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Evolution and Current State of Floating Ports/Terminals

A Comprehensive Literature Review and Future Research Directions

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Title

Evolution and Current State of Floating Ports/Terminals: A Comprehensive Literature Review and Future Research Directions

Research question / objective

This study investigates the emerging concept of floating ports as transformative maritime infrastructure, systematically analyzing their technological readiness, current applications, and future potential. The primary research question is: What is the current state of knowledge on floating ports, and how prepared is the field for scaling floating ports into operational, sustainable maritime hubs? The objective is to consolidate fragmented literature, assess technological and systemic readiness, and provide actionable insights to guide research, governance, and policy toward enabling sustainable floating ports.

Method and Data

We employed a systematic literature review combining bigram-based keyword analysis across Scopus and Web of Science. Starting from 19,473 records identified under the broader "floating structures" concept, iterative filtering and refinement focusing on "floating port," "floating harbor," and "floating terminal" yielded 817 relevant studies. Further screening through reference lists expanded the dataset to 884 studies. From this pool, we identified 140 core studies explicitly addressing floating ports and harbors. We categorized floating port applications into eight types (e.g., floating breakwaters, terminals, piers, berths, VLFS, tourism platforms, shipyards, renewable energy platforms) and conducted a Balanced Readiness Level Assessment (BRLa) across five dimensions: technological, market, regulatory, acceptance, and organizational readiness.

Results/Findings

The BRLa revealed high technological readiness in several floating port components, such as floating breakwaters, modular terminals, and floating piers, supported by decades of technical advancements. However, critical gaps remain in market readiness, regulatory frameworks, organizational integration, and societal acceptance across most applications. Despite successful deployment in niche contexts (e.g., marina expansions, offshore energy hubs, modular shipyards), no fully independent floating port exists at the scale or operational capacity of conventional seaports. Publication trends indicate fragmented and project-specific research, lacking continuity or a cohesive research trajectory. Our analysis also highlights uneven progress across application types, with greater maturity in technical design but lagging integration with governance, finance, and regulatory systems.

Implications for Research/Policy

The findings underscore that technical feasibility alone is insufficient for floating ports to evolve into sustainable maritime hubs. Integrated governance models, regulatory harmonization, innovative financing (e.g., public-private partnerships), and inclusive stakeholder engagement are needed to address systemic gaps. Future research should prioritize the development of adaptable governance frameworks capable of managing floating ports across jurisdictions, aligning legal and environmental compliance, and ensuring economic viability. Cross-sector collaboration between maritime logistics, engineering, environmental science, policy, and law is essential to advance floating ports beyond isolated experiments toward scalable, resilient infrastructure solutions addressing land scarcity, climate change, and logistical challenges in global port systems.