOREIGN SHIPBUILDING PRACTICES

A. INTRODUCTION

This chapter compares U.S. shipbuilding with leading shipbuilding nations and applies the integrated theoretical framework introduced in Chapter II. Using Porter's competitive advantage model, it examines how factor conditions such as workforce depth and industrial infrastructure shape outcomes; through a systems innovation lens, it assesses how coordinated national programs accelerate modernization; and through a national resilience framework, it evaluates how dual-use, allied, and security-driven shipbuilding ecosystems enhance strategic capacity.

B. U.S. AND FOREIGN WORKFORCE DEVELOPMENT AND INDUSTRIAL TRAINING PIPELINES

1. U.S. Workforce Challenges

An issue that has plagued policymakers in the U.S. shipbuilding sector for decades is the shortage of a skilled workforce. In Porter's terms, the United States is constrained by weak factor conditions—particularly the depth, pipeline, and technical readiness of its labor force—which undermines competitiveness even when funding is available. Years of underinvestment and deindustrialization have depleted the ranks of welders, pipefitters, riggers, and marine engineers. Despite investments of billions of dollars, the Navy has encountered challenges of delivering product to meet production schedules, primarily due to the absence of a trained workforce (GAO, 2024). Figure 2 shows a worker grinding a bulkhead at Puget Sound Naval Shipyard, one of several specialized technical skills required to sustain critical naval infrastructure. In addition, there is also the risk of an aging labor force. Compounding this issue is a failure to attract younger generations to skilled trades.

2. South Korea's Integrated Workforce Model

South Korea's shipbuilding success stems from its vertically integrated ecosystem, which begins with workforce development and extends into advanced technological innovation. Unlike the U.S., South Korea has deliberately strengthened its factory conditions by creating purpose-built training institutions such as HD Hyundai's Root Academy Hall, and has done so within a coordinated, multi-actor program that reflects a systems innovation model—workforce, technology, and policy advancing together rather than in isolation. These programs go beyond classroom instruction by simulating real shipyard tasks with state-of-the-art equipment, including robotics training, welding certification, and AI-integrated modules. This approach enables South Korea to sustain a consistently high level of technical readiness while quickly assimilating new entrants into highly mechanized shipyard environments.

In addition to domestic initiatives, South Korea has strategically expanded its training influence abroad. By opening workforce training centers in Indonesia, the country has created a pipeline of internationally trained labor while simultaneously extending its geopolitical and industrial reach (Labrut, 2024). As shown in Figure 3, HD Hyundai Chairman Kwon Oh-gap is pictured alongside foreign workers, underscoring South Korea's hybrid approach of combining domestic talent development with foreign labor integration.

Figure 2. A Worker Grinds a Bulkhead at Puget Sound Naval Shipyard. Source: Kreishner (2019).

3. National-Level Industrial Investments

These efforts are further reinforced by South Korea’s national-level investments. In February 2025, the government announced a 40% increase in shipbuilding funding to approximately $180 million, focused on accelerating green shipping technologies, digital transformation, and autonomous ship development under its “K-Shipbuilding Super Gap Vision 2040” initiative (Lee et al., 2025). Along with the U.S.–South Korea Make American Shipbuilding Great Again (MASGA) initiative, this partnership marks a turning point in allied industrial cooperation.

Backed by nearly $9 trillion ($6.7 billion) won in investment, the K-Shipbuilding plan aims to secure South Korea’s global lead in green, digital, and smart shipbuilding through eco-friendly propulsion, digital shipyards, and autonomous vessel development (Kardon et al., 2025). HD Hyundai and Hanwha Ocean are developing ammonia- and hydrogen-powered ships, digital-twin production systems, and AI-driven autonomous navigation technologies that support both commercial and defense applications (Hayes, 2025). These innovations are reinforced by MASGA’s $178 million cross-border investment, which links Korean engineering expertise with U.S. shipyard modernization, workforce training, and clean-energy goals.

Together, the initiatives illustrate a coordinated trans-Pacific effort to decarbonize shipping, digitize production, and strengthen allied maritime competitiveness—offering a viable counterbalance to China’s state-subsidized dominance in global shipbuilding. This comprehensive public-private roadmap aims to secure South Korea’s position as a global leader in shipbuilding innovation, ensuring that workforce training, technological advancement, and production capacity are tightly aligned.

4. Emerging U.S. Workforce Initiatives and Policy Implications

While programs such as the Navy’s Submarine Industrial Base (SIB) Talent Pipeline Project and regional apprenticeship initiatives have begun to address critical labor shortages—bringing together over 290 defense industry and 140 academic partners and celebrating more than 2,100 new workers joining the submarine workforce (U.S. Navy, 2024)—these efforts remain program-specific, fragmented, and small in scale relative to South Korea’s coordinated ecosystem. However, they demonstrate that the U.S. can build targeted, employer-linked training pipelines when federal, state, and industry stakeholders are aligned. In this sense, SIB should not be viewed only as a one-off response to submarine labor shortfalls, but as a prototype for regional shipbuilding clusters that connect community colleges, yards, and OEMs under a common demand signal. By comparison, the United States still lacks a comprehensive national workforce strategy for shipbuilding. Yet the existence of SIB, Norfolk-area apprenticeship partnerships, and state-funded maritime academies shows that the institutional pieces already exist; what is missing is the federal framework to knit them together and replicate them in the United States’ shipbuilding corridors. Without a scaling step such as this, the United States risks ceding industrial leadership—not due to rising costs, but due to an inability to produce the skilled labor necessary to meet production goals.

Figure 3. HD Hyundai Chairman Kwon Oh-gap (center) poses for a photo with foreign workers in Ulsan, South Korea. Source: HD Hyundai (2024).

C. SMART SHIPYARDS AND TECHNOLOGICAL INTEGRATION

The U.S. shipyard fleet is widely considered to be technologically outdated. Most shipyards still use paper-based inspection methods, along with manual part building and older IT systems not suited to modern industrial needs (Weeks et al., 2025).

Figure 4. A precast entrance basin is positioned prior to lowered at the Portsmouth Naval Shipyard. The new entrance basin will support the Navy's future fleet of submarines. Source: Eckstein (2022).

These systemic inefficiencies do not necessarily retard overall production, but they hamper quality development and deny opportunities for data-driven optimization. Despite Portsmouth Naval Shipyard (see Figure 4) pursuing pilot programs in additive manufacturing and robotics, there has been a failure to achieve full-scale transformation (Weeks et al., 2025). By contrast, Samsung Heavy Industries and HD Hyundai have spearheaded a revolution in 'smart yard' design. These smart yards operationalize the systems innovation framework outlined earlier—digital twins, IoT-enabled scheduling, and robotics are not adopted as isolated technologies but as mutually reinforcing components of a redesigned production system. These facilities leverage digital twins—the virtual representation of a physical ship that continuously mirrors its condition and performance in real time across its entire life cycle, AI-driven predictive maintenance, Internet of Things (IoT) sensors, and automated scheduling to reengineer every stage of shipbuilding—from steel cutting to final outfitting (Ruzicka, 2022). Assembly workers equipped with connected smart helmets interface directly with cloud platforms, while cobots and humanoid robotic welders reduce ergonomic strain and improve weld quality (Weber, 2025). These advancements enable South Korean shipbuilders to deliver vessels faster and more accurately than their competitors, underscoring that the nation's global dominance in commercial shipbuilding is the result of sustained investment and seamless value chain integration.

In response, the U.S. Navy has allocated over $174 million to the Shipyard Infrastructure Bridge (SIB) program to drive technological improvements and advance pilot programs in additive manufacturing and collaborative robotics (U.S Navy, 2025). For example, Newport News Shipbuilding's cobots have improved first-time weld quality rates by more than 45%, while reducing new welder training times (Weeks et al., 2025). Likewise, crawler robots—robots used for automated tasks including welding and inspection, especially in hard-to-reach areas of large structures and digitized radiographic film review are modernizing non-destructive testing—the evaluation of the properties of a material or component without causing damage, ensuring its future usability. Though limited in their commonality, rather than viewing these efforts as isolated experiments, they can be read as early U.S. demonstrations of the same systems-innovation approach used by South Korea—introduce digital tools, pair them with training, and then standardize across yards. Until such technologies are integrated nationwide, U.S. shipyards will continue to face behind-schedule projects, significant cost overruns, and the erosion of their industrial base.

As then-Chief of Naval Operations Admiral John Richardson warned, the pace of competition has "accelerated in many areas, achieving exponential and disruptive rates of change," creating strategic uncertainty that demands faster adaptation (Wirtz, 2019). Yet the U.S. Navy faces unique challenges: where once it controlled much of its own research and development pipeline, innovation has now shifted largely to the private sector. This transition requires Navy planners to monitor, assess, and integrate commercially developed technologies at unprecedented speed, while competing against adversaries—such as China and Russia—who aggressively deploy hypersonic missiles, autonomous systems, and other asymmetric capabilities (Wirtz, 2019).

Disruptive changes in naval warfare—from sail to steam, breech-loading cannons, and carrier aviation—once unfolded gradually over decades. Today, however, breakthroughs such as AI-driven unmanned vessels, swarm technologies, and robotics emerge far more rapidly, demanding accelerated innovation cycles. The Navy’s struggle to adopt these technologies at scale exacerbates its disadvantage relative to nations such as South Korea and China, whose integrated digital shipbuilding ecosystems enable faster, more efficient production (Cecire and Oh, 2025). Unless the U.S. develops a coordinated strategy to exploit emerging technologies—including robotics, AI, and additive manufacturing—the gap between overseas shipbuilding leaders and U.S. naval and commercial shipbuilding industrial capacity will continue to widen.

D. INFRASTRUCTURE AND INDUSTRIAL CAPABILITY

China’s state-owned shipyards, by contrast, which specialize in both naval and commercial orders, have a superior scale of capacity in that Chinese shipbuilding capacity has reached 230 times that of U.S. shipyard capabilities (Funaiole, 2024). China State Shipbuilding Co (CSSC) and China Shipbuilding Industry Co (CSIC) announced a merger in 2019, and ultimately completed the merger in 2025 (see Figure 5).

Figure 5. All the yards of China State Shipbuilding Co (CSSC) and China Shipbuilding Industry Co (CSIC) announced merger in 2019, and ultimately completed the merger in 2025. Source: Vavasseur, X. (2019).

Responding to infrastructure deficiencies such as aging facilities, limited shipyard space, and outdated equipment, the Navy initiated the SIOP, a 20-year, $21-billion effort to modernize public shipyards after a 2022 GAO report. The aim is to replace aging drydocks, modernize the facilities, and update utilities and IT systems. However, progress has been sluggish and implementation uneven. This reflects what the systems innovation literature warns about: without institutional alignment across funding, facilities, and workforce, modernization efforts remain project-based rather than transformational. The GAO found that "the backlog of facility restoration and modernization projects has increased by over $1.6 billion in the last five years," and that "more than half the equipment at the shipyards is past its expected service life" (GAO, 2022, p. 3). Furthermore, "the cost of just the first three dry dock projects has grown by over $4 billion," and "detailed shipyard investment plans will not be complete until fiscal year 2025—three years later than planned" (GAO, 2022, pp. 3–4). The report concluded that fully implementing the SIOP will require "funding well above the levels allocated in recent years… as well as significant planning and sustained management attention over 20 years" (GAO, 2022, p. 5).

E. INNOVATION POLICY AND PUBLIC INTERVENTION

One trend emerges among the major shipbuilding nations: powerful, coordinated government support. China exemplifies the extreme case. Indeed, as described in the USTR Section 301 report (2024), the PRC government pursues an array of industrial policies that seek control of the global maritime industry, such as:

- Direct subsidies to state-owned shipbuilders
- Preferential financing through state banks
- Export credit insurance and tax breaks
- Mandated domestic purchasing policies
- Merger designed to reduce competition and allow for increased scale (USTR, 2024)

It is this government-directed model that has spurred China's shipbuilding industry to develop at an explosive rate (see Figure 6). It is now able to build more naval and mercantile ships in one month than the United States can in a year (Funaiole, 2024). Chinese shipbuilders are free from financial constraints, and a national mandate for naval dominance ensures they have resources far beyond what U.S. yards possess.

Figure 6. The extent of Chinese state support for its shipping industry from 2010 to 2018. Source: Blanchette et al. (2020).

South Korea and Japan present more market-oriented but still highly managed systems. Both governments invest in R&D for shipbuilding technology, export financing, and work with industry on training and workforce development (Martini, 2025; Labrut, 2024).

Because most shipbuilding dollars flow through annual defense appropriations, shipyards are constantly exposed to budget delays, political debates, and shifting priorities. The Government Accountability Office has pointed out that this lack of predictability has contributed to chronic production delays, cost growth, labor shortages, and outdated infrastructure across major Navy programs—even though Congress has poured billions into the industrial base in recent years (Beebe, 2025). GAO's findings also show that the Navy and the Department of Defense often pursue investments without fully assessing whether those initiatives fix the underlying capacity problems. Taken together, these issues undermine the nation's ability to generate the surge production, sealift strength, and industrial resilience needed in an era of great-power competition.

Analysts at the Center for Strategic and International Studies argue that decades of consolidation and the departure of many commercial firms have left today's defense sector far more isolated from the wider economy than it was during the Cold War (Allen et al., 2024). They point out that most major programs are now concentrated in the hands of a small group of defense-specialist contractors. That narrow structure limits competition, slows the adoption of commercial technology, and reduces the kind of innovation spillover that typically comes from industries with mixed commercial-defense participation. As a result, the U.S. military is increasingly dependent on a small, consolidated supplier base at the very moment it needs flexibility, speed, and new technology.

The Merchant Marine Act of 1920—better known as the Jones Act—requires that any vessel carrying goods between U.S. ports must be built in the United States, owned by a U.S. corporation, flagged in the United States, and crewed by American mariners (MARAD, 2025). At the time, the law was meant to ensure that the United States kept a healthy shipbuilding sector, preserved a skilled mariner workforce, and had vessels available in a national emergency. Congress reinforced this system through the Merchant Marine Act of 1936, which created the U.S. Maritime Commission and introduced subsidy programs to strengthen the merchant fleet and support domestic shipyards (Shipbuilders Council of America, 2024). Over the past century, however, the Jones Act has evolved into a focal point of ideological and economic debate. Critics such as Colin Grabow of the CATO Institute argue that its protectionist design has raised costs and discouraged innovation. In Rust Buckets: How the Jones Act Undermines U.S. Shipbuilding and National Security, Grabow contends that the law's restrictions—though well-intentioned—have produced an aging fleet, an eroding mariner workforce, and a near-total loss of commercial competitiveness (CATO Institute, 2019). The CATO Project on Jones Act Reform similarly argues that the statute survives through political inertia and public misunderstanding, calling for repeal or major reform to reduce shipping costs and revitalize domestic maritime trade.

This conversation has recently entered the political mainstream. Connecticut Governor Ned Lamont urged Congress to "rethink the Jones Act," citing how its constraints inflate energy costs in New England by preventing U.S.-flagged liquefied-natural-gas (LNG) carriers from serving regional ports (Hagen et al., 2025). Lamont also pointed to offshore-wind projects at New London's State Pier that must rely on foreign vessels to deliver turbine components, driving up costs and slowing clean-energy deployment.

Lamont's remarks prompted a rare public disagreement with U.S. Representative from Connecticut, Joe Courtney, a long-time maritime ally and ranking member of the House Armed Services Seapower and Projection Forces Subcommittee. Courtney defended the Act as vital to sustaining the U.S. merchant-marine workforce, warning that "whittling away at the Jones Act … would be a race to the bottom" that could hollow out the remaining mariner pool (Hagen et al., 2025). His position underscores the bipartisan coalition—spanning labor unions, shipbuilders, and national-security officials—that continues to shield the Act from large-scale repeal.

Beyond this domestic debate, external proposals such as the Heritage Foundation's "Project 2025" advocate transferring MARAD from the Department of Transportation to the Department of Homeland Security, aligning it with the U.S. Coast Guard to streamline maritime oversight (Maiya, 2023). The same plan calls for "serious consideration" of repealing or substantially reforming the Jones Act, arguing that the economic costs now exceed its strategic benefits (Maiya, 2023). Project 2025 highlights persistent inefficiencies—such as the absence of any U.S.-flagged LNG carriers—which constrain energy transport between American ports (Schuler, 2025). Proponents of this view claim that shifting MARAD and modernizing the Act could reduce bureaucratic duplication and improve disaster-response logistics.

In contrast, maritime unions, the American Maritime Partnership, and the U.S. Navy maintain that dismantling the Jones Act would weaken America's strategic sealift capability. The Navy warns that repealing domestic-build requirements could "hamper [America's] ability to meet strategic sealift requirements and maintain and modernize our naval forces" (Schuler, 2025). They argue that the Act remains one of the few mechanisms ensuring the retention of U.S.-credentialed mariners—an essential human-capital base in wartime.

These opposing positions reveal the crux of U.S. maritime policy: how to balance economic modernization with national security and workforce resilience. Sweeping repeal remains politically improbable, but maintaining the status quo is equally untenable. A pragmatic reform path lies in selective modernization—retaining the U.S.-build and U.S.-crew provisions that sustain the mariner pool while introducing targeted tax credits, cost-sharing incentives, and carefully designed foreign-partnership carveouts to lower construction costs and encourage technology transfer. Congress could also authorize pilot co-production programs with allied shipyards under U.S. regulatory oversight to assess cost savings and workforce impacts before broader adoption.

Such incremental measures would preserve the Act's national-security intent while addressing its economic shortcomings. They would also align with broader industrial-base goals by stimulating new vessel construction, promoting cleaner propulsion technologies, and revitalizing shipyard capacity without undermining maritime sovereignty. In effect, the Jones Act could evolve from a static protectionist statute into a strategic instrument of maritime resilience—a policy that both sustains a ready merchant-marine workforce and rebuilds U.S. competitiveness in commercial and naval shipbuilding. Unlike China and South Korea, which sustain their shipyards through a steady flow of subsidized commercial ship orders, U.S. yards face prolonged gaps between naval contracts, leaving production capacity underutilized. Initiatives within the National Defense Authorization Act (NDAA), Shipyard Infrastructure Bridge (SIB) investments, and the SIOP provide new resources to the defense industrial base—yet, without a cohesive national strategy and strong leadership, these efforts often result in short-term gains without sustained industrial progress.

F. MANUFACTURE OUTPUT AND DELIVERY SCHEDULE

China's vessels roll off the ways with a speed the U.S. Navy cannot match because it builds simultaneously in parallel lines in multiple yards carriers, cruisers, and submarines (Al Jazeera, 2022).

Figure 7. Jiangnan Shipyard shows an Evergreen container ship hull under construction parallel to three Chinese military ships. Source: CSIS via Al Jazeera et al. (2022).

This rhythm is maintained by a regular flow of labor and capital, all government-controlled. China's civil-military fusion strategy also uses commercial yards for military purposes and makes more with less (Al Jazeera, 2022). State-owned enterprises such as CSSC and CSIC are vertically integrated behemoths that can, with relatively little friction, deliver ships at scale (McCartney, 2025). Furthermore, China’s delivery deadlines are usually expressed in months, not years. The construction time for the larger combatant class (e.g., frigates) is half of what is required by the U.S. shipbuilding enterprise, yet another threat to maritime force posture (Funaiole, 2024).

South Korea and Japan rank second and third globally behind China in commercial output (Panella, 2025). A naval affairs specialist told lawmakers that how these two allies manage their shipyards and construct vessels offers practical solutions for U.S. shipbuilding challenges (Panella, 2025). Their success stems from practices such as comprehensive materials management—by “monitoring and managing the flow of work through the shipyard on a continuous basis” (Panella, 2025, para. 4).

South Korean and Japanese shipbuilders also rely on innovative design and construction techniques that reduce labor requirements and improve productivity. South Korean yards, for example, produce larger modular sections that simplify worker access and streamline the manufacturing and installation processes (Panella, 2025). Although these larger sections increase upfront costs, they ultimately lower total labor hours and result in ships that are “easier and less expensive to build, maintain, and modernize over their life cycles” (Panella, 2025). Former Secretary of the Navy Carlos Del Toro noted that South Korea’s real-time digital monitoring systems track production progress down to individual stock materials, allowing executives to predict exact delivery dates—a capability U.S. shipyards currently lack (Panella, 2025).

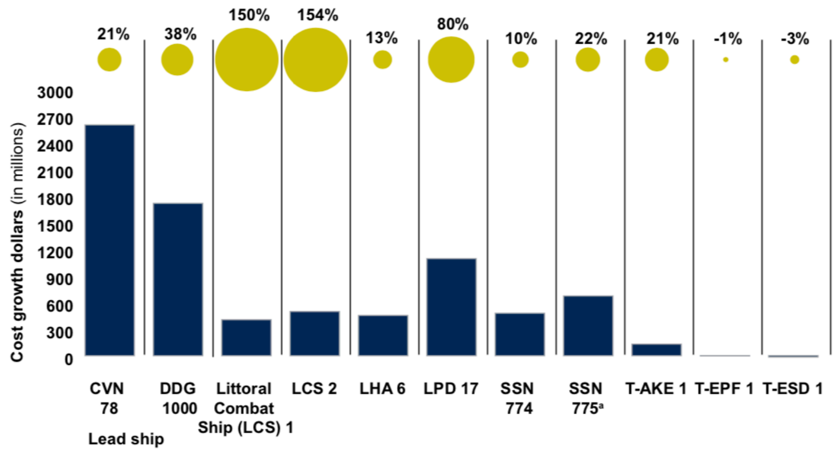
Japan also offers valuable lessons through its steady procurement strategies, which maintain a consistent production tempo even during changes in force structure (Panella, 2025). By preventing the boom-and-bust cycles common in U.S. yards, Japan sustains a skilled workforce and avoids supply chain disruptions (Panella, 2025). While there are significant differences between commercial and naval shipbuilding—such as density, survivability, propulsion, and combat systems integration—the practices of modular construction, integrated workforce training, digital process monitoring, and streamlined production represent transferable solutions for U.S. yards (Panella, 2025).

In contrast, U.S. shipbuilding continues to face persistent cost, schedule, and capacity challenges. Despite nearly doubling its shipbuilding budget over the past two decades, the U.S. Navy has not significantly increased the size of its fleet, with many programs over budget and years behind schedule (GAO, 2025).

These inefficiencies are particularly visible in submarine programs. The Virginia-class submarine program is currently achieving only 60% of its planned annual production goal, resulting in delays of nearly three years and an estimated $530 million in additional costs for the first two submarines in the latest block (GAO, 2025). Similarly, the Columbia-class ballistic missile submarine program is at least one year behind schedule and faces significant cost growth risks (GAO, 2025). GAO further reported that the Navy and the Department of Defense have not fully coordinated their investments, increasing the likelihood of overlapping efforts and missed opportunities for efficiency (GAO, 2025).

These problems illustrate what some officials describe as a "shipbuilding doom loop"—a cycle of delayed deliveries, escalating costs, and reduced industrial capability (Eaglen, 2025). Pentagon leaders testified that U.S. shipbuilding faces interconnected challenges, including industrial base atrophy, post-COVID contract misalignments, workforce shortages, diminished worker proficiency, supply chain disruptions, design immaturity, and inconsistent industry investment (Eaglen, 2025). Officials emphasized that reversing these trends requires providing the private sector with a reliable demand signal—stable, predictable contracts that encourage long-term investments in capacity and workforce development (Eaglen, 2025). However, the testimony also acknowledged that historic underinvestment in Navy-owned shipyards and government-directed industry consolidation following the Cold War have severely constrained production throughput, further weakening the U.S. industrial base (Eaglen, 2025).

Navy leaders have stated that revitalizing U.S. shipbuilding will require a generational increase in demand, alongside modernizing facilities, investing in workforce development, and improving acquisition processes (Eaglen, 2025). Figure 8 highlights the magnitude of this challenge, showing Navy ships organized by platform and illustrating over $11 billion in cost overruns caused by frequent construction delays and performance shortfalls. These issues underscore the structural weaknesses of the U.S. shipbuilding enterprise and the urgent need to implement systemic changes that improve efficiency, predictability, and quality across naval acquisition programs.



[a]SSN 775 is the second Virginia class submarine, but was the first hull delivered by Newport News shipyard. SSN 774, the lead ship of the class, was delivered by Electric Boat shipyard.

Source: GAO analysis of Navy documentation. | GAO-18-238SP

NOTE: Cost growth is measured as the difference between the initial cost estimate reflected in the Navy's budget request documents prior to ship construction (year in which the Navy requested authorization for the ship from Congress) and the cost estimate reflected in the Navy's fiscal year 2018 budget request documents or the actual cost. All cost estimates and cost growth calculations are in fiscal year 2018 dollars.

Figure 8. Navy ships organized by platform, highlighting over $11 billion in cost overruns, due to frequent construction delays and ships that often fail to meet quality and performance expectations. Source: USNI News (2018).

These delays have strategic consequences. As our adversaries grow their fleets, the United States must speed to keep pace with them. But the current production is insufficient to meet even minimal deterrence requirements. So long as this does not change, the inability to provide vital platforms will continue to be a bottleneck for U.S. maritime readiness.

G. STRATEGIC PARTNERSHIPS

Understandably, the "go it alone" approach is no longer feasible in an age when great power competition has returned, so the U.S. is now reaching out to its allies, particularly those with strong shipbuilding industries, to build mutual defense production capacity. South Korea and Japan, in particular, are natural partners with strategic interests in the Indo-Pacific and among the world's largest commercial shipbuilders. These countries have traditionally placed restrictions on the level of direct military cooperation in shipbuilding with the U.S., but circumstances reflect a changing posture. For instance, HD Hyundai and Eastern Pacific Shipping from the USA have teamed up to develop the United Shipbuilding Project to increase shipbuilding capacity, and these two partners will introduce Korean smart yard systems to the American industrial landscape (Ahn, 2024). These joint projects are also an indication of what could be a new age of technology transfer and coproduction, a mixture of American strategic need with Korean efficiency and automation.

The USS Miguel Keith (ESB-5) (see Figure 9) completed a $12 million, five-month Regular Overhaul (ROH) at Mitsubishi Heavy Industries in Japan—the first ROH of this scale at a Japanese shipyard (U.S. Pacific Fleet, 2025). The overhaul included extensive work on the deck, superstructure, and equipment maintenance while allowing the Naval Ship Repair Facility and Japan Regional Maintenance Center (SRF-JRMC) to focus on other fleet repairs. While U.S. law (10 U.S.C. § 863) generally prohibits overhauls of U.S. ships abroad, the ship qualified for an exception because the work lasted less than six months and the vessel was not scheduled to return to the United States within 15 months**.** This case illustrates how selective use of allied foreign shipyards can expand repair capacity, reduce turnaround times, and incorporate advanced industrial practices that relieve pressure on U.S. facilities and demonstrate the potential benefits of international collaboration in naval maintenance.

Figure 9. USS MIGUEL KEITH (ESB-5) completed a $12 million, five-month regular overhaul at Mitsubishi Heavy Industries in Japan. Source: U.S. Pacific Fleet (2025).

International collaboration is also a strong driver of leapfrogging in technology. The U.S. Navy's Maritime Industrial Base (MIB) program is placing greater focus on working with innovative companies in allied countries to file fewer and better requests for prototype proposals (RPP) (Secretary of the Navy, 2025). Among these is bringing in additive manufacturing best practice, digital shipyard design, AI-supported predictive logistics, and cobotic automation (Secretary of the Navy, 2025). A promising way forward is uncovering dual-use technology. AI-enabled welding systems, as just one example, created for high-volume commercial yards in Korea from German engineering, can quickly be integrated onto U.S. platforms (Cohen, 2025). To further expedite this, the United States could seek interoperable shipyard standards with allies that would allow shared tooling, coordinated digital infrastructure, and worker exchanges. Akin to Figure 10 below, which depicts an aircraft carrier overlaid with virtual blue alignment grids and augmented-reality design markers, these technologies illustrate how U.S. shipyards are beginning to merge physical production environments with digital engineering models to improve precision, streamline workflows, and enable real-time design validation.

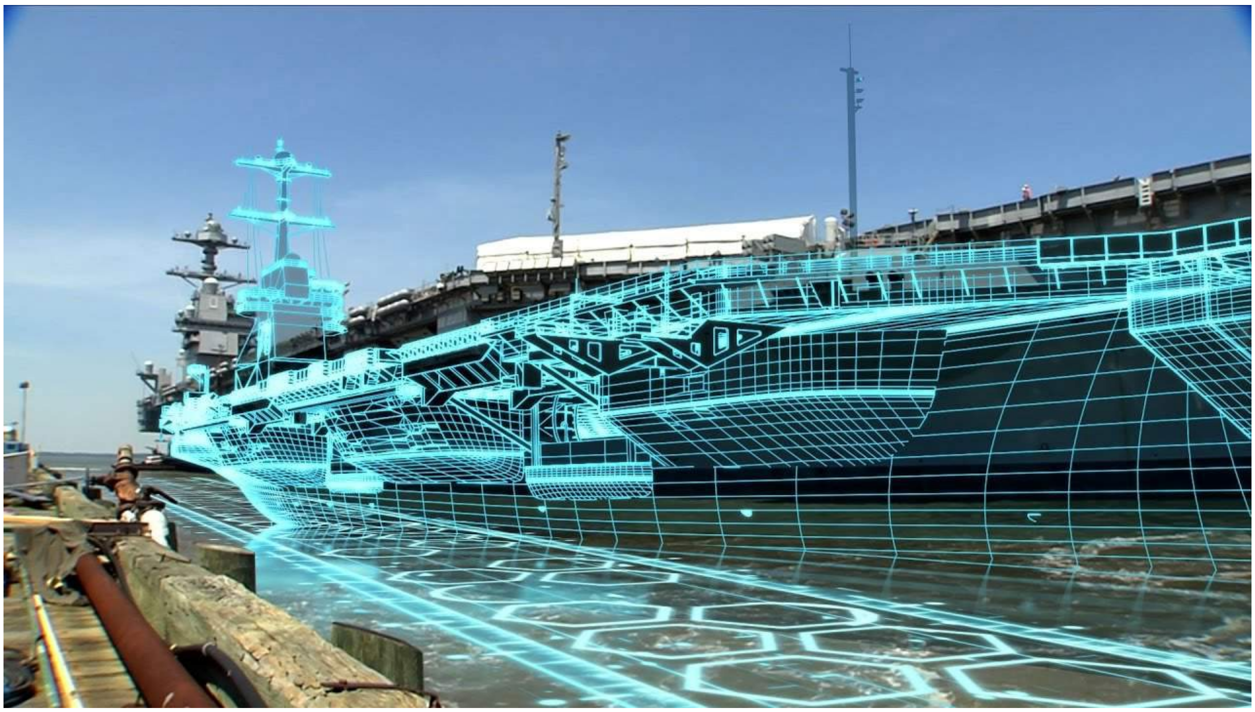


Figure 10. Huntington Ingalls Industries (HII) leverages artificial intelligence to advance defense and intelligence systems across air, cyber, space, and joint all-domain operations. Source: Huntington Ingalls Industries (2025).

The United States could not have produced such effective artifacts as it did during WWII when it articulated alliance-based production in the Lend-Lease program and in integrated supply chains for the Allied nations (Clark, 2024). Today, the geopolitical stakes are just as high. The modernization of the U.S. shipbuilding base does not have to be a one-man show, though. By building the capacity of allies—particularly in Europe, Japan, and South Korea—to perform non-sensitive production, the United States could move non-sensitive production abroad, creating greater industrial depth and allowing the United States to concentrate domestic resources on platforms requiring the highest security classification. In addition, alliances are a diplomatic tool. Constructing ships with partners builds trust, assures interoperability, and displays the unity of coalitions opposing revisionist maritime powers.

H. DELIVERABLE SCHEDULE AND PRODUCTION RATES

The U.S. Navy has experienced substantial schedule delays and cost overruns on all of its major shipbuilding programs, despite record levels of investment by Congress in that area (GAO, 2024). The Navy is currently more than $32 billion over budget and months to years behind schedule for its shipbuilding projects (GAO, 2024). The Navy's historic problems of spike in cost growth due to immature designs, lack of skills in the workforce and prime contractor and subcontractor coordination failures have all affected the Columbia class ballistic missile submarine, Ford class aircraft carrier and some of its Littoral Combat Ship (LCS) members (GAO, 2024). The average construction duration for a Virginia-class submarine, originally planned to be 60 months, has grown to 84 months, as industrial base members attribute the delay to material availability, skill shortage, and rework (GAO, 2024). In summary, U.S. shipbuilding does not have the industrial resiliency or process control to produce predictable outputs on a reliable timeline.

Contrary to traditional production methods, South Korea has adopted "smart yard" concepts that rely on parallel construction made possible through digital-twin technologies. In a shipbuilding sense, a digital twin is a virtual model of a ship or process that updates continuously using real-time data, allowing builders to track performance, identify problems early, and anticipate maintenance needs (Lee, 2024). In South Korea's shipyards, digital twins are being used to optimize production workflows, enhance worker training through VR and AR simulations, improve safety by identifying risks before they occur, and even track a vessel's condition through IoT-enabled monitoring systems. Platforms such as Beamo create 360-degree digital models of complex ship structures, enabling managers to conduct virtual inspections, attach manuals or videos directly within the model, and oversee progress with far greater accuracy and efficiency (Lee, 2024).

Japanese shipbuilding yards focus on lean production in which Kaizen, or the philosophy of continuous improvement, is deeply embedded in operations (Phogat, 2013). Kaizen emphasizes waste elimination, efficiency gains, and incremental refinements in both processes and culture, ensuring that improvements are sustained over time (Phogat, 2013). Thanks to strict quality controls and close ties with suppliers, Japanese companies manage to remain competitive even while facing high labor costs (Phogat, 2013). Their experience demonstrates that efficient output is not simply the product of capital investment but also the result of organizational discipline and cultural commitment to lean practices (Phogat, 2013). Productivity improvements in Japan are linked to principles such as one-piece flow, just-in-time material delivery, and worker engagement in problem-solving—core aspects of lean that were adapted from the Toyota Production System (Phogat, 2013). Thanks to strict quality controls and close ties with suppliers, Japanese companies manage to compete, even faced with high labor costs.

China has become the world's dominant shipbuilder by tonnage, number of new ships delivered and the rate of naval expansion. Its shipbuilding ecosystem combines civil and military work with a common infrastructure, centralized management and access to state-subsidized finance and raw materials. China's production capacity is estimated at 230 times that of the United States—a vast discrepancy that directly challenges U.S. maritime deterrence (Funaiole, 2024). What makes it possible is a wartime-industrial posture, directed by centralized planning and aided by incentives that enable Chinese yards to overproduce and soak up inefficiencies (Blanchette et al. 2020). And while this model generates questions about transparency and quality, China's scale endows it with strategic choices that the United States is unable to muster at present.

I. DUAL-USE SYNERGISTIC MILITARY AND CIVIL INDUSTRIAL BASE

Dual-use has manifested in many ways, as a reality, an intention, and expectation. There is a unique and unhealthy dichotomy between military and commercial construction in the U.S. shipbuilding industry. As argued in Chapter II's national resilience framework, states that maintain a healthy commercial–military shipbuilding loop are better positioned to absorb shocks and scale naval output. The U.S. currently lacks this dual-use depth.

Nearly every major U.S. shipyard does nothing but government work, mostly Navy surface ships, submarines and cutters for the Coast Guard. Commercial shipbuilding—which was once a driver of employment and innovation—has atrophied in the United States such that, today, the United States' share of so-called global commercial ship orders—which, by most definitions, include those vessels that stay within the countries building them—is less than one percent (Funaiole et al., 2025). This divestiture creates an economic diversity and production stability that here in America, U.S. shipyards are not allowed to have. South Korea, Japan and China all possess vibrant commercial industries that permit their shipyards to expand their infrastructure, retain workforce and amortize capital costs across military and non-military lines. In the United States, shipbuilders are handcuffed to episodic congressional appropriations that generate feast-or-famine spurts and make it difficult to plan more than a decade ahead.

South Korea's major shipbuilders, including Samsung Heavy Industries and Hyundai Heavy Industries, build both commercial and naval vessels on a common design platform, with modular construction and a common network infrastructure (Kinyua, 2024). It is the dual-use nature of this capability that gives Korea not just scale but resilience: When military orders are low, it is commercial work keeps the lights on, and when military orders surge, commercial work keeps the lights brighter.

Similar patterns hold among Japan's shipbuilders, which manufacture everything from commercial ferries to guided-missile destroyers. In these two countries, the dual-use model enables innovation to be two-way. China takes this even further. Its shipyards are deliberately dual-purposed, routinely constructing a container ship and a guided-missile destroyer in berths next to each other (Ahn, 2024). The Chinese government insists or even requires that its commercial yards maintain military readiness and support the naval mobilization plans. It enables Beijing to surge its naval production base without constructing any new infrastructure.

The U.S. risks being forced to rely on old government-owned ships or foreign-flagged vessels to transport troops and supplies in a crisis if it does not maintain a strong domestic commercial shipbuilding base. MARAD has repeatedly warned that the Ready Reserve Force (RRF) "requires recapitalization to meet the initial, massive lift of U.S.

forces" and that readiness exercises indicate ships "may not be immediately available in an emergency, largely due to maintenance needs" (MARAD, 2024, p. 4). There are some hopeful hints of change. In 2024, a joint venture was established between HD Hyundai of S. Korea, and ECO Marine of the U.S. in Philadelphia to design and build larger commercial and military projects (Ahn, 2024). This potentially can serve as a model for future dual-use facilities. It is the dual-use nature of this capability that gives Korea not just scale but resilience: When military orders are low, it is commercial work that keeps the lights on, and when military orders surge, commercial work keeps the lights burning brighter. A competitive, dual-use industrial base would possibly enhance America's strategic flexibility and achieve a range of other benefits: lower per-unit costs, greater retention of workers and enhanced flow of innovation across sectors.

J. CONCLUSION

The comparative data present a sobering reality: the United States, once the world's foremost builder of naval and commercial vessels, now lags in nearly every dimension of industrial competitiveness — from cost control and schedule performance to workforce proficiency, infrastructure capacity, technological adoption, and supply chain resilience. Yet this is not a terminal prognosis. Rather, it is a strategic imperative—to reimagine, reinvest, and rebuild.

Korea has shown the benefit of an ecosystem approach—tying together workforce training, smart yard technology, and a state-backed export strategy. China has used massive industrial scale, subsidized energy, and centralized policy to leapfrog ahead, far outstripping the number of ships in the U.S. Navy in a single year. Japan's quiet power lies in precision, quality, and lean efficiency, allowing it to take over niche shipping markets even with fewer resources. What unites all these success stories is national alignment: Shipbuilding policy is not an afterthought but a key part of economic and strategic planning. Each country understands that industrial capacity is not just about delivering ships—it's about delivering sovereignty, resilience, and deterrence. Five key areas must be addressed to restore the nation's competitive edge and reverse the decline of its talent base in U.S. shipbuilding

1. Workforce Pipeline Development: Develop national maritime technical academies, grow apprenticeships, and reset societal attitudes regarding trade skills. Training and skills must finally be given the same priority as procured funding.
2. Smart Yard Upgrade: Digitize every aspect of the shipyard guided by technologies such as additive manufacturing, cobotics, AI-driven logistics, and IoT monitoring systems. Piecemeal pilot initiatives have to be succeeded by comprehensive modernization mandates.
3. Infrastructure Investment: Complete and accelerate the SIOP, and invest in commercial yards as well. Definitions of liability, facilities, and activities can be updated to better suit the needs of the 21st century, including modernizing drydock space, utilities, transportation, and waterfront real estate.
4. Industrial Policy and Coordination: Develop a national shipbuilding plan that brings the acquisition requirements of the Navy, the commercial priorities of MARAD, investment of private capital, and the workforce requirements together in an integrated plan. Appoint a federal shipbuilding coordinator, or task force, to synchronize the players at the federal, state, and private-sector levels.
5. Innovation and Green Leadership: Invest in dual-use and Green ship-building technologies with strong commercial export potential. Utilize public-private partnerships to explore and validate zero-emission vessels as well as hybrid power and modular vessel designs that can benefit all markets.

IV. FINAL THOUGHTS

A. CONCLUSION

To regain its footing, a coordinated and forward-looking strategy must be adopted. Whereas China has engineered an all-of-government approach to industrial development—directing capital, consolidating supply chains, and setting long-term priorities—the United States continues to rely heavily on Defense Department budgets, which fluctuate with each appropriations cycle. This instability discourages private investment and perpetuates cyclical boom-and-bust patterns. The absence of a robust commercial shipbuilding sector further isolates naval yards from steady workload, innovation feedback loops, and economies of scale. By contrast, top shipbuilding nations such as South Korea and Japan integrate commercial and naval construction within the same ecosystem, achieving resilience, flexibility, and cross-pollination of technology. In the United States, this dual-use capacity is largely absent.

Despite these challenges, the path forward is clear. America must adopt a coordinated, forward-looking approach to revitalizing its maritime industrial base, one that treats shipbuilding not simply as a procurement function but as a strategic enterprise vital to sovereignty, deterrence, and economic resilience. The coming decades will determine whether the United States can remain competitive on the world's seas.

B. STRATEGIC RECOMMENDATIONS TO REVITALIZE U.S. SHIPBUILDING

To turn the decline around and begin modernizing the U.S. shipbuilding base, the following policy reforms should be pursued:

1. Establish a National Maritime Industrial Policy Board to align efforts across the Department of Defense, Department of Commerce, Department of Transportation, MARAD, and private industry. MARAD should be restructured to operate as a national shipbuilding investment bank, modeled after Korea's Export-Import Bank. Realistically, inter-agency friction and overlapping jurisdictions will complicate coordination. A

pragmatic first step would be to appoint a White House–level National Shipbuilding Coordinator empowered to unify strategic planning and mediate bureaucratic competition before the board assumes full statutory authority

2. Create a shipbuilding innovation fund, modeled after DARPA, to finance yard automation, digital-ship design, and additive-manufacturing pilot programs. Funding streams for new research agencies often stall amid competing priorities, so the initiative should be structured as a competitive, time-bound program jointly managed by DoD and DOE, with clear performance milestones and industry cost-sharing to ensure rapid impact.

3. Adopt multi-decade acquisition contracts for critical naval platforms to give shipyards the predictability needed to expand capacity, strengthen workforce pipelines, and modernize technology. Long-term contracts may face congressional hesitation due to concerns over flexibility and fiscal oversight. A phased approach—starting with a few pilot platforms such as auxiliaries or frigates—could demonstrate measurable cost savings and build legislative confidence.

4. Reform the Jones Act to stimulate domestic demand while preserving national security protections. Deep-rooted political divisions make broad reform unlikely; therefore, narrowly targeted adjustments tied to U.S.-yard workshare, tax credits, or cargo-preference expansion would balance economic and strategic interests without undermining national control of maritime logistics.

5. Develop regional shipbuilding clusters near technical colleges and workforce hubs through targeted grants and performance-based subsidies. Because local initiatives often lack sustained participation, each cluster should be anchored by a tripartite partnership among state governments,

shipyards, and community colleges, ensuring that training programs directly feed into stable employment pipelines.

6. Invest in dual-use shipbuilding platforms that can serve both military and commercial markets, stabilizing workloads and strengthening industrial resilience. Divergent procurement rules between defense and commercial sectors have long slowed such integration; establishing a shared modular hull or digital design baseline endorsed by both MARAD and the Navy would align certification standards and reduce development time.

7. Position the United States as a leader in green shipbuilding by advancing LNG, ammonia, hydrogen, and zero-emission propulsion technologies through DOE- and MARAD-supported programs. Because private firms hesitate to enter unproven fuel markets, the government should complement R&D investment with charter guarantees and port-infrastructure grants to create an initial network of "green corridors" demonstrating commercial viability.

8. Expand allied partnerships with South Korea, Japan, and other advanced maritime nations through co-production ventures, training exchanges, and alignment of digital-infrastructure standards. Security restrictions and incompatible digital systems often impede collaboration; starting with non-sensitive repair work, workforce exchanges, and data-standard alignment would build trust and pave the way for deeper industrial integration..

9. Create a Maritime Security Trust Fund to provide stable, multi-year financing insulated from annual appropriations volatility. Dedicated trust funds face budgetary skepticism, so initial capitalization could come from maritime-related user fees or cargo-preference receipts, accompanied by statutory safeguards ensuring consistent reinvestment in shipyard modernization.

10. Implement financial incentive programs to modernize U.S. shipyards and strengthen component supply chains, establishing “maritime prosperity zones” that attract allied and private capital while updating cargo-preference laws to expand the use of U.S.-built and flagged vessels. Smaller shipyards may struggle to meet matching requirements; tiered incentives and embedded technical-assistance teams would help ensure equitable participation and wider industrial impact.

11. Expand mariner training and workforce-development programs to sustain long-term industrial and national-security capacity (Trump, 2025). Overcoming cultural and economic disincentives to maritime careers will require integrating paid apprenticeships, GI Bill eligibility, and guaranteed sea-time pathways—making maritime professions both financially and socially competitive with other skilled trades.

The industrial capacity that once made the United States the Arsenal of Democracy has not disappeared; it has merely gone dormant. Revitalizing this foundation will take more than nostalgia. It will require vision, bold public-private action, and the unapologetic confidence that America can once again lead the world in shipbuilding. China, South Korea, and Japan are not waiting, and neither can the United States.

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