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**SUSTAINING GLOBAL POWER THROUGH U.S.
TRANSPORTATION INFRASTRUCTURE: SETTING THE
CONDITIONS FOR OPTIMAL MULTIMODAL LOGISTICS**



TRANSPORTATION AND LOGISTICS INDUSTRY STUDY

STEPHEN J. DUBERNAS, PH.D., DLA

DANIEL D. BROWN, CDR, USN

SEMINAR #17

**The Dwight D. Eisenhower School
for National Security and Resource Strategy
National Defense University
Fort McNair, Washington, D.C. 20319-5062**

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Author Team

Lt Col Meghann Allison, U.S. Air Force Reserve
CAPT Aaron Asimakopoulos, U.S. Navy Reserve
LTC Michael Cotovsky, U.S. Army
LTC Jason Halligan, U.S. Army Reserve
CAPT Michael Haymon, U.S. Navy
Lt Col Jon Hobart, U.S. Air Force
LTC Gregory Holmes, U.S. Army
LTC Hayk Mkrtchyan, Armenian Army
Dr. Katherine Obradovich, Department of the Army
Lt Col William Parker, U.S. Air Force
Lt Col Henry Pflugradt III, U.S. Air Force
LtCol Dana Sanford, U.S. Marine Corps Reserve
CAPT Robby Trotter, U.S. Navy
Col Jun Yamada, Japan Air Self-Defense Force

Instructors

CDR Daniel Brown, U.S. Navy
Dr. Stephen Dubernas, Defense Logistics Agency

Domestic Field Studies

Military Sealift Command (MSC), Norfolk, VA
Norfolk International Terminal (NIT), Norfolk, VA
U.S. Maritime Administration (MARAD), Washington, D.C.
Defense Logistics Agency (DLA), Fort Belvoir, VA
Amazon Distribution Center, Baltimore, MD
FedEx Memphis Hub, Memphis, TN
U.S. Army Corps of Engineers, Ensley Engineer Yard, Memphis, TN
Pine Bluff Sand and Gravel Company, Nashville, TN
Fort Campbell, KY
Seamen's Church Institute, Paducah, KY
Ingram Marine Group, Paducah, KY
Kentucky Lock and Dam, Grand Rivers, KY
CSX Railways, Jacksonville, FL
Crowley Maritime Corporation, Jacksonville, FL
Blount Island Command, Jacksonville, FL
University of North Florida, Jacksonville, FL
Jacksonville Port (JAXPORT), Jacksonville, FL

International Field Studies

Movement Coordination Centre Europe (MCCE), Eindhoven Air Base, The Netherlands
Van Der Vlist Logistics, Groot-Amers, The Netherlands
World Port Center, Rotterdam, The Netherlands
Shipping and Transport College (STC) Group, Rotterdam, The Netherlands

Acronyms

B3W	Build Back Better World
BRI	Belt and Road Initiative
CCP	Chinese Communist Party
COVID-19	Coronavirus Disease 2019
CRAF	Civil Reserve Air Fleet
DOD	Department of Defense
DOT	Department of Transportation
ERIMP	En Route Infrastructure Master Plan
FAA	Federal Aviation Administration
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
GWAS	Global Warehouse Application Solution
IIJA	Infrastructure Investment and Jobs Act
JLEnt	Joint Logistics Enterprise
LIO	Liberal International Order
LMIC	Low- and Middle-Income Countries
MARAD	Maritime Administration
MCCE	Movement Coordination Centre Europe
MSC	Military Sealift Command
NPRN	National Port Readiness Network
NSS	National Security Strategy
U.S.	United States
PRC	People's Republic of China
PSR	Precision Scheduled Railroading
SDDC	Surface Deployment and Distribution Command
STRACNET	Strategic Rail Corridor Network
TWCF	Transportation Working Capital Fund
USCG	United States Coast Guard
USTRANSCOM	United States Transportation Command
VISA	Voluntary Intermodal Sealift Agreement

Executive Summary

The United States' dependence on uncoordinated public and private investment across the transportation and logistics ecosystem (trucking, railroad, air freight, port and harbor, inland waterway, deep-sea shipping, and warehousing industry) puts the nation's ability to mobilize for major military action at risk. Despite various laws and government programs designed to protect the U.S. industry, recent wide-ranging supply chain chaos exposed systemic vulnerabilities which impinge on industrial, consumer, and national security interests. As economic activity normalizes in the wake of the Coronavirus Disease 2019 pandemic, there is no expectation that the various corporate and government entities will construct a robust, long-lasting, system-wide framework to repair these exposures.

To fulfill the 2022 United States National Security Strategy's long overdue promise to build robust supply chains, the nation must promote order within the chaotic transportation and logistics system. First, United States policy must address immediate concerns such as port and harbor and inland waterway infrastructure coordination, industry quality of life and maritime qualification constraints, technology application and regulation, warehousing and logistics strategy and planning, and national and international partnerships to guide immediate supply chain evolutionary forces, specifically in strategic coordination and the human capital domain. Second, the White House should appoint a senior, special coordinator to integrate the interagency and drive an integrated long-term transportation ecosystem development strategy to achieve national priorities. Finally, these efforts contribute to—and enhance—U.S. interoperability with partners and allies across global logistics in peace and war.

Transportation and Logistics in the Strategic Environment

The United States of America's ability to project military forces is inextricably linked to its commercial transportation industry. Transportation is the nation's means to access global networks and is essential to satisfying day-to-day economic needs and national security issues in peace and crisis. The nation's strategic competitors use powerful authoritarian governance to influence this system and the global network overtly and covertly to gain a competitive advantage. The nation's transportation and logistics ecosystem must be robust enough to thrive under this pressure.

The Department of Defense's (DOD) organic capacity to fully mobilize for major military action is limited. To realize the full power of the joint logistics enterprise, commercial transportation and logistics industry capacity must be robust. This is not the case today. The nation's patchwork attempts to address aging infrastructure and policy, labor, and technology gaps resulted in a host of issues revealed during the Coronavirus Disease 2019 (COVID-19) induced supply chain crisis. The 2021 bipartisan Infrastructure Investment and Jobs Act (IIJA) attempts to correct the system's foundational weaknesses, yet it does not address infrastructure needs from a national security perspective. The United States (U.S.) must address a variety of immediate transportation and logistics industry concerns to preserve the nation's mobilization capacity in the short term and form a comprehensive logistics strategy to ensure national resiliency that supports economic and security needs far into the future.

This paper reflects on the most immediate infrastructure, labor, technology, and policy issues in the U.S. port and harbor, deep-sea shipping, trucking, railroad, warehousing, inland waterway, and air freight industries discovered through immersion with government, corporate and academic experts, and executives both within the U.S. and the Netherlands. It also examines

the impact of the People’s Republic of China’s (PRC) Belt and Road Initiative (BRI) (see Annex A) and contrasts U.S., PRC, and Russian strengths in each sector (see Annex B). This analysis demonstrates the need to bring order to the volatile, uncertain, complex, and ambiguous environment through a Department of Transportation (DOT)-led strategic plan with an emphasis on strategic cross-sector coordination and human capital that meets comprehensive national security needs.

Industry Overview

The U.S. transportation and logistics network is known for its efficiency, innovation, and scale. An extensive infrastructure, including an expansive inland waterway system, warehouse network, highways, railroads, ports, and airports, supports commerce. These transportation components enable goods and people moving across the country and around the world. Furthermore, the size of the U.S. economy and population creates a massive demand for transportation and logistics services. This demand drives innovation and competition, enabling companies to achieve economies of scale that can lead to lower consumer prices and a relatively high standard of living.

Ports and Harbors

There is a saying in the industry “Once you’ve seen a port, you’ve seen one port.”¹ This statement reflects the federal government’s reluctance to interfere in competitive relationships between ports by instituting standardized requirements for their organization and governance. Although the U.S. Constitution places navigable waterways within federal responsibility, Article I also states, “No preference shall be given by any regulation of commerce on revenue to the ports of one State of those over another.”² This relatively hands-off approach evolved into a decentralized governance structure for U.S. ports and harbors with no single leader among the 18

federal departments and agencies governing portions of the port system, although the Committee on the Marine Transportation System is a coordinating entity across waterways broadly.³

Instead, locally autonomous port authority structures oversee inland waterway ports connecting 28 states and deepwater or coastal ports on all four contiguous borders, with more facilities in non-contiguous states and territories.⁴ The port authorities own one or more ports and may exercise operational control (i.e., owning the wharves, cargo-handling equipment, and coordinating or hiring labor for port activities), landlord control, or both.⁵ Regardless of governance, ports and harbors are operated by organized and influential labor groups, which can disrupt commerce through strikes. High concentration and competition mark the U.S. ports and harbor industry structure as they vie for cargo movement through their ports to generate revenues. The tendency will be for port authorities to invest in additional infrastructure development to meet shipping companies' increased requirements and boost their port's competitive advantage. There may be a rise in port collaboration or consolidation as port authorities work to offset shipping companies' and local labor unions' leverage.

Deep-Sea Shipping

The deep-sea shipping industry is a tertiary service industry that moves agricultural products, minerals, and manufactured goods between domestic and foreign ports.⁶ The industry may be divided into two segments. First, domestic deep-sea transportation providers serve intra-U.S. port transportation needs between the east and west coasts and the U.S. mainland and outlying states and territories. Much of this segment is sustained by the Merchant Marine Act of 1920 as amended (also known as the Jones Act). This act requires any cargo shipped between U.S. ports to be carried by U.S.-built, U.S.-flagged, and U.S.-crewed vessels. Second, some U.S. firms also engage in international deep-sea shipping between the U.S. and foreign ports. The

Cargo Preference Act of 1904 and amendments support U.S. international deep-sea cargo transporters by giving preference to U.S.-owned, registered, and staffed vessels for federal cargo.⁷ This international shipping segment is dominated by three large corporate alliances: Ocean Alliance, the Transport High Efficiency Alliance, and the 2M Alliance.⁸

Trucking

The trucking industry serves as the vital connective tissue between other strategic transportation modes: airlift, rail, and sealift. Long-haul trucking, also known as long-distance or over-the-road trucking, involves moving goods using large commercial trucks typically designed to carry heavy loads over great distances and covering hundreds or thousands of miles in a single trip.⁹ Understanding the trucking industry is incomplete without acknowledging its operators' significance. When defining truckers, the U.S. Centers for Disease Control and Prevention stated, "These men and women are essential to the transportation of goods in the U.S., but high job demands and low control (e.g., tight delivery schedules and delays) may cause stress and lead to poor health."¹⁰ A driver's life is marked by long days and demanding work. Life on the road complicates living what many consider a healthy lifestyle. Irregular schedules, little physical activity, limited access to healthy food options, and stress contribute to increased health conditions. Compared to other workers in the U.S., truck drivers have higher rates of heart disease, diabetes, hypertension, and obesity.¹¹ Despite these sobering workforce factors, trucking remains a dominant economic force in transportation.

Rail

The U.S. freight rail industry has long served as a primary domestic transportation mode, propelling economic growth and enabling national security. Freight rail connects shippers, producers, and consumers by transporting bulk commodities such as coal, lumber, fertilizer, and

intermediate and finished goods. With 140,000 miles of track, the U.S. freight rail network is the largest in the world.¹² It is environmentally friendly, responsible for only two percent of U.S. transportation-related greenhouse gas emissions.¹³ Unlike the U.S. highway system, the rail network is privately owned and operated, and freight rail carriers invest up to \$25 billion annually to update and maintain the network.¹⁴ Various government departments, agencies, and boards oversee the industry.¹⁵ Based on annual operating revenues, the Surface Transportation Board categorizes more than 620 freight rail carriers into three classes (I, II, and III).¹⁶ Class I carriers have annual operating revenues above \$943.9 million.¹⁷ There are six Class I carriers: Burlington Northern Santa Fe, Union Pacific, CSX Corporation, Norfolk Southern, Canadian National, and the recently merged Canadian Pacific – Kansas City Southern.¹⁸

Warehousing

Warehousing services include storage, handling, packing, and other activities to enable distribution within the manufacturing, wholesale, and retail sectors.¹⁹ Other warehousing industries include refrigerated storage, farm product storage, and specialized storage & warehousing. Warehousing is a keystone industry that supports the overall transportation and logistics ecosystem. A 2022 industry survey indicates warehouse utilization rates range from 85.6 percent to 95 percent at peak.²⁰ Consumer spending and e-commerce demand are expected to drive industry growth over the next five years.²¹

Inland Waterways

The U.S. Army Corps of Engineers manages the inland waterway infrastructure system with appropriations via the Corps and additional funding through the Inland Waterways Trust Fund.²² The “water highway” encompasses about 12,000 miles of navigable waterways with

infrastructure that includes locks, dams, and navigation channels.²³ Within the U.S., the inland waterway system generates an annual revenue of \$7.9 billion.

The Mississippi River and its tributaries comprise most of the inland waterway system, but 43 of the 50 states have an inland waterway presence.²⁴ The industry is protected from foreign entry by language written into the Jones Act and its ship origin and operating requirements. Three companies, Ingram Industries, American Commercial Barge, and the Kirby Corporation, account for nearly half of the industry's revenue.²⁵ The other half of the sector includes smaller entities with fewer than six employees—generally sole proprietors operating one boat.²⁶

Air Freight

Air freight is the fastest transportation mode over long distances, providing extreme convenience to buyers.²⁷ Shipping by air allows businesses and consumers to place orders on demand, significantly reducing lead times, excess inventory, and storage costs.²⁸ Air freight is also the most secure mode because airports are controlled environments and require less handling, thus reducing theft and damage risks.²⁹ Air shipments support locations inaccessible to railroads, ships, and trucks.³⁰ However, air freight's convenience comes at a significant expense: up to twenty times the cost of other modes due to jet fuel, labor, maintenance, and landing fees.³¹ Additionally, airports are susceptible to inclement weather and have a greater environmental impact than truck, rail, and water modes.³²

Airlines earn the most revenue from passenger travel; therefore, they typically carry cargo in the belly of passenger aircraft to earn additional revenue.³³ Logistics companies and some passenger airlines also fly special cargo planes, with cargo flights making up 15 percent of U.S. international flights and 7.6 percent of U.S. domestic flights.³⁴ As the most expensive mode

of transportation, air freight is best suited for high value-to-weight ratio goods, such as electronics and high-end products.³⁵ Air freight carriers can also be certified to transport explosives, flammables, and toxic or radioactive materials.³⁶ Additionally, pharmaceuticals and perishable items are prime candidates for air transportation.³⁷ There is a strong correlation between consumer demand for these products and demand for air shipment.³⁸

International and Domestic Economic Impact

The 2022 National Security Strategy (NSS) describes the importance of maintaining robust supply chains in the face of strategic competition. Competitors like the PRC and Russia use their influence in critical supply chains to coerce nations and corporations while repressing democratic values and exporting “an illiberal model of the international order.”³⁹ Ultimately, U.S. interests continue to center on protecting the security of the American people, expanding economic prosperity and opportunity, and defending democratic values.⁴⁰ Failure to address resilience within the nation’s critical supply chains harms these interests at home and abroad.

Ports and Harbors

Access to ports provides nations with a distinct economic advantage by increasing access to new goods and services for the host nation and fueling increased domestic and international competition, cumulatively offering potentially cheaper goods and a better quality of life. Ports and harbors have never been more critical to fueling supply chains, with sea trade increasing in volume from eight billion metric tons to ten billion metric tons between 2010 and 2020.⁴¹ These movements deliver food, energy, medical and commercial items via critical ports and harbors.

More than 99 percent of cargo entering the U.S. by volume does so by ship.⁴² With 30 percent of the U.S. Gross Domestic Product (GDP) coming from international trade, this is a significant path into the U.S. economy, mainly via container ships received at U.S. deepwater

ports.⁴³ Presently, 360 commercial U.S. ports, including 150 deep draft ports, generate an estimated \$3 trillion annually for the American economy.⁴⁴ Port throughput (or lack thereof) and expanding demand for imported and exported goods immediately after the 2020 COVID-19 lockdowns was the rock that started a ripple resulting in the global supply chain meltdown.

Deep-Sea Shipping

The U.S. Chief of Naval Operations recently stated, “The global economy literally floats on seawater.”⁴⁵ The international segment moves roughly 80 percent of the world’s internationally traded goods through nine hundred ports.⁴⁶ This activity engenders a host of other industries. For example, U.S. seaport operations alone account for over 30 million jobs and, as stated above, an estimated \$3 trillion in economic activity while contributing \$371 billion to the U.S. tax base.⁴⁷ Ultimately, the international segment enables nations to exploit comparative advantages in production across nations, corporations, and industries while global consumers generally benefit from higher living standards. The Jones Act sustains these jobs and is necessary to protect the fragile U.S. shipping segment and other domestic maritime industries.⁴⁸

Industry revenue and profitability correlate with cyclical demand for consumer goods. In 2021, aggregate demand for deep-sea shipping attributable to the U.S. grew 1.2 percent and generated \$117 billion, accounting for 16 percent of the industry’s \$710 billion global annual revenue.⁴⁹ Of this amount, U.S. firm revenue was only \$6.9 billion despite the U.S. possessing the largest national GDP and the second largest import and export market.⁵⁰ Asian and European firms generate a significant market share, which is expected to grow 37.6 percent through 2026.⁵¹ Although the U.S. flagged fleet is not essential to the global economy, it plays a unique role in moving U.S. government-impelled cargo overseas as required by the Cargo Preference Act of 1954. U.S.-flagged operators indicate that there would be little incentive to maintain

vessels under a U.S. registry without this cargo preference because overhead and insurance are costlier, with U.S. mariner wages nearly three times more expensive than foreign mariners.⁵²

Trucking

Trucking remains the primary method of inland transportation for most goods. With few exceptions, such as crude petroleum products and organic chemicals, most imported and exported goods will be hauled by a U.S. truck at some point in time. According to the U.S. DOT's Bureau of Transportation Statistics, trucking is the most significant contributor to the GDP of any freight mode. In the latest figures from 2019, trucking (excluding warehousing and other related services) accounted for \$368.9 billion toward the U.S. GDP.

Rail

On top of the economic stimulus generated from annually investing approximately \$25 billion in the freight rail system, the industry plays a critical role in domestic and international economies as an essential transportation mode in the global supply chain.⁵³ While the Class I rail network predominately serves the U.S. market, it also connects to Canada and Mexico. Freight rail carriers transport items that manufacturers, producers, and wholesalers depend on to drive economic activity, hauling nearly 40 percent of all long-distance ton-miles in the U.S., more than any other mode of transportation.⁵⁴ The industry directly employs nearly 178,000 people and has an annual revenue of over \$110 billion, transporting 33 percent of all U.S. exports.⁵⁵ Freight rail also plays a role in global energy production, with approximately 16 percent of the top Class I freight rail firms' annual revenue coming from transporting coal for foreign energy production.⁵⁶

Warehousing

In 2022, the U.S. warehousing industry employed 1.9 million people, and in 2021, it had a \$98.7 billion value-added contribution to the U.S. GDP (0.4 percent of the total).⁵⁷ The

industry must provide the right product in the right quantity at the right place and time both domestically and internationally. Adequate warehousing in proximity to wholesale, manufacturing, and retail sectors is the connective tissue that enables transportation modes to deliver for customers. Increases in consumer spending and e-commerce sales increased the demand for warehouse space and the tendency for businesses to contract warehousing from third-party providers.⁵⁸

Inland Waterways

U.S. inland waterways impact the economic engines of the U.S. and its trading partners due to the quantity and type of cargo transported. Five hundred million tons of commodities move along U.S. inland waterways, accounting for nearly five percent of the total commercial transportation tonnage in the country.⁵⁹ This commercial cargo often is cumbersome, heavy, and generally not time-critical and is carried in open barges or those designed to keep cargo dry.

The Waterways Council notes, “America’s economy benefits from the cost efficiencies barge transport provides over transport by truck or rail. More than 60 percent of the nation’s grain exports move by barge, helping our agricultural exports stay competitive in global markets,” and losing this system would result in over \$1 trillion lost across ten years.⁶⁰ If heavy cargo such as grain, coal, or chemicals had to be moved solely by truck or rail within the U.S., there is no chance that the products could be exported for profit as the transportation costs would be too high. A genuine connection to the U.S. GDP is a complicated equation because inland waterways mainly move intermediate goods. However, experts believe the combined freight and passenger water transportation industry accounts for \$15 billion or 0.1 percent of the nation’s GDP.⁶¹ While the system is not a prime GDP driver, it powers the production that does grow GDP. This is conceptually supported in the IBISWorld reporting when it concluded that the

inland waterway system is a minor contributor to the GDP but is a significant player in the transportation of coal, grain, and petroleum products.⁶²

Air Freight

The U.S. economy increasingly relies on air cargo to quickly deliver consumer goods and packages due to the rise of e-commerce. Air shipments keep products moving from shelves to consumers, enabling money to change hands faster. Moreover, the air cargo industry directly contributes to the economy, employing over 280,000 workers and creating over ten million U.S. jobs.⁶³ Globally, the air cargo industry earned \$210 billion in revenue and contributed \$44.9 billion toward global GDP in 2022.⁶⁴

Experts are divided in their outlook on air freight's future. MarketLine analysts believe there is growing demand for air freight in the U.S. and worldwide, with traffic projected to increase 3.5 percent annually for the next 20 years.⁶⁵ Boeing and Airbus also predict 50 to 80 percent growth in the cargo fleet over the next 20 years.⁶⁶ On the other hand, IBISWorld expects the global industry revenue and contribution to GDP to decline about 29 percent and 28 percent in 2023, respectively, before flattening for the next six years.⁶⁷ Some also believe that growing international competition constrains the U.S.'s potential for further growth.⁶⁸ These skeptics note that air cargo rates from China to North America declined by 40 percent in 2022.⁶⁹ Moreover, FedEx, the world's market leader, plans to cut twenty-three daily domestic flights and up to nine international daily flights and is temporarily parking aircraft to cut costs.⁷⁰ While air cargo may soon enter a temporary correction period as logistics stabilize post-COVID-19, online shopping's rise and increased consumer willingness to pay more for fast delivery will contribute to long-term growth in the industry.⁷¹

Support to National Security and Mobilization

Ports and Harbors

U.S. ports and harbors are the focal points for launching U.S. response to sustained overseas combatant commander operations.⁷² The DOD monitors U.S. port readiness to respond to contingencies through the National Port Readiness Network (NPRN), an interagency body that assesses 18 voluntarily participating U.S. ports' operations. Participating ports are selected for their proximity to military installations and assets and their ability to support unique military sealift requirements. NPRN focuses on these strategic ports' infrastructure and capability and readiness to provide mobilization and transportation services within 48 hours of deployment notification. They also assess intermodal connectivity to the ports, which the Maritime Administration (MARAD) compiles capability reports and delivers quarterly to inform DOD contingency planning.⁷³ NPRN participation is non-binding and does not require participants to consider military mobilization requirements or assessments in local port development plans. Further, local port governance bodies recognize that a potential conflict of interest may occur during mobilization operations, as they risk frustrating commercial shippers who may choose to shift their movements to competing ports. A final concern is that as port operators continue to adjust infrastructure and operations to support increasing commercial vessel size, shoreside infrastructure suitability for supporting unique military requirements may diminish. This tendency could shift DOD mobilization towards inferior port facilities.⁷⁴

To assess mobilization readiness, the United States Transportation Command (USTRANSCOM) administers the En Route Infrastructure Master Plan (ERIMP). This plan provides a framework to evaluate the U.S. Global Campaign Plan for Distribution, combatant commander operational plans, and domestic and international port suitability for military needs.

ERIMP program managers use these assessments to advise allied and partner nations on U.S. support requirements. Unfortunately, partner nations must concur with identified weaknesses and be willing to invest in closing gaps, typically without U.S. financial support.⁷⁵

Deep-Sea Shipping

When involved in military action overseas, the U.S. government transports nearly 90 percent of its oversized cargo by sea.⁷⁶ The DOD maintains the maritime Ready Reserve Force, Military Sealift Command (MSC), and Maritime Security Program, which provide 221 organic and government-subsidized strategic sealift vessels to meet routine and emergent needs.⁷⁷

Approximately 70 percent of the government-owned fleet (many steam-powered) will complete their service life by 2032.⁷⁸ Unsurprisingly, a recent DOD exercise, TURBO ACTIVATION 19-PLUS, suggests this fleet can meet only 64 percent of Pacific mobilization surge requirements.⁷⁹ With insufficient resources to maintain the fleet at current levels or sustain a one-for-one replacement program, the DOD will continue to rely on commercial charter augmentation to support various federal maritime transportation needs at a sum of at least \$1.2 billion annually.⁸⁰

However, U.S. deep-sea freight capacity may not be sufficient to meet surge demand. In 2022, the Director of USTRANSCOM's Joint Distribution Process Analysis Center stated that the depleted U.S. flagged merchant fleet exposes a substantial weakness in the mobility enterprise. Further decline of the fleet "reduces the nation's ability to unilaterally project and sustain the force during war."⁸¹ Without a healthy deep-sea transportation industry, the U.S.'s ability to get things from where they are to where they are needed is a risk to U.S. mobilization.⁸²

Trucking

Truck drivers transport essential military goods and materials, including food, fuel, ammunition, and equipment between military installations and other strategic domestic locations.

These items often are forwarded to different military bases worldwide. Furthermore, the trucking industry also offers third-party logistical support for military operations, such as transporting equipment to and from war zones and providing supplies and services to troops once deployed. The industry also plays a role in interagency disaster relief and recovery efforts. In a natural disaster like a hurricane or earthquake, the Federal Emergency Management Agency or other government agencies may call on truckers to transport food, water, and supplies to affected areas.⁸³

During mobilization, the trucking industry will transport a large volume of goods and materials to support the deployment and sustainment of military forces at home and abroad. The increased demand for transportation services will strain an already stretched workforce.⁸⁴ Unless the U.S. modifies its trucking framework, truckers must be ready to work longer hours and make more deliveries. Additionally, during a wartime scenario, the government will likely implement heightened security measures to protect the transportation of goods and materials. Measures could include increased inspections of trucks and cargo, further extending standard work hours, and potentially leading to delayed deliveries.⁸⁵

Rail

The military transports heavy, oversized equipment, tracked vehicles, bulk cargo, and containerized cargo via rail between military installations and ports of embarkation for training and deployments. As previously stated, freight rail is well-suited for this cargo and costs a fraction compared to trucking, typically 33 percent cheaper per net ton.⁸⁶ To ensure access and the free flow of materiel via rail lines, the Surface Deployment and Distribution Command (SDDC), a USTRANSCOM component, is the lead agent for overseeing the Strategic Rail Corridor Network (STRACNET).⁸⁷ STRACNET “consists of 33,000 miles of rail line critical for

the movement of essential military equipment to ports located around the country and another 4,700 miles of track essential to connect one facility to another.”⁸⁸ The SDDC plays a critical role in ensuring STRACNET is available for 193 U.S. military bases that require rail transportation for training and during mobilizations by consistently monitoring the health of the rail network, engaging with the freight carriers that own and maintain the track, and working with state, local, and federal rail agencies to monitor the health of this critical infrastructure.⁸⁹

Warehousing

Warehousing supports national security and mobilization from the two broad categories of (1) general sustainment and (2) contingencies during peacetime and crisis. General sustainment broadly provides for physiological needs such as sustenance, shelter, and healthcare. Contingency warehousing maintains general sustainment plus security and defense requirements as the operating environment changes. Positioning, inventory management, and distribution enable operational resilience. Historically, warehousing requirements and distribution requirements increase with mobilization to enable joint operations that span the competition continuum.⁹⁰

Inland Waterways

The inland waterway system’s usefulness in military mobilization is limited by access and geography. Fort Campbell, Kentucky, is among the few military installations with direct access to the inland waterway system. Under normal circumstances, the destination is limited to Fort Polk, Louisiana, where cargo is used for training or could be processed for forward movement via other modes.⁹¹

While the system does not have many direct linkages to moving military equipment, the inland waterway system is critical to the U.S.’s national security. Cargo carried by barges on

waterways ensures food security for major population centers and allows for the export of excess quantities. Additionally, the system ensures that the U.S. can meet its energy requirements and export commodities internationally.

Air Freight

The U.S. military uses air freight assets to deliver equipment, supplies, and personnel worldwide to support combat, training, and humanitarian operations.⁹² DOD air assets provide routine and emergency resupply operations and deliver ammunition, food, fuel, equipment, supplies, and repair parts.⁹³ Movement by air reduces the threat to ground units and allows the U.S. military to rapidly conduct operations in remote areas with extended operational reach.⁹⁴ The ability of U.S. commanders to continue to press offensive operations with limited delays to resupply is a decisive advantage over America's competitors and adversaries. The DOD's reliance on robust commercial air capabilities enables it to project power forward, strengthening U.S. negotiation power and influence and reserving funds for combat-specific airframes.

Strong multilateral agreements support logistics interoperability and extend the Joint Logistics Enterprise (JLEnt). Acquisition and Cross Servicing Arrangements and Multilateral Air Transport and Air-to-Air Refueling Exchange of Services (ATARES) Technical Arrangements (TA), leveraged through the Movement Coordination Center Europe (MCCE), allow the U.S. to augment organic capabilities while recouping dollars for USTRANSCOM's Transportation Working Capital Fund (TWCF).⁹⁵ Bilateral and Multilateral TAs allow joint logistics planners across the JLEnt to incorporate allied transportation capabilities into the operation planning process, accelerating the road to war and expanding theater distribution networks while preserving U.S. organic capabilities and bringing the full force of U.S. alliance structures to bear.⁹⁶

When time allows, the U.S. military transports most materials overseas through sealift because water is the most cost-effective transportation method.⁹⁷ However, cost matters little in a time of crisis. The U.S. must transport its military equipment and supplies through the fastest means possible to overmatch its adversaries' capabilities. In a mobilization scenario, the U.S. will maximize its use of air freight and only resort to slower transportation methods when necessary. Because the DOD's wartime air freight requirements exceed its organic capabilities, the military must rely on the Civil Reserve Air Fleet (CRAF) to fill its capabilities gap.⁹⁸

During peacetime, the CRAF supports the full spectrum of the DOD's travel requirements, including rotational deployments, exercises and training events, and even day-to-day temporary duty travel. CRAF members support requirements via voluntary commitments and peacetime contracts with USTRANSCOM and the DOT. In a contingency, whether a natural disaster, humanitarian assistance, military operations, or war, the CRAF can be activated to transport personnel, cargo, and equipment for DOD operations. The CRAF moves over 90 percent of DOD personnel and nearly 40 percent of DOD bulk cargo during armed conflict.⁹⁹

Industry Issues and Concerns

According to the U.S. DOT, the U.S. transportation system is stressed with a myriad of factors contributing to this diagnosis. The U.S. transportation infrastructure has overwhelming deferred maintenance costs that far exceed the DOT's plan or resources for getting the U.S. transportation grid healthy again.¹⁰⁰ While the IIJA invests \$1.2 trillion into the U.S. infrastructure development overall, the \$265 billion allocated for roads, rails, air, seaports, pipelines, and waterways improvements may be too little too late.¹⁰¹ The increasing demand for faster delivery services and a boom in e-commerce trade are compounding the problem.¹⁰²

The transportation industry's concerns focus on personnel and equipment shortfalls, and although individual segments are performing or even covering for gaps elsewhere (e.g., air freight), the siloed components do not coordinate across and within the ecosystem. U.S. flag carrier fleets continue to attrit despite long-standing protectionist laws like the Cargo Preference Act. The DOT reports that the deep-sea vessel fleet has been reduced by 75 percent over the last decade.¹⁰³ Transportation providers report staffing shortfalls and difficulty recruiting and retaining personnel. Post-pandemic, companies failed to retain employees laid off during the pandemic. Workers are also opting for a healthier work-life balance or fleeing adverse work environments. The transportation sector struggles to offset personnel shortages exacerbated by a systemic inability to recruit women into a historically male-dominated workforce due to perceived gender bias, incidents of workplace violence across the industry, extended time away from family, and poor living conditions.¹⁰⁴ In today's competitive labor market, where prospective employees have a choice, quality of life takes precedence over higher-paying jobs.

Ports and Harbors

Labor Conflicts

Labor issues, especially on the U.S. West Coast, which handles 40 percent of all U.S. maritime imports, required federal intervention in 2002, 2014, and 2015. Similar disputes caused the Ports of Los Angeles and Long Beach to repeatedly close portions of their wharves in 2022 and 2023 due to a lack of port workers and cargo handlers, forcing cargo to other locations and exacerbating existing congestion at ports.¹⁰⁵

In response to labor shortages and increasing workplace restrictions benefitting labor, shipping companies want to establish or expand port automation to mitigate labor shortages and reduce labor costs, while workers worry this will eliminate jobs.¹⁰⁶ Automation could boost the

volume processed, port operation hours, or both. However, labor resistance to automation is high—although skilled tradespersons are an aging workforce that is not regenerating, even at the current, albeit insufficient, levels—union leaders insist they can maintain and achieve future staffing levels.¹⁰⁷ Port authorities are not leaving recruitment to labor organizations, though. The Port of Seattle, for instance, is spending \$4.75 million from 2022 to 2028 for outreach to traditional workers as well as minorities, women, and from economically disadvantaged areas.¹⁰⁸ This is a circular environment where mitigation options are viewed as existential threats, leading to increased demands for industry concessions and protectionist labor clauses that shipping companies perceive as barriers to long-term health, all playing out as labor disputes.

Jones Act Constraints

While the Jones Act protects inland shipping and a minimal amount of commercial seagoing capacity and shipbuilding, it also constrains short-sea services (maritime transport over relatively short distances, whether along coastlines or into rivers to smaller inland ports). With the advent of containerized shipping, U.S. seaports are uninterested in offering wharf space to small vessels transiting to and from the inland waterways, which has resulted in U.S. shipbuilders creating purpose-built watercraft for Jones Act duties, predominately dredging or towing vessels and barges.¹⁰⁹ Therefore, while the Jones Act provides the bare minimum of a base from which to adjust during times of war, it offers insufficient capacity for ocean-going ships for military deployment. It also increases costs for non-contiguous states and territories.¹¹⁰ With such a boutique focus, foreign investors are not interested in U.S. shipbuilders. Given ship durability and cost, there is insufficient domestic demand, resulting in even fewer shipyards.

Decentralized Port Development Strategy

The absence of a central U.S. port development strategy has contributed to a federal investment in port infrastructure based largely on state and local government preferences and individual entities' persuasive political power and resolve. It has left some U.S. ports with unnecessary infrastructure improvements while potentially leaving other ports with capacity and efficiency concerns due to under-investment and a longer lead time for port development. This infrastructure inefficiency was evident during the supply chain crisis, which emanated from clogged U.S. ports and harbors during the COVID-19 pandemic shocks in 2021 and 2022. However, the infrastructure investment drive is fueled by the competitive environment—in other words, efforts to grow large-ship wharves and container throughput capacity—due to shipping operators' efforts to place more cargo on fewer vessels. Specifically, U.S. port authorities have planned an increased infrastructure investment of \$163 billion from 2021 to 2026, an \$8 billion boost from the previous five years. Yet despite this investment, 37 percent of freight forwarding intermodal connectors are rated as “poor,” and landside investment is anticipated to fall billions short of all infrastructure requirements.¹¹¹

Deep-Sea Shipping

Threats to Jones Act Protections for the Domestic Fleet

U.S. firms are concerned about national and international political pressure to alter Jones Act protections. For example, a Congressperson from Hawaii claims the act creates a “monopolistic stranglehold” on distant U.S. states and territories and that his constituents are forced to pay inflated prices for basic consumer goods while corporations profit.¹¹² There are similar requests for open trade from foreign partners as well as adversaries.

Shifting from a domestic oligopoly toward a slightly more competitive international marketplace may benefit the American consumer in the short run. Over the long term, however, one U.S. industry executive claimed that U.S. companies could not compete with loosely regulated foreign firms that have the legal support to operate with far lower operating costs and the benefit of economies of scale.¹¹³ Taken to a logical end, there would be insufficient demand to sustain an already ailing U.S. industry. At that point, foreign firms and governments could exert substantial influence over U.S. domestic supply chain resilience, economic viability, military mobilization, and other areas of national concern.

Labor Concerns

Experts and executives across the maritime industry indicate that the U.S. suffers from a labor shortage. Corporations cannot fully staff their vessels, while MARAD and MSC claim that a 1,800-mariner shortage threatens future national mobilization during crisis.¹¹⁴ The cause for this shortfall is multifaceted. First, those working in the industry endure prolonged periods away from home performing physically demanding work. Many vessels lack the modern amenities to which many have grown accustomed. Second, a U.S. Coast Guard (USCG)-issued qualification is required before an employee is authorized to perform in key positions. This employment condition is a significant barrier to entry. Additionally, entry-level training for unlicensed positions takes approximately 30 weeks to complete, with an additional four to six months of commitment to a labor union, while entry-level training for licensed positions takes four years or more to complete.¹¹⁵ Although MARAD, in cooperation with the USCG and the U.S. Navy, is working to streamline the mariner credentialing process, the effects are not yet realized.¹¹⁶

Trucking

Trucker Shortfalls

Direct engagements, interviews, press releases, and financial reports from trucking industry leaders unanimously cite the truck driver shortfall as a primary concern. Leaders of the Truckload Carriers Association, the American Trucking Associations, and the Owner-Operator Independent Drivers Association emphasized that labor must be a focus for the industry and regulators in 2023.¹¹⁷ Unfortunately, there is little room for optimism that industry leaders will change the personnel landscape without transforming their truckers' lifestyles and working conditions. Driver retention has been a concern since the 1980s when government deregulation negatively affected drivers' working conditions. Deregulation arguably led to declining wages for nonunion truckers, increased work hours, and decreased driver safety.¹¹⁸ Drivers are paid about 40 percent less than in the late 1970s but are twice as productive as they were then.¹¹⁹

Rail

Debate Over Precision Scheduling Railroading

Five of the six Class I freight rail firms employ Precision Scheduled Railroading (PSR).¹²⁰ While there is no universal PSR definition, a 2022 Government Accountability Office report defines it as an operation that is about "relentlessly identifying and eliminating every unnecessary step, every unproductive asset, every extra mile, and every extra car handling that does not contribute to the quality and consistency of [the] transportation product."¹²¹ Since industry-wide PSR adoption, Class I freight rail carriers have been highly successful from a financial perspective. However, PSR has also resulted in several unintended consequences, such as poor customer service, safety issues, labor tension, and a lack of capacity and resiliency in the system, directly affecting economic and national security.¹²²

The most visible unintended consequence of PSR's impact on the economy was during the supply chain crisis resulting from the COVID-19 pandemic. After a decade of cost-cutting and efficiency initiatives to improve financial performance while adhering to PSR principles, Class I freight rail carriers were ill-equipped to handle a shock to the system. Class I freight rail firms reduced capacity and resiliency in the system by closing important intermodal facilities, reducing labor, and cutting service. During the supply chain crisis, this caused bottlenecks between critical nodes in the supply chain, and wait times tripled for freight rail containers at ports.¹²³ Most importantly, when Class I freight rail carriers could not meet surges in demand during the supply chain crisis, shippers pivoted to a higher-cost substitute in trucking. This mode change added significant costs to consumer products and drove up inflation.¹²⁴ While this shows the negative consequences that PSR can generate for economic security, a close examination of the potential impacts of PSR on national security raises cause for concern.

The military moves a large amount of equipment via rail annually, but it pales in comparison to freight rail carriers' overall volume. For instance, a 2017 RAND Corporation study on U.S. Army rail operations found that it "shipped a total of approximately 20,000 loaded rail cars at the cost of \$120 million in fiscal year 2015, compared to nearly 30 million rail cars carried and \$70 billion in revenue for U.S. Class I railroads."¹²⁵ Thus, it is reasonable to assume that isolated military installations could be targets for demarketing caused by PSR because of the limited and sporadic volume they generate relative to other customers. The gravity of this situation can be seen when put in the context of short-notice or no-notice mobilizations, which would require a massive surge of freight rail capacity for the movement of military equipment.

Warehousing

Balancing Warehouse Inventories in a Constrained Economic Environment

The warehousing industry continues to drive toward automation to improve efficiency since labor costs range from 39.7 to 66.8 percent of U.S. warehousing sector revenue.¹²⁶ As a result, warehouse utilization rates retain little margin to take on buffer inventories for an inefficient, costly “just-in-case” strategy.¹²⁷ Today, transportation industry managers indicate shipments are down because companies are working off excess inventories from 2021 and 2022, demonstrating the cyclic fluctuations in the market.¹²⁸ The probability of contested global logistics increases as supply chains are constrained by strategic competition. There is a growing need to diversify supply chains in addition to vigilant planning, anticipation, and inventory management to determine warehouse expansion strategies when requirements are increased.

Inland Waterways

Lack of Infrastructure Advocacy

The inland waterway industry needs help solving the infrastructure issues within the system. The waterways are much different from the tracks and roads used by railroading and trucking companies. That difference is who pays the bills for the infrastructure repair or upgrade as well as the visibility of the system to the population. It is relatively easy for railroad companies to deal with infrastructure issues as they own their rails. Financing necessary repairs or upgrades will cost the railroad company itself, but it can repair the problems on its own schedule. The roads receive funding via various state and federal options, but issues are readily visible to the public. Truckers do not use a special road; they drive the same roads as the general population. Hence, when there is an infrastructure issue, the public sees it and shares in pushing for the repair or replacement. There are plenty of under and unfunded roadway and bridge

projects, but there is constant advocacy for the repairs. The inland waterway system lacks a central advocacy agent with the authority to affect change.

Complicated Funding and Prioritization

There are various complications to the funding and priorities of improving the infrastructure of the waterway system. Fifty percent of the inland waterway construction cost is funded by the U.S. Army Corps of Engineers, which is tasked to maintain the system.¹²⁹ In addition to these appropriations, the system also has a trust fund, known as the Inland Waterways Trust Fund, which is mandated to cover the other 50 percent of waterway construction costs.¹³⁰ The authorized projects often cross multiple fiscal years, resulting in insufficient appropriated funds as the U.S. continues to endure inflationary pressure on construction costs.

Air Freight

Incompatible Air Cargo Systems

The U.S. Air Force and the commercial airline industry use incompatible systems to containerize and load cargo. Most critically, pallets, loaders, and rolling and locking systems.¹³¹ To receive commercial cargo from commercial aircraft, the cargo must be off-loaded, broken down, and repalletized for onward movement on a U.S. military aircraft. This inefficiency leads to longer commercial aircraft dwells at military airfields or intermediate staging bases and carriers must convert their aircraft to accommodate military cargo. For example, converting a Boeing 767-200 takes one leading CRAF carrier up to 100 staff hours, and it would take three weeks to convert their entire 767 fleet.¹³²

The differences between cargo handling systems also increases risk to aircrew and expensive aircraft. In 2013, a CRAF member's 747-400 crashed at Bagram Airfield, Afghanistan, because of shifting cargo, killing seven crew members.¹³³ The Federal Aviation

Administration's (FAA) subsequent investigations found incompatibilities and vulnerabilities with the commercial platforms' locking and restraining systems.¹³⁴

FAA Drone Regulations

Air freight industry leaders have invested heavily in aerial delivery through drones, however, they believe the FAA takes too long to approve their permits and is too cautious.¹³⁵ By the time the FAA approves a drone design, the commercial industry has already developed a new technology that requires a renewed permitting process.¹³⁶ Plus, the FAA requires a human physically observe a drone throughout its flight, which increases expenses and defeats the purpose of delivering packages autonomously.¹³⁷ The result is that some industry leaders are developing their drone technology in other countries with more favorable regulations.¹³⁸

Military Installation Access Difficulties

Industry leaders consistently highlighted how installation access challenges negatively impacted their ability to provide efficient air freight and trucking delivery service to the DOD.¹³⁹ Access requirements vary among installations, causing challenges with industry compliance.¹⁴⁰ Furthermore, industry representatives complained that when new installation commanders take command, they frequently suspend and revamp their access requirements.¹⁴¹ Sometimes, commercial pilots and drivers are uncomfortable providing the amount of personal information military installations request before delivering their cargo.¹⁴² Moreover, installations may restrict access for crews or drivers with a criminal background, even though they are cleared to transport sensitive cargo.¹⁴³ These friction points cause delays and limit supply and equipment throughput.

Policy Recommendations

A comprehensive transportation and logistics strategy is required to drive interagency coordination and ensure that U.S. commercial transportation and logistics assets are developed and postured to meet U.S. national security needs. Multiple executive departments share responsibility for critical aspects of the transportation and logistics industry. Each cabinet department has its nested strategy document that supports the goals of the NSS. For the DOT, a key actor, the only mention of defense is a reference to cyber security, and there are zero references to national security or mobilization.¹⁴⁴ Are U.S. government agencies all rowing in the right direction? Is the U.S. maximizing its mobilization capacity? The PRC, through its Military-Civil Fusion policy and BRI, indicates a deliberate integration of its transportation and logistics apparatus to support national security interests. The following policy recommendations identify opportunities to promote U.S. industry and address national security concerns.

1. Create a Special Coordinator and Committee for Transportation, Logistics, and Mobilization.

The U.S. supply chain network is a dual-use industry that simultaneously supports U.S. commerce and a globally postured defense force. As such, the industry requires close coordination to support U.S. security and economic goals. Pandemic-induced supply chain disruptions prompted the Biden Administration to appoint a Ports and Supply Chain Envoy to oversee domestic supply-chain operations. The appointment paid dividends in terms of alleviating congestion by improving efficiency. The President should appoint an official to integrate the commercial and defense logistics networks to support the NSS. This individual must be a public figure, apolitical, have bipartisan support, and have the respect of the interagency community. Without this key coordinator, a comprehensive strategy will only be an idea or document and will not meet its stated goals.

This Special Coordinator should establish and lead a centralized transportation and logistics coordination committee, linking many of the federal agencies involved in transportation, logistics, economic development, and national mobilization to establish a well-defined U.S. National Transportation, Maritime, and Logistics strategy supporting peacetime and mobilization requirements. It is recommended that, at minimum, the Departments of Transportation, Defense, Commerce, Environmental Protection Agency, and Homeland Security, along with members of relevant industry associations, local government representatives from state and municipal port and logistics hubs, and leading transportation and logistics industry representatives participate to ensure a unity of effort from across the private sector with local, state, and federal government. This agency's strategy must include broad goals and objectives to guide, coordinate and synchronize U.S. federal, local, state government, and private sector transportation and logistics development, investment, policies, and utilization to support national economic and national defense needs. A better coordinated, coherent, and clearly planned federal government logistics strategy and associated policies, guided and monitored at a central level, will significantly improve the development of all modes of transportation and logistics to support U.S. economic growth and national security needs and avoid the inefficient and ineffective current state of fragmented bureaucratic actions. This Special Coordinator should consider the following policy recommendations for quick action as part of the developed strategy to resolve acute issues within the U.S. Transportation and Logistics ecosystem.

Ports and Harbors

2. Identify U.S. ports and harbors needing priority future investment and provide federal investment in Artificial Intelligence originating at ports that links ecosystem to integrate operations across sectors.

Conduct a comprehensive study of all U.S. commercial ports based on a framework centered on the current and future capacities of port activities with a particular focus on intermodality connectivity and dock-side storage and processing capabilities. The U.S. National Transportation, Maritime, and Logistics strategy would inform and guide such a framework. The final report must identify and prioritize ports for future development and investment. Prioritizing the funding and development of modern artificial intelligence-driven information technology, which is linked and integrated across all U.S. ports and harbors with input and access throughout the critical players of the supply chain, will enable consistent and reliable freight deliveries and smooth shocks to the supply system. Given the cost and complexity of this effort, it will require government intervention to realize its full adoption. The U.S. potentially has an advantage in artificial intelligence technology innovation and development, which the nation should exploit.

Deep-Sea Shipping

3. Improve credentialing processes for military and veteran mariners and seafarers.

MARAD and the USCG should work diligently to implement Executive Order 13860 Supporting the Transition of Active Duty Servicemembers and Military Veterans into the Merchant Marine.¹⁴⁵ Service members whose service record documents time at sea should be issued an entry-level merchant mariner credential alongside their DD Form 214, Certificate of Release or Discharge from Active Duty. Moreover, sailors should be offered sealift training at one of the two MSC Training Centers before transitioning and offered guaranteed employment with MSC upon successful completion of coursework. The Maritime Center of Excellence should review domestic and international merchant mariner credentialing requirements and recommend modifications to U.S. military seafaring services' training programs. These changes will allow individuals to obtain entry-level third mate or third assistant engineer credentials

during a four-year college education and first sea tour requirements. For example, most U.S. Navy-qualified Officers of the Deck could meet the minimum time, training, and experience requirements to navigate a merchant vessel.

4. Develop Jones Act exemptions for certain foreign workers and a path to citizenship.

The U.S. Congress should amend the Merchant Marine Act of 1920 and the Immigration and Nationality Act and charge MARAD with administering a program to increase the pool of eligible maritime workers. This program would allow U.S. firms to request a limited number of H1-B visas for highly qualified foreign workers from certain friendly or allied nations. Workers would fill positions unfilled by U.S. citizens after 45 days of open advertisement and attempts to hire. The program would exempt employers from the 75 percent U.S. citizen crew requirement on a position-by-position basis and, for those who desire, authorize “fast track” U.S. citizenship to foreign workers after they complete five years of qualifying service. The Department of State would be required to secure agreements from the selected partner and allied nations. This program would attract highly qualified maritime workers and allow the industry to fill critical positions promptly. The benefit of a path to naturalization also allows firms to count foreign workers against U.S. crewing requirements after five years of service.

5. Revise U.S. Cargo Preference policies to allow the use of foreign-flag carriers to support U.S. government distribution requirements.

U.S. policy should revise cabotage laws to support allied interoperability, allowing for reciprocal use of vetted foreign-flag carriers through established government agencies. For example, U.S. traffic managers could leverage a foreign-flag vessel delivering or receiving goods as part of a security cooperation or Foreign Military Sales mission, utilizing the pre- or repositioning leg to support inter-theater cargo movement requirements, maximizing cargo

utilization, and practicing partner interoperability and predictive logistics planning. Participants in a multilateral cabotage relationship could begin with NATO allies (with whom the U.S. has significant basing and mission-partnering relationships) and expand to non-NATO nations, such as Japan and South Korea.

Trucking

6. Promote the development of routes near drivers' homes to improve truckers' quality of life.

The most revolutionary option to improve the quality of life for long-haul truck drivers is to make long-haul truck driving an exception in the over-the-road freight industry. Research by the Georgia Institute of Technology's Physical Internet Center suggests that hyperconnected transportation will enable 80 percent of drivers to sleep at home with near-zero sleeper routes. Furthermore, leveraging the physical internet allows for faster cargo delivery, a 50 percent reduction in operational costs, and a decrease in carbon dioxide emissions by 60 percent.¹⁴⁶

Adopting physical internet concepts will shield drivers from long, sedentary days with limited access to healthy food and opportunities for physical fitness will improve their lifestyles. Other options to advance truck driver health are improving food selections at truck stops, dedicated or trucker-friendly fitness centers along interstate highways, and employee wellness incentives. Trucking companies or businesses supporting road transportation should seek underutilized Department of Health and Human Services grants to adopt these wellness initiatives.¹⁴⁷ Likewise, the Department of Labor offers many workforce-focused grants to assist with implementing the IIJA.¹⁴⁸ Without improvements to the current system, the industry will continue to suffer from retention issues.

Rail

7. Change the SDDC's STRACNET review process to every two years.

SDDC should change the STRACNET review process to every two years. This change would provide a more realistic assessment of freight rail service levels within the STRACNET on a time horizon more consistent with the velocity of industry change. Second, the U.S. Code of Federal Regulations, Title 49, details rail abandonment procedures but does not address service level changes.¹⁴⁹ Therefore, SDDC should work with Congress, the DOT (including the Federal Railroad Administration), and the freight rail industry to identify minimum required service levels within the STRACNET. Title 49 and the STRACNET should codify service-level reviews. Furthermore, Defense Connector Lines and freight rail carriers should be required to notify SDDC when services are expected to fall below prescribed levels. Doing so would provide SDDC with a fair warning to assess mobilization implications and offer time and space to negotiate with the freight rail industry to ameliorate the impacts to national mobilization.

Warehousing

8. Promote the case for supply chain diversification and redundancy.

The U.S. must develop a strategic communication plan to urgently promote supply chain diversification and resiliency, including incentives for either friend or re-shoring industry segments to reduce dependencies. Incentives include tax relief, grants, partnerships, and audit exemptions (not all solutions meet efficiency guidelines).

9. Increase access through partnerships with innovation.

Long-term contracts or access agreements for warehouse utilization must be leveraged to provide an expanded network of vertically integrated options in crisis. The DOD should partner with academia and industry to develop a Global Warehouse Application Solution (GWAS) that serves as a planning tool for real property options (from vacant facilities to parking lots and everything in between) that could be utilized as warehousing and distribution solutions

domestically and internationally. GWAS would be utilized with a warehousing CRAF or VISA-like program for select providers with either long-term contracts, access agreements, or both.

10. Validate warehousing planning assumptions.

Increase the frequency and scope of combined DOD and industry logistics exercises under the European and Pacific Deterrence Initiatives and other geographic and functional combatant commands. The post-COVID-19 era presents an opportunity to expand the Global Health Engagement Program to reinforce logistics, stockpiles, and access. Contracts and access agreements must support operations across more expansive geographic areas to support distributed operations in the Joint Warfighting Concept.¹⁵⁰ The DOD, with its allies, partners, and commercial industry, must continuously plan, exercise, and rehearse detailed transportation and logistics plans that are validated before a crisis. Expand alliances and partnerships to increase access to commercial warehousing (domestically and internationally).

Inland Waterways

11. Stabilize funding for the inland waterways system.

There must be stable and continued funding for the inland waterways. The inland waterways desperately need greater funding prioritization to ensure planned projects are completed on schedule. Although the waterways have a trust fund, it is self-funded through fuel tax and directed to provide 50 percent of necessary funding. Congress needs to take bold action, reduce the necessity of the trust fund to less than 30 percent, and fully fund, through completion, the projects that the U.S. Army Corps of Engineers have identified. Changing the process will be complicated as money moves across fiscal years, but these projects take time between construction and permitting. If another legislative action is required to fund the dam and locks

needs to completion, then Congress must also take action to amend contracting requirements to ensure that projects receive the necessary funding.

Air Freight

12. USTRANSCOM should adopt civilian aircraft loading standards.

To speed the air freight process and increase interoperability with most cargo aircraft, USTRANSCOM should adopt the palletization and tiedown standards used in commercial aircraft to the maximum extent possible. When asked about the possibility of the DOD adopting the widely accepted commercial cargo standards, a senior military official said they are not interested in changing how the DOD traditionally palletizes and moves equipment, but they have someone looking into it.¹⁵¹ It is certainly possible that current military equipment requires unique tiedown methods because they are larger and heavier than more common air cargo. However, DOD contractors may be able to adapt military equipment to use commercial tiedown standards. Plus, the DOD could require that future equipment be transportable with commercial aircraft without additional or extensive conversion. In a crisis, the DOD cannot wait for slow commercial aircraft conversions.

Another benefit of adopting the more widely used commercial palletization and air cargo standards is that it would enable servicemembers to more easily transition to the civilian logistics industry upon completion of their military commitment. Servicemembers may be more marketable and experience less stress during separation, and the military could capitalize on recruit experience.

13. The FAA should ease drone regulations to promote drone development.

Land and air-based drones could ease the transportation industry's human capital constraints. However, FAA regulations are hindering progress. U.S. officials should be alarmed

that U.S. air cargo companies are moving their drone development and testing programs overseas.¹⁵² The U.S. risks other countries benefiting from innovative technology that would otherwise be developed in the U.S. The FAA should adopt more reasonable drone regulations that allow testing and commercialization of aerial delivery beyond line-of-sight operations. Furthermore, the FAA should study individual state efforts to regulate drone activity to ensure states are not further hindering drone innovation.

Regulators may argue that U.S. logistics is already highly efficient, and that the safety risk is not worth the current benefits of drone delivery. However, other countries are also developing drones.¹⁵³ The U.S. cannot cede its technological advantages to its competitors and must ease the development of drone delivery.

14. Streamline installation security screening procedures.

To facilitate prompt cargo delivery and improved cooperation with industry and CRAF partners, DOD should ease installation security screening for trusted parties. Critics argue that individual installations may have unique security situations that justify differing access standards (e.g., located where there is significant drug trafficking or higher security mission sets are present) requiring stringent background checks. However, the DOD can take simple steps such as developing a centralized database of cleared commercial pilots, crews, and drivers and educating installation leadership on the importance of quick screening procedures for trusted commercial partners. This approach would allow commanders to continue making installation-specific decisions while streamlining the clearance process.

15. Extend Air-to-Air Refueling and Exchange of Services (ATARES) Technical Arrangement (TA) and appoint USTRANSCOM as Executive Agent.

USTRANSCOM should serve as the Executive Agent for the multinational ATARES TA that supports U.S. participation in the MCCE. Additionally, the ATARES TA needs to be revised to support all U.S. combatant commands, encompassing the entire Defense Transportation System (DTS). This would allow planners across the JLEnt to incorporate allied transportation capacities into the operational planning process, accelerating the road to war and expanding theater distribution networks. Additionally, the Defense Transportation Regulation must publish partner-use business rules and revise existing payment mechanisms to support partner integration into the DTS. U.S. logistics planners could then routinely ease the burden on U.S. organic fleets while reaping financial benefits for USTRANSCOM's TWCF as joint and coalition forces purchase special assignment airlift missions and pay for ridership on U.S. channel missions where excess capacity exists.

Conclusion

The U.S. has an effective logistics network that is economically beneficial and supports military operations—under the near-perfect conditions that the U.S. has benefitted from over the past 50 years. However, all signs indicate that this freedom of maneuver is being degraded by high costs, protectionist domestic policies, and increasingly tight commercial operating margins. The U.S. relies on its transportation network for national security power projection. The prospect of contested logistics should drive U.S. actions to deliberately modernize the transportation ecosystem for the DOD to maintain an asymmetric advantage. The U.S. military and its commercial partners have always met challenges with innovation and determination to deliver success. Time after time, when the nation called, they delivered. With a coordinated strategic transportation policy and innovative policies to address labor needs, there is no reason to doubt that the logistics enterprise will do the same in the future.

Annex A: Countering the PRC's Belt and Road Initiative (BRI)

The Belt and Road Initiative (BRI) has significant short and long-term impacts on the United States (U.S.), its partners, and its allies. In the short term, an unchecked BRI has the potential to capture low- and middle-income countries (LMIC) around the world in debt traps which the PRC can leverage for its benefit. In the long term, the BRI represents a threat to the foundational underpinnings of the Liberal International Order (LIO), which has enabled global stability since the end of World War II. Countering the BRI and mitigating its harmful impacts on the U.S. and its allies and partners can take many forms and requires a whole of government approach. Most importantly, the U.S. response must avoid the BRI's strengths and expose its vulnerabilities. The U.S. transportation and logistics industry can play a critical role in this effort by creatively leveraging its comparative advantage in infrastructure advisory services and paving the way for the role of digital trade standards.

BRI: An Overview

Xi Jinping, the leader of the Chinese Communist Party (CCP), formally introduced the BRI in 2013 during a series of speeches. Xi described the BRI as infrastructure, energy, and communications projects that would fully integrate China with Eurasia as a “community of shared destiny.”¹⁵⁴ While Xi has described BRI participation as mutually advantageous, he also has grander ambitions. Nadege Rolland, a thought leader on Chinese strategy, describes the true purpose of the BRI as a way to return to the “glorious times when Chinese civilization was flourishing, and the Chinese empire was dominant and stood at the center of the known world—as *Zhongguo* (literally ‘middle kingdom’).”¹⁵⁵ Rolland’s research shows that the BRI’s true purpose, while cloaked in altruistic language, is to center the world on China and supplant the LIO.

Short and Long-Term Impacts

The BRI has grown tremendously over the past decade. AidData, a research lab at the College of William and Mary, found that there are now 147 countries participating and hundreds of billions of dollars committed to nearly a thousand projects worldwide.¹⁵⁶ The rapid growth of BRI participant countries is partially due to its alternative approach compared with traditional LIO institutions. Xi has made it clear that, for BRI participants, China will “respect the development paths and domestic and foreign policies chosen independently by the people of every country.”¹⁵⁷ AidData found that Chinese state-owned enterprise financial institutions have funded 81 percent of BRI projects with semi-concessional and non-concessional loans.¹⁵⁸ This means that the BRI

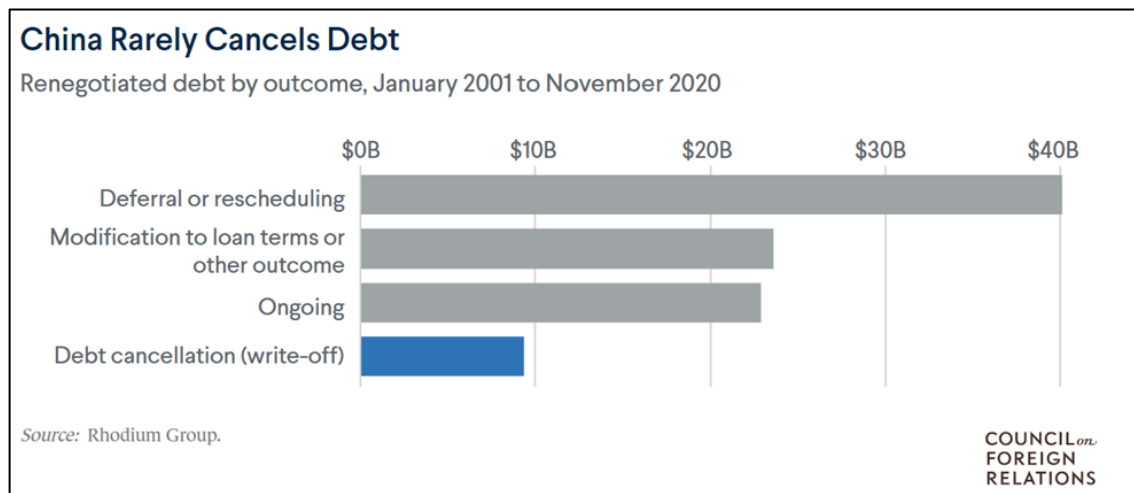


Figure 1: PRC Debt Practices with BRI

is enticing, especially for LMICs, because there are no human rights litmus tests, and financing is relatively easy to acquire. China turns a blind eye to a country’s internal affairs in the spirit of growing global influence. However, BRI project financing has been described as debt-trap diplomacy. In the short and long term, this can have significant geopolitical consequences. Sri Lanka provides a cautionary tale in this regard.

Sri Lanka was an early BRI participant in building a new shipping port in the coastal city of Hambantota. Though feasibility studies showed that the port would not be profitable, the Sri

Lankan government, struggling to maintain its grip on power, pushed the project through.¹⁵⁹ The port quickly became a commercial failure, and the Sri Lankan government had limited options to repay the unfavorable BRI financing deal with the PRC and entered into a 99-year lease agreement for a Chinese state-owned enterprise to operate the port. This example shows BRI's impact on partners and allies in both the short and long term.

In the short term, the PRC expands its global influence by supporting development, especially for LMICs. BRI projects represent large, visible, and potentially economically beneficial development projects for participating countries. With low barriers to access capital, a country does not have to improve its human rights record. Therefore, this model undermines LIO principles and makes the PRC seem like a better partner than the U.S. and its allies. In the long term, the consequences could be much more significant. The *Wall Street Journal* recently reported that “nearly 60 percent of China’s overseas loans are now held by countries considered to be in financial crisis.”¹⁶⁰ This shows that Sri Lanka is not an isolated case. As BRI participant countries default on loans held by PRC state-owned enterprises, China can leverage the debt for geopolitical gain and extend its influence and freedom of movement to strategic points around the world.

Options for Countering the BRI

If the BRI's end state is to center the world on China by building a network of advantageous infrastructure projects, as Rolland contends, then the American response should be to expose the weaknesses and vulnerabilities of this strategy. The Biden Administration is currently leveraging a latticework of diplomatic, information, military, and economic tools to counter the rise of the BRI. The most prominent among these is Build Back Better World (B3W). While B3W's intent is well-meaning, it positions the U.S. to go head-to-head with the BRI

instead of confronting its critical vulnerabilities. For example, despite the drawbacks of the BRI's approach to debt financing, two factors indicate that it will not wilt away anytime soon. First, total LMIC infrastructure needs are estimated to be nearly \$40 trillion.¹⁶¹ B3W, and its partner nations in the G7, has only committed to an initial \$60 billion.¹⁶² Second, research has shown that many countries prefer the BRI's one-stop shop for infrastructure development projects instead of the burdensome and time-consuming lending standards required by Western institutions.¹⁶³ Last, the Biden Administration's strategy pays little attention to the comparative advantages offered by the U.S. transportation and logistics industry and American technology prowess.

Though countries may still be lined up to participate in the BRI, the model is flawed and creates bad relationships between the PRC and participant countries. The U.S. can exploit this vulnerability in two ways. First, allow B3W to continue in its current form since it serves as an alternative to the BRI, represents sound development practices, and funds projects with a higher chance of success. Second, the U.S. should leverage its comparative advantage in infrastructure advisory services and lead the evolution of digital trade standards to demonstrate the enduring value of the LIO.

Developing countries typically do not have the technical expertise needed to assess the feasibility of infrastructure projects.¹⁶⁴ The BRI compounds this challenge by enticing the most vulnerable countries with appealing loans while failing to identify the significant risks entailed.¹⁶⁵ If the problem with investment in BRI countries is not a lack of capital, but a lack of bankable deals, then technical advisors are needed to conduct due diligence, identify feasible projects, and mitigate governance, environmental, or social issues.¹⁶⁶ The U.S. could play to its strengths by creating a program to provide technical advisors to interested countries. Such

advisors must come from across the transportation and logistics industry with specialized finance, law, engineering, and construction skills to provide the comprehensive advice required for major infrastructure projects. This approach could be beneficial because not only does it leverage a U.S. comparative advantage in transportation and logistics, but it also reinforces a current business trend. Many U.S. companies are reducing risk in their supply chains by moving production and manufacturing away from China.¹⁶⁷ However, the PRC's dominance in areas such as deep-sea shipping ports makes this a difficult endeavor and will require U.S. government intervention.

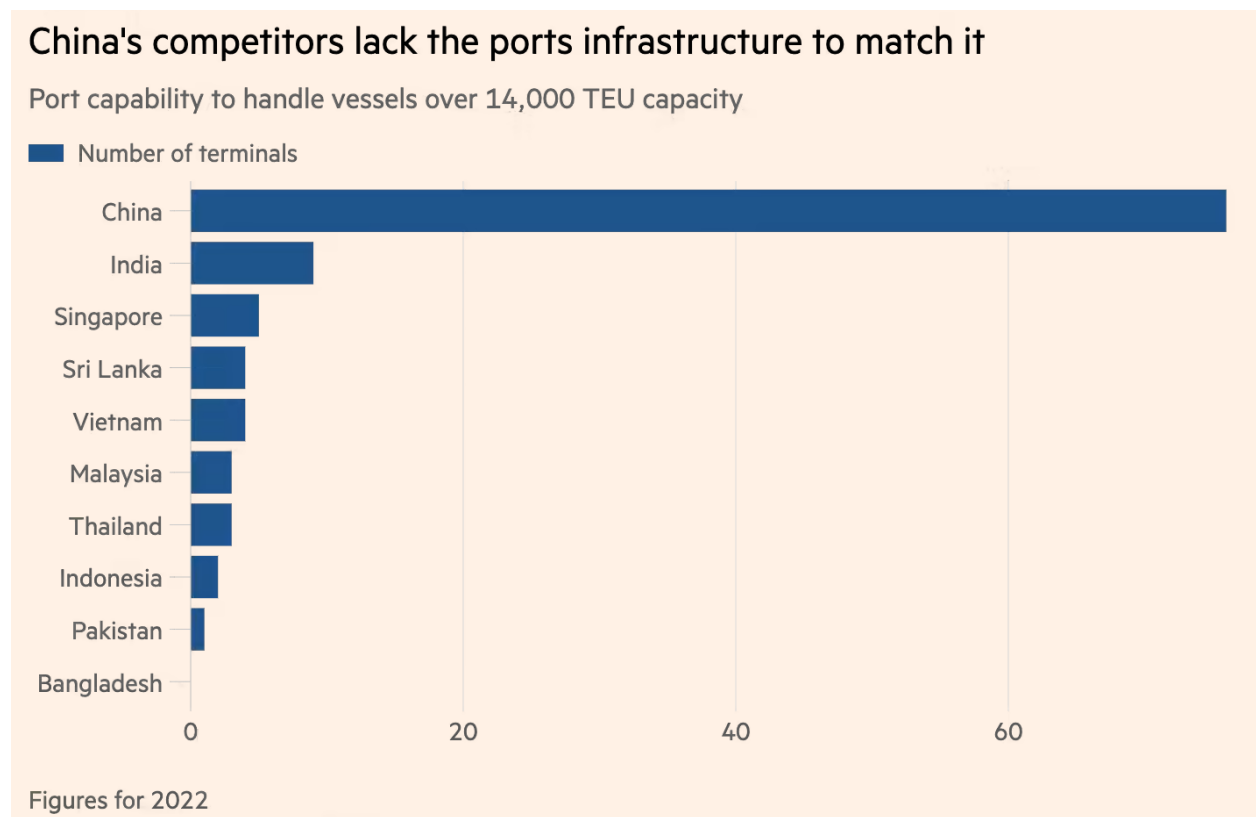


Figure 2: PRC Dominance in Port Infrastructure

Therefore, by leveraging American transportation and logistics industry experts as advisers to potential BRI participants, the U.S. government can support the resiliency of domestic supply

chains, build trustworthy relationships with friends and allies, and, over time, blunt the impact of the BRI.

Additionally, the U.S. should leverage its global leadership position in technology by creating international digital trade standards. Doing so would guide the use of rapidly emerging technologies such as artificial intelligence and standardized data transfers, financial technology, digital payments, and public use of government data. In the long term, this would set the conditions for greater trade in the new digital economy between the U.S. and other countries, further limiting the impact of the BRI.

Countering the BRI: A Solvable Problem

Countering the BRI and its impact on allies and partners is a complex problem. The BRI has several strengths that make it an attractive option in terms of funding and low barriers to entry. However, the consequences of leaving the BRI unchecked could threaten the LIO. While the U.S. approach to countering the BRI through initiatives such as B3W is well-intentioned, they are attempting to match the BRI head-on instead of exploiting critical vulnerabilities. Therefore, the U.S. should continue to support B3W as an example of appropriate development, but it should reinforce this effort by leveraging its comparative advantages in infrastructure advisory services and leading the evolution of digital trade standards. Doing so will increase the likelihood that the LIO remains the guiding principle for organizing a world characterized by volatility, uncertainty, complexity, and ambiguity.

Annex B: Strategic Competition Line of Effort Analysis

This annex compares the situation of each transportation sector in China and Russia with that of the U.S. to identify comparative advantages. To this end, an LOE analysis was conducted for each sector using factors identified through Porter’s Five Forces Approach.¹⁶⁸ This section considers how the transportation and logistics industry can improve its contributions to the security of the U.S. and mitigate weaknesses through optimal policy recommendations.

Ports and Harbors

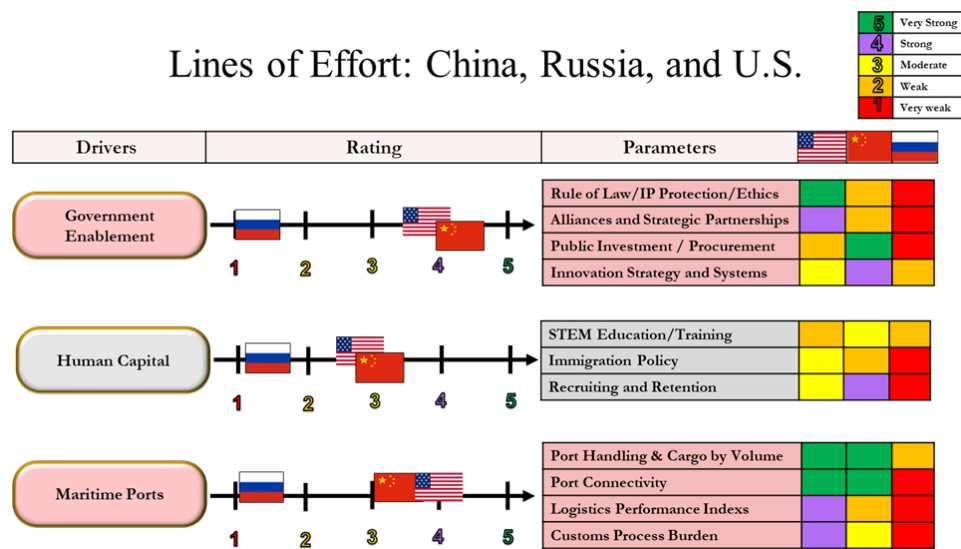


Figure 3: Maritime Port Comparison

Russia’s 151 ports and harbors are overall poor from a strategic competitive perspective due to their significant geographical limitations and growing requirements for massive infrastructure investment. Due to the geopolitical fallout from the country’s invasion of Ukraine, Russia has lost foreign capital investors and lacks domestic funding.

The PRC is a dominant power in ports and harbors, with six of the top ten ports by freight volume located in China. The PRC has heavily invested in ports to increase automation, capacity, and efficiency, enabling the communist nation to increase port production while reducing the overall number of berths by ten percent. Chinese port development plans are

required to align with regional, economic [commercial], and national defense needs and must meet dual military-civil interoperability requirements. Port plans must be reviewed and approved by central government officials. China is leveraging the Belt and Road and Maritime Silk Road initiatives to fill port investment and infrastructure gaps in the developing world, much of this investment throughout south-central Asia, Africa, and elsewhere. These investments increase Chinese influence and access across the globe and create national security vulnerabilities. Finally, China has a 70 percent worldwide market share of all ship-to-shore cranes in operation in the world’s ports. These cranes create an avenue for data collection and monitoring, potentially exposing other national security susceptibilities.

Deep-Sea Shipping

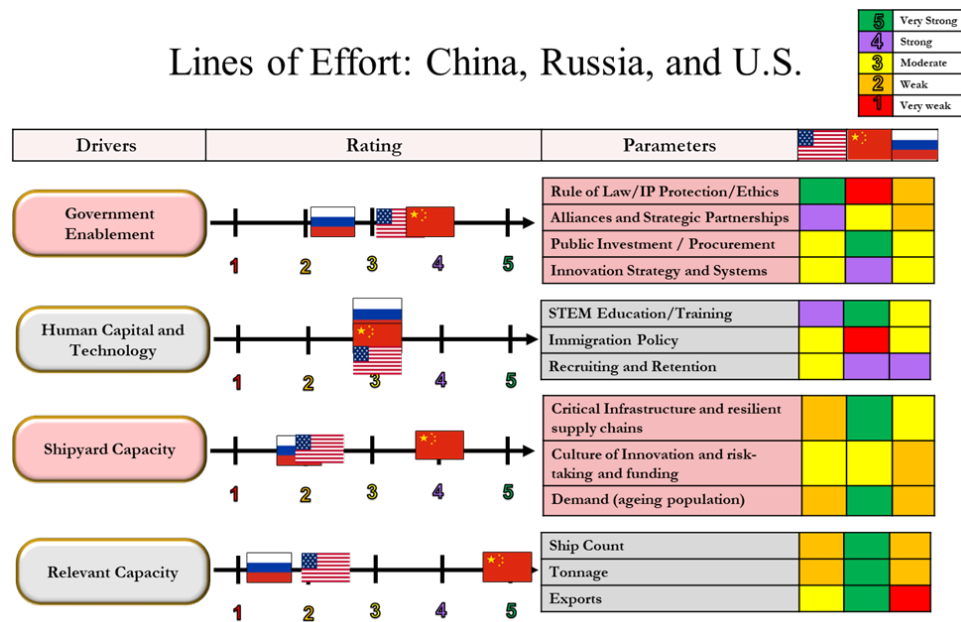


Figure 4: Deep-Sea Shipping Comparison

Government Enablement and Economic Output

The PRC state-owned firms, including the two largest transporters, COSCO Shipping Lines and Shandong International Transportation Corporation, produced a combined annual revenue of \$510 billion in 2022.¹⁶⁹ It has vastly more economic power in this industry at 20

times the revenue of all U.S. oceanic transportation sectors combined with twice the profit margin.¹⁷⁰ At \$127 billion, PRC state investment in the shipping and shipbuilding industry exceeded U.S. firm revenue in 2022.¹⁷¹ Due to “shadow fleet” operations, reliable data for Russia is scarce. Russian officials reported a mere 4.1 percent year-over-year decrease in 2022 GDP attributable to the transportation and storage sector.¹⁷² U.S. firms produced \$116.8 billion in annual revenue in 2021.¹⁷³

CCP authorities fund and control aspects of state-owned multinational enterprises such as COSCO and China Shipping Company. The PRC grants military authority to its mariners and subsidizes vessels, particularly fishing vessels, to sustain its economy and exert political and military power over territories. These programs nurture a large and convertible maritime labor base. However, the CCP’s authoritarian attributes may suppress disruptive innovation to a degree. Notwithstanding, China has free trade relationships with 17 countries, including Canada and the U.K.¹⁷⁴ Russian rule of law is fluid, and its activities in Ukraine constrain Russia’s ability to engage in legitimate economic activity.¹⁷⁵ Therefore, assessing the nation’s current approach to maritime issues is difficult. Russia is also tacitly (perhaps proactively) authorizing a growing “shadow fleet” to transport Russia’s energy exports to Chinese, Indian, African, and South American clients while skirting international sanctions.¹⁷⁶ Given this activity, there is little indication of a persistent decline in Russian shipping and various incentives to promote continued illicit activity.¹⁷⁷ Russia also continues to invest in the Northern Sea Route.¹⁷⁸

The Jones Act and the Cargo Preference Act are widely believed to sustain the organic U.S. maritime industry. The U.S. federal government also partners with state and local authorities and private entities to fund maritime academies, skills training, and other programs. However, the U.S. has alliances and partnerships and maintains 20 free trade agreements.¹⁷⁹

Human Capital, Development, and Technology

The PRC claims seven percent of the world's maritime labor force (134,000) and adds the equivalent of one U.S. Maritime Security Program fleet to its navy annually.¹⁸⁰ The Chinese are producing far more workers in the maritime trades (26,000 enrolled at Shanghai Maritime University alone) and have not reported a substantial labor shortage.¹⁸¹ This condition may be attributed to information control or central authority to direct labor to address government and commercial endeavors.¹⁸² Russia claims several leading maritime educational institutions and ten percent of the world's maritime workforce (198,000).¹⁸³ Although few labor shortages are reported, analysts speculate that Russia's conscription program diminishes the country's ability to fulfill a broad range of critical industrial jobs.¹⁸⁴ Given the Russian supply of mariners, these efforts will unlikely pose a capacity or mobilization threat to the country.

The U.S. is home to only 3.1 percent (59,000) of the world's qualified or skilled maritime workers and produces 1,000 licensed mariners from its maritime academies annually. Unions and other sources contribute to unlicensed accessions. Nevertheless, the U.S. claims a significant worker shortage.¹⁸⁵ Traditionally, the PRC seeks to sustain innovation to increase efficiency and volume (fast follower model). Recent recognition of the strategic nature of the industry accelerated state investment in pioneering research and development in advanced technology, integration, and governance to achieve "ocean-based prosperity," "marine security," and "collaborative governance."¹⁸⁶ Similarly, Russian industry and academia actively collaborate in developing autonomous navigation and shipbuilding technologies, educational approaches, and legal frameworks that might integrate into current and future commercial fleets.¹⁸⁷

In the U.S., academia partners with domestic and foreign firms to advance technologies to meet international environmental goals. Given the limited fleet size, there is little U.S. firms can accomplish to set the pace for technological change within the industry.

Shipyards and Relevant Capacity

Chinese firms own 12 percent of the world's seagoing self-propelled fleet tonnage (greater than 100 gross tons) at 1,084,813,000 DWT. They also control 246,738,000 DWT of self-propelled ocean-going vessel capacity attributable to vessels greater than 1,000 GT.¹⁸⁸ The United Nations Conference on Trade and Development assesses that the PRC is the most "connected" of the three nations based on the number of international ship calls, deployed capacity, services, and international routes (a connected index of 177).¹⁸⁹ Russian firms own nearly one percent of the world's seagoing self-propelled fleet tonnage (greater than 100 gross tons) at 10,922,000 DWT. They also control 23,855,000 DWT of self-propelled ocean-going vessel capacity attributable to vessels greater than 1,000 GT.¹⁹⁰ Russia's connected index is a mere 25.¹⁹¹ U.S. firms control 12,537,000 DWT of the world's seagoing self-propelled fleet tonnage (greater than 100 gross ton vessels). They also control 54,907,000 DWT of self-propelled ocean-going vessel capacity attributable to vessels greater than 1,000 GT.¹⁹² The U.S. connected index is 99.¹⁹³

Trucking

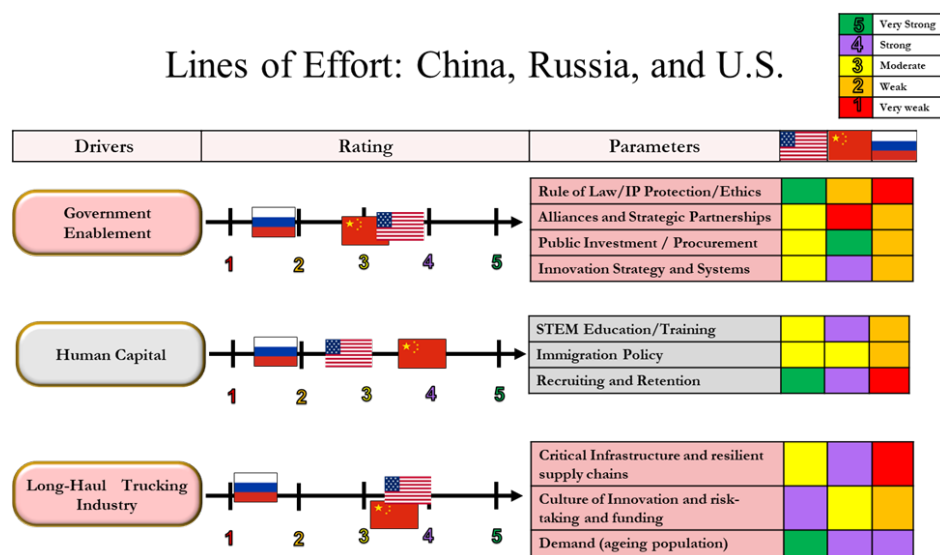


Figure 5: Trucking Comparison

The trucking industry’s ability to support U.S. national security is essential in strategic competition with Russia and the PRC. Despite domestic and international turmoil resulting from Russia’s unprovoked aggression against Ukraine, a report from 2022 states that the country has a healthy trucking industry. It is the largest segment of the land transport market, accounting for 66.5 percent of the total freight volume in Russia. Akin to the U.S., the industry is very competitive, with the top five companies occupying nearly 35 percent of the market share. There are, however, many smaller companies that also operate in the market. The trucking industry is growing, with a Compound Annual Growth Rate of nearly five percent from 2019 to 2023. Several factors, including the expansion of the wartime Russian economy, the development of domestic e-commerce, and the increasing demand for the transportation of goods between Russia and the PRC, are driving this growth.¹⁹⁴

The PRC’s trucking industry is also expected to grow at an annualized 4.7 percent until 2027 to total \$163.9 billion. According to a 2022 IBISWorld report, over 64,000 trucking

companies in the PRC employ approximately 1.3 million people. In 2021, the trucking industry accounted for over 35 percent of transportation volume. Unlike the U.S., the PRC freight rail and sea transport industries are large competitors to the Chinese trucking industry. Nevertheless, the PRC’s rapidly growing economy and highway infrastructure development have benefited the trucking industry.¹⁹⁵

Rail

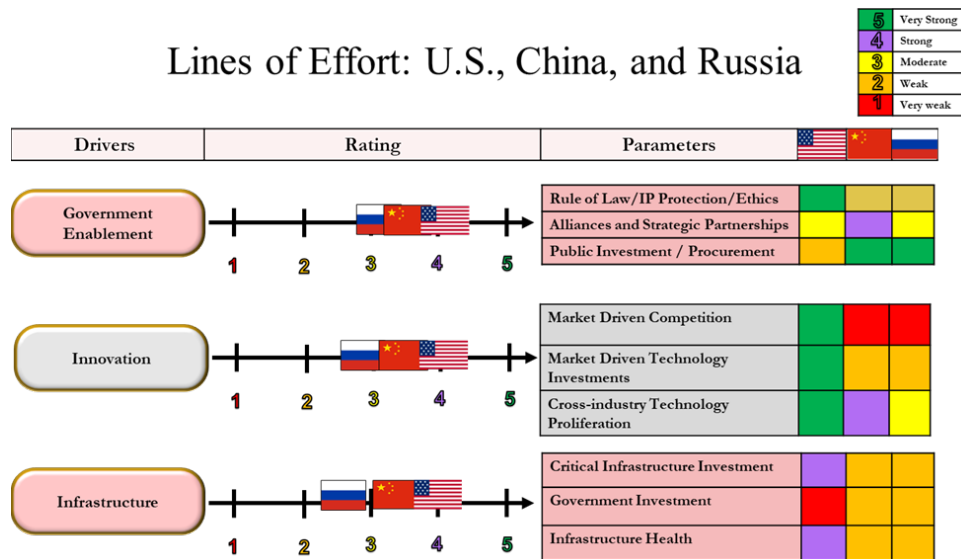


Figure 6: Rail Comparison

To fully understand the national competitive advantages and disadvantages of U.S. freight rail as an economic and national security asset, it is necessary to compare the industry with the PRC and Russia. While each country has unique characteristics and attributes that offer competitive advantages, the U.S. freight rail system maintains a slight edge over the PRC and Russia.

The primary reason for the U.S. competitive advantage is rooted in the fact that American freight rail is a private industry. In contrast, the PRC and Russian freight rail industries are state-owned enterprises. Though U.S. freight rail has several challenges, the fact that the industry is highly competitive and is free to set its prices means that it has been able to grow revenue,

develop innovative technologies, and invest in infrastructure in a way that reflects market conditions. Conversely, the PRC and Russian freight rail have prices and revenue goals set by their respective governments. Therefore, investments in infrastructure and innovative technologies are centrally planned and do not benefit from basic free market economic principles, such as creative destruction, by not allowing the natural flow of investments from unproductive activities to more productive ones.¹⁹⁶

Warehousing

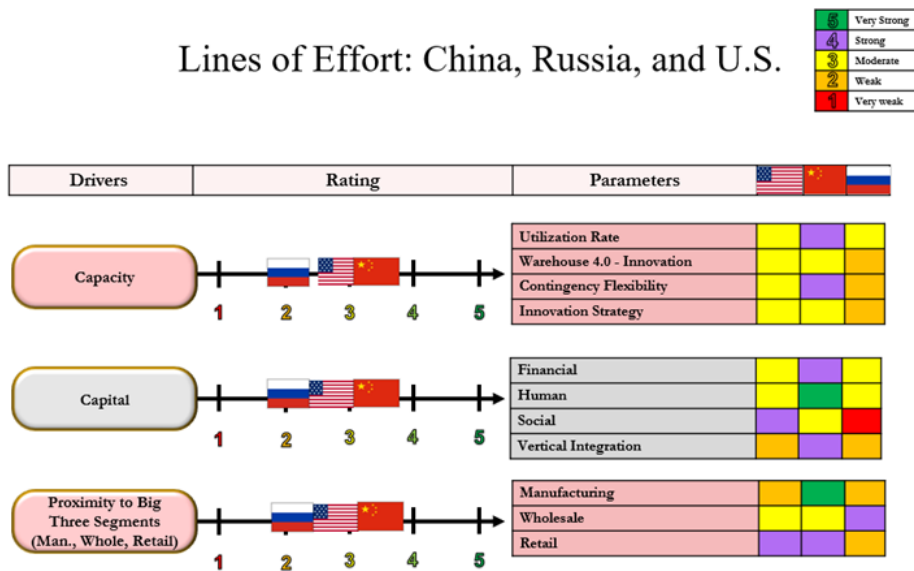


Figure 7: Warehousing Comparison

U.S. national competitiveness with the PRC and Russia in strategic competition can be assessed across three warehousing lines of effort (LOEs): (1) Capacity, (2) Capital, and (3) Proximity of the three business segments (manufacturing, wholesale, and retail). Overall rough order of magnitude, China is assessed as strong, U.S. moderate, and Russia as moderate trending down in all three LOEs. China's competitive advantage stems from quantity (having nearly five times the amount of U.S. warehouses), vertically integrated capital, and relative proximity of all

three warehousing segments. The U.S. competes, albeit from a capitalist free market framework, which creates business-influenced actions rather than vertically integrated strategies that account for security.

Inland Waterways

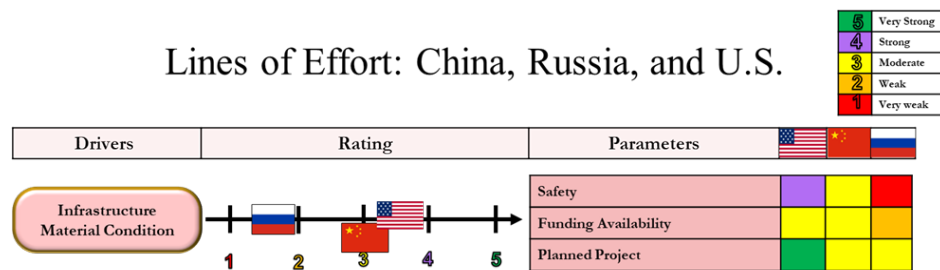


Figure 8: Inland Waterways Comparison

The U.S.’s most significant competitors, China and Russia, also have inland waterway systems. In China, the Yangtze River has been developed into the world’s busiest freight waterway; much like in the U.S., it connects industrial and farming hubs to seaports.¹⁹⁷ The central government of China manages its waterways, while the local government funds the required port infrastructure.¹⁹⁸ The Chinese waterways are managed well and share commonality with the inland waterways of the U.S. Additionally, as the Chinese population grows, road congestion will continue to increase, just like in the U.S., which may drive more commerce to waterborne options. Russia has been exploiting inland waterways and creating canals since the early 1700s.¹⁹⁹ The present waterway system within Russia is more than 63,000 miles, with the main segments of the system including the Volga-Baltic waterway in the northwest and the Volga-Don navigation channel in the south.²⁰⁰ The Russian geography and the distance that their industry must transport coal, grains, and other raw materials makes using inland waterways ideal for the nation, just as is the case for the U.S. and China.²⁰¹ As in the U.S., most of the locks and

dams in Russia have been operating for 70 or more years, but in Russia, 61 percent of them are classified as substandard in their level of safety.²⁰²

Air Freight

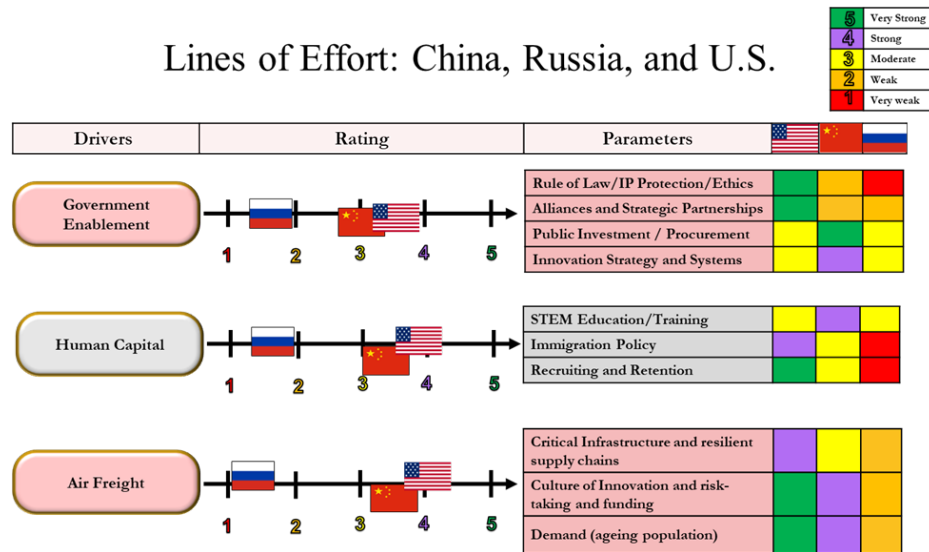


Figure 9: Air Freight Comparison

The U.S. has significant competitive advantages over China and Russia in the air freight industry, although China has the potential to narrow the gap. The U.S. makes up 16.5 percent of the value of the global air freight industry, and the largest air freight companies in the world are American, including FedEx and United Parcel Service.²⁰³ Moreover, the U.S. has more air cargo traffic because its residents are more likely to spend their high disposable income on the items more likely to be flown, such as electronics and jewelry. On the other hand, China’s air freight industry has struggled financially with low profits and low growth, although increasing demand for Chinese goods drives future growth.²⁰⁴ China lags significantly behind the U.S. in its airport infrastructure and the quality of its airport operations.²⁰⁵ China also faces a more urgent pilot labor crisis than the U.S.²⁰⁶ In terms of organic military aircraft, China only has about 240 transportation aircraft compared to the U.S.’s 677.²⁰⁷

Russia faces substantial challenges as manufacturers have stopped exporting planes and spare parts in response to Russia's invasion of Ukraine.²⁰⁸ The lack of repair parts has led to at least nine Russian airlines ceasing operations and the government authorizing the cannibalization of aircraft for parts.²⁰⁹ Worker error and neglect have further contributed to numerous mechanical failures.²¹⁰ Despite Russia's current struggles, analysts anticipate resumed growth of seven to eight percent annually over the next five years.²¹¹ From a military perspective, the Russian Air Force has 410 dedicated transportation aircraft, 61 percent of the U.S. fleet.²¹² Overall, the U.S. maintains a strong lead in the industry in financial health, organic military capabilities, human capital, and infrastructure, followed by China, then Russia, with China potentially narrowing the gap over time.

Conclusion

China has a notable edge over the U.S. in ports, harbors, and deep-sea shipping domains. The U.S. must take immediate action to enhance its industrial base to remain competitive and secure on a global level. The U.S. remains closely matched or slightly ahead of China in other transportation components, with Russia trailing in every sector. However, without continued and consistent physical and human capital investments, China could soon surpass the U.S. in all other transportation and logistics components.

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