BREAKBULK NEXTWAVE EDUCATION DAY

TEXAS A&M UNIVERSITY GALVESTON CAMPUS®

HOUSTON MARITIME Center & Museum

SAN JACINTO COLLEGE

BACHELOR OF APPLIED TECHNOLOGY - LOGISTICS & SUPPLY CHAIN MANAGEMENT

ABSTRACT

COMMERCIAL PORTS. STRONGER CONNECTIONS. A MORE SECURE TOMORROW.

Commercial Strategic Seaports are critical nodes connecting maritime transportation to the inland logistics network required to support military force deployment during national defense emergencies. The Maritime Administration's National Port Readiness Network coordinates federal agencies and commercial ports to maintain readiness for force deployment during contingencies and defense emergencies. However, a seaport's ability to support a logistics surge depends not only on port capacity, but also on the capacity, connectivity, and redundancy of the inland transportation network.

This study develops a GIS-based framework to evaluate military logistics surge capacity at U.S. Commercial Strategic Seaports. The framework integrates port infrastructure, Class I railroad connectivity, highway access, military destination accessibility, and other critical transportation infrastructure. Network analysis is used to evaluate primary and alternative routes between port facilities and inland military destinations and to identify potential bottlenecks under increased demand. A five-pillar Strategic Seaport Surge Capacity Index is developed to compare the relative ability of ports to support increased logistics activity using publicly available data. Rather than estimating classified military throughput, the study evaluates observable infrastructure capacity and network constraints under baseline conditions, increased demand, and demand with critical infrastructure disruptions.

The results highlight how multimodal network connectivity and redundancy influence port readiness, providing a basis for identifying infrastructure dependencies and investment priorities relevant to port authorities, transportation agencies, and the project cargo industry.

STRATEGIC IMPORTANCE Seaports enable military force deployment during national emergencies.

MULTIMODAL ANALYSIS Integrates port, rail, highway, and military access.

NETWORK RESILIENCE Evaluates primary and alternative routes under increased demand.

COMPARATIVE INDEX Ranks ports using a five-pillar Strategic Seaport Surge Capacity Index.

PRACTICAL OUTCOMES Identifies bottlenecks and investment priorities using publicly available data.

PEOPLE + INFRASTRUCTURE + READINESS = A STRONGER TOMORROW

RESEARCH GAP

FROM PORT CAPACITY TO NETWORK READINESS

UNDERSTANDING CONNECTIONS. STRENGTHENING READINESS.

WHAT IS KNOWN
Existing Research Focus

Port Infrastructure Studies assess berth capacity, depth, and terminal operations.

Cargo Throughput Research examines historical and projected port cargo volumes.

Individual Mode Analysis Highway, rail, and port studies often analyze modes separately.

Limited Scope Most studies focus on commercial efficiency, economic impacts, or single-infrastructure performance.

THE RESEARCH GAP
What Is Missing

Lack of Multimodal Integration Few studies evaluate ports and inland transportation networks together for military surge scenarios.

Insufficient Focus on Redundancy Limited analysis of alternative routes and network resilience under disruptions.

Limited Military Accessibility Analysis Proximity and connectivity to military destinations are rarely incorporated into port readiness assessments.

No Comparative Framework There is no standardized, publicly based index to compare the relative surge capacity of U.S. strategic seaports.

THIS STUDY
How It Addresses the Gap

Multimodal Network Analysis Integrates port, rail, highway, airport, and military infrastructure in a GIS framework.

Evaluates Redundancy Identifies alternative routes and infrastructure dependencies under increased demand and disruptions.

Incorporates Military Accessibility Analyzes proximity to military bases and key defense destinations.

Comparative Surge Capacity Index Ranks U.S. Commercial Strategic Seaports using a five-pillar framework with publicly available data.

THE RESEARCH GAP IS NOT A LACK OF PORT DATA, BUT A LACK OF INTEGRATED, NETWORK-BASED ANALYSIS FOR MILITARY LOGISTICS READINESS.

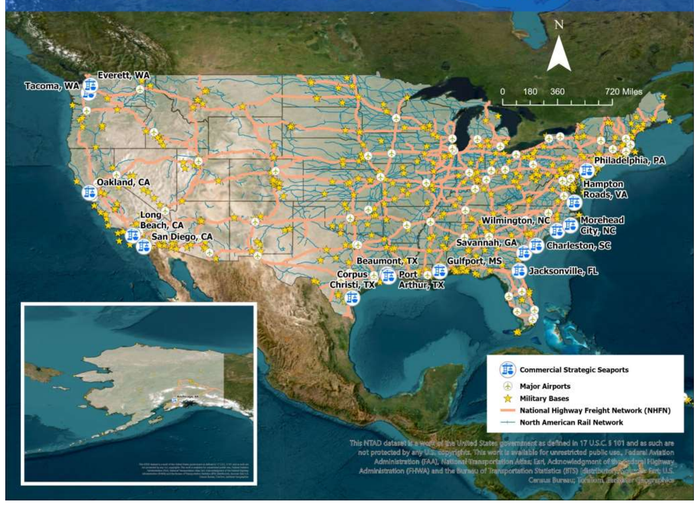
RESEARCH QUESTION

FROM PORTS TO READINESS

STRATEGIC PORTS. CONNECTED NETWORKS. STRONGER DEFENSE.

Which U.S. commercial strategic seaports are best positioned to support a military logistics surge, based on publicly available infrastructure and network characteristics?

U.S. COMMERCIAL STRATEGIC SEAPORTS AND TRANSPORTATION NETWORKS



BACKGROUND & IMPORTANCE

Commercial strategic seaports connect global maritime trade to the inland transportation network needed for military force deployment during national defense emergencies.

The National Port Readiness Network (NPRN) coordinates federal agencies and commercial ports to maintain readiness during contingencies.

Surge capacity depends on more than the port itself — it relies on the capacity, connectivity, and redundancy of the inland transportation network.

STUDY AREA & DATA

17 MARAD commercial strategic seaports (within the contiguous U.S. + AK) (Apra Harbor, Guam excluded)

Multiple public datasets: ports, rail, highway freight network, airports, military bases, USACE navigation facilities, and bathymetry

Analysis conducted in ArcGIS Pro 3.7.1 using geodesic distance (WGS 1984)

RANKING SYSTEM

FIVE PILLARS. EQUAL WEIGHT. LOWER SCORE = HIGHER READINESS.

Every component was ranked 1–17 (1 = best). Ties share the minimum rank. Components were grouped into five pillars so correlated dock fields would not triple-count Long Beach. Pillars were averaged with equal weight. The overall score is that average; lower is better. Remaining ties were broken by total berth feet.

MARINE Port Infrastructure
- Berth feet
- Max depth (DEPTH_MAX)
- Docks ≥ 45 ft
- Docks with a rail note

20% WEIGHT

VOLUME Cargo Throughput
- MARAD cargo total on the NPRN layer

20% WEIGHT

INLAND Rail & Highway Connectivity
- Unique rail owners within 5 miles
- Unique NHFN signs within 10 miles

20% WEIGHT

PROXIMITY Access to Key Facilities
- Miles to nearest major airport, rail, NHFN, and military base

20% WEIGHT

BACKUP Redundancy & Alternatives
- Major airports within 50 miles
- Military bases within 25 miles
- Miles to next NPRN port

20% WEIGHT

OVERALL SCORE AVERAGE OF FIVE PILLARS (LOWER IS BETTER)

RANKING 1 – 17 (1 = BEST)

TIEBREAKER TOTAL BERTH FEET

KEY FINDINGS

Long Beach ranks #1 overall Best marine plant (151k ft berth, 72 ft depth) and 81M tons of cargo.

Hampton Roads is a close second Strongest inland freight network and 18 military sites within 25 miles.

Philadelphia has the best proximity Nearest-facility distance alone ranks it first, but weaker cargo volume and limited diversion lower its overall score.

Corpus Christi and Beaumont move the most tons but rank #7 and #11 due to limited inland alternatives and military access.

Morehead City ranks last (#17) Few docks and no NHFN sign within 10 miles.

Scan here to view interactive maps and data VIA Esri Story Map

Scan here to view References

5 PILLAR RANKING RESULTS

LOWER SCORE = HIGHER READINESS

Rank	Port	Overall Avg (Lower = Better)	Headline
1	Long Beach, CA	3.95	Best marine plant (151k ft berth, 72 ft depth); 81M tons
2	Hampton Roads, VA	4.32	Best inland routes; 18 military sites within 25 miles
3	Philadelphia, PA	6.97	Best proximity; weaker cargo and diversion
16	Anchorage, AK	11.88	Tight locally; 1,422 miles to next NPRN port
17	Morehead City, NC	12.12	Few docks; no NHFN sign within 10 miles

Table 1. Top three and bottom two ports on the overall five-pillar score.

STRATEGIC PORTS. STRONGER CONNECTIONS. A MORE SECURE TOMORROW.

CONCLUSION

STRATEGIC PORTS. STRONGER NETWORKS. A MORE SECURE TOMORROW.

CONNECTING INFRASTRUCTURE. STRENGTHENING NATIONAL READINESS.

KEY TAKEAWAYS

NETWORK MATTERS MOST SURGE READINESS DEPENDS ON THE ENTIRE MULTIMODAL NETWORK — NOT JUST PORT CAPACITY.

SIGNIFICANT VARIATION ACROSS PORTS PORTS DIFFER IN STRENGTHS AND VULNERABILITIES BASED ON INFRASTRUCTURE, CONNECTIVITY, AND REDUNDANCY.

KEY VULNERABILITIES IDENTIFIED LIMITED INLAND ALTERNATIVES AND MILITARY ACCESS CONSTRAIN SURGE CAPACITY AT SOME PORTS.

REDUNDANCY IMPROVES RESILIENCE ALTERNATIVE ROUTES AND NEARBY FACILITIES REDUCE RISK AND SUPPORT CONTINUITY UNDER DISRUPTIONS.

INFORMS STRATEGIC INVESTMENT RESULTS HELP PRIORITIZE INFRASTRUCTURE IMPROVEMENTS TO STRENGTHEN NATIONAL DEFENSE LOGISTICS.

CONCLUSION

STRATEGIC SEAPORT READINESS DEPENDS ON THE BROADER TRANSPORTATION NETWORK.

THIS GIS-BASED FRAMEWORK PROVIDES A PRACTICAL, DATA-DRIVEN APPROACH TO IDENTIFY INFRASTRUCTURE BOTTLENECKS AND INVESTMENT PRIORITIES THAT ENHANCE MILITARY LOGISTICS SURGE CAPACITY.

SUPPORTS REAL-WORLD DECISIONS

PORT AUTHORITIES IDENTIFY INFRASTRUCTURE RISKS AND IMPROVEMENT OPPORTUNITIES.

TRANSPORTATION AGENCIES PLAN FOR NETWORK RESILIENCE AND MULTIMODAL CONNECTIVITY INVESTMENTS.

DEFENSE & EMERGENCY PLANNERS SUPPORT CONTINGENCY PLANNING AND STRENGTHEN NATIONAL PREPAREDNESS.

PROJECT CARGO INDUSTRY INFORM ROUTING, RISK ASSESSMENT, AND LONG-TERM STRATEGIC PLANNING.

PEOPLE + INFRASTRUCTURE + READINESS = A STRONGER TOMORROW.

PROJECT NAME: Evaluating Multimodal Network Resilience for Military Logistics Surge at Commercial Strategic Seaports

STUDENT NAME: Samantha Pedraza, Paul Judice CDR USN. (Ret.), and Dat Bui
FACULTY ADVISOR NAME: Alfred Henson Ph.D.
UNIVERSITY NAME: Texas Southern University
INDUSTRY ADVISOR NAME & CO.: Robert Morgan, Jacqueline Young

TSU

TEXAS SOUTHERN UNIVERSITY