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Abstract

How has the concept of sea power evolved from Mahan's classical formulation to the 21st century, and what continuities and transformations define its contemporary meaning? In what ways does artificial intelligence reshape the determinants and methods of exercising sea power, particularly in relation to naval force structures, underwater warfare, and strategic competition? To what extent does the integration of AI challenge or reinforce the traditional geopolitical foundations of sea power—such as geography, economic strength, and political capacity—within an emerging multipolar maritime order? Using a qualitative, historical-interpretive analysis that combines conceptual history with analytical synthesis, this study seeks to systematically trace the evolution of the concept of sea power since Mahan, clarify its various interpretations, and examine the key factors shaping sea power in the 21st century. In this context, it is important to consider the role and influence of artificial intelligence on power, which is undoubtedly unprecedented. However, at present, recent transformations do not suffice to overturn the fundamental principles and underlying dynamics of sea power, nor are they powerful enough to

completely alter the influence of geographical factors. Meanwhile, the methods of maintaining and exercising sea power are undergoing significant transformations. Contemporary sea power, while building on Mahan's legacy, now encompasses not only naval strength but also institutional capacity, legal frameworks, and technological innovation, with modern navies adopting hybrid force structures to navigate a multipolar maritime order beyond the framework of large-scale conflicts and decisive battles.

Keywords

Alfred Thayer Mahan; artificial intelligence; decisive battle deterrence; sea power; underwater warfare

Introduction

Artificial Intelligence (AI), since its emergence as a branch of computer science in the late 1950s, has been defined in numerous ways. Broadly speaking, these definitions can be distilled into a simple formulation, one that highlights the role of "computer systems capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision making, and language translation (Brass, et. al., 2024, p. 30)". Certainly, AI is by no means a new concept or term; its progress has largely been driven by incremental improvements in data storage and computing power. With the comprehensive improvement in hardware performance and the accumulation of massive datasets in the internet era, however, AI technology has entered a new phase of rapid development in the second decade of the 21st century (Tangredi and Galdorisi, 2021; Feng, 2018).

Certainly, AI is an enabling technology, comparable to electricity or the internal combustion engine. It not only affects specific aspects of military capabilities but also has the potential to reshape global economic power and even the fabric of society itself. The actual impact of AI largely depends on how individuals and organizations choose to utilize it, rather than on the technology alone (Horowitz, 2018, 54; McMaster, 2015). This being said, it would not be an exaggeration to argue that, from a broader perspective, AI will

significantly accelerate the pace and expand the scope of conflict. In maritime strategic and tactical competition, AI-enabled unmanned platforms and autonomous systems are playing an increasingly critical role. With substantial advancements in big data, storage technologies, and computing power, these systems are extending the depth and breadth of human operational capabilities. Experts predict that fully autonomous weapon systems will most likely first be deployed in relatively uncluttered maritime environments (Lucas, 2014).

As different from AI, sea power, like land power, air power, and space power, is a geopolitical concept associated with a specific domain, with its core essence rooted in the control and utilization of the seas. It has long been a central subject of strategic discourse. As early as the eras of Ancient Greece and China's pre-Qin period, sea power and its practical applications were already remarkably sophisticated and well-developed. This being said, the theoretical framework of sea power was first systematically articulated by Alfred Thayer Mahan, whose seminal work, *The Influence of Sea Power Upon History, 1660–1783*, left an enduring mark on global strategic thought. Yet, the concept of sea power is neither static nor confined to a fixed paradigm. Its evolution is shaped by military technology, broader historical conditions, and the shifting dynamics of international politics. Every pursuit of sea power reflects a conscious choice influenced by historical context, technological possibilities, and national endowments—no two sea powers in history have ever been identical. The form and substance of sea power develop through the complex interplay of geography, technology, and norms. Among these, technology has consistently served as the defining force, delineating distinct eras of maritime dominance: the Age of Sail, the Age of Steam, the Mechanical Age, and the current Information Age, which also brings to the fore the strategic significance of AI. Against the backdrop of AI technology, the present article seeks to systematically trace the evolution of the concept of sea power since Mahan, clarify its various interpretations, and examine the key factors shaping sea power in the 21st century.

How has the concept of sea power evolved from Mahan's clas-

sical formulation to the 21st century, and what continuities and transformations define its contemporary meaning? In what ways does artificial intelligence reshape the determinants and methods of exercising sea power, particularly in relation to naval force structures, underwater warfare, and strategic competition? To what extent does the integration of AI challenge or reinforce the traditional geopolitical foundations of sea power—such as geography, economic strength, and political capacity—within an emerging multipolar maritime order? Using a qualitative, historical-interpretive analysis that combines conceptual history with analytical synthesis (Skinner, 1969; George & Bennett, 2005), this study addresses its research questions in four sections. The first section examines how artificial intelligence is reshaping naval operations, force structures, and underwater warfare, while noting its limits and ethical constraints. The second section traces the historical evolution of sea power concept from Mahan and Corbett to contemporary theorists, highlighting the interplay of technology, geography, and politics in shaping its meaning. The third section identifies the essential elements of sea power in the AI era—maritime force, geography, economic strength, and political capacity—demonstrating how AI functions as a transformative multiplier rather than a replacement of classical determinants. The fourth section explores the methods through which sea power is acquired and maintained today, emphasizing the hybridization of naval force structures and the increasing importance of diplomacy, law, and norms in sustaining maritime influence within a multipolar order.

Artificial Intelligence and Sea Power

It is important to recognize that AI remains a broadly defined and often ambiguous concept, generally categorized into three tiers: simple AI, narrow AI, and general AI. Simple AI functions primarily as an automated processing tool, lacking self-learning or adaptive capabilities. Narrow AI can self-learn and self-program but remains confined to specific domains. General AI (or "strong AI") mimics human consciousness, enabling decision-making across

multiple tasks. Current military applications predominantly rely on simple and narrow AI, meaning that its full potential in naval contexts remains largely untapped compared to its growing influence in the commercial sector (Tangredi and Galdorisi, 2021).

While one could not deny the significance of newly emerging trends in machine learning, industrial robotics, and materials science, their combined impact on future naval warfare remains uncertain (Fu, 2019, 7). This issue has been intensely debated for over a decade (UNIDIR, 2015) and continues to provoke heated discussion today. A prevailing consensus holds that AI will have a revolutionary impact on navies and sea power, comparable to the transformative effect of the Age of Exploration, fundamentally altering organization, doctrine, policy, and operations (Arquilla and Denning, 2019). AI is reshaping strategic balances at sea; navies that achieve AI superiority are expected to dominate the oceans of the twenty-first century, where computational power and algorithmic innovation may decide the outcome of great-power competition.

However, unlike more aggressive approaches to AI integration in other domains, naval applications currently favor human-machine hybrid systems or neural networks. This paradigm reflects the unique challenges of maritime environment awareness, the complexities of situational perception at sea, and the legal and ethical constraints surrounding military AI deployment. As contemporary naval doctrine envisions: "Tomorrow's navies may go into battle with humans and computers fighting side by side—the former providing insight and judgment, the latter offering lightning-swift calculations to guide choices in fast-moving, uncertain situations." The autonomy levels of current systems remain deliberately constrained; they are designed to augment rather than replace existing command hierarchies and platforms (Tuneer, 2018).

Indeed, the deployment of autonomous technologies at sea is not a novel development. Highly automated weapon systems, such as the Aegis air defense system, have been operational for over three decades (UNIDIR, 2015). Observing the practices of various national navies reveals several emerging trends. First, AI is changing decision-making processes and efficiency. AI integration into

command and combat systems primarily enhances command and control capabilities through intelligent software processes, thereby improving operational performance. AI also supports combat systems by enhancing the targeting and tracking of enemy assets, though final decision-making authority remains with human operators. While major powers actively research autonomous weapons, they maintain significant reservations regarding their deployment. On the one hand, difficulties in environmental perception, particularly in deep-sea environments, limit autonomous platforms' ability to undertake offensive tasks without risking escalation. On the other hand, unresolved ethical and accountability concerns continue to politically constrain their use.

Relatedly, AI is redefining naval force structures. Unmanned platforms—including Unmanned Surface Vehicles (USVs), Unmanned Underwater Vehicles (UUVs), and aerial drones—are increasingly used for reconnaissance, logistics, and mine countermeasure missions. Although most platforms remain under human control, many are demonstrating growing levels of autonomy (Tuneer, 2018). In future procurement strategies, unmanned platforms are prioritized, significantly expanding human capacity for oceanic perception, exploration, and exploitation. In the military domain, underwater competition is already manifesting new operational paradigms. The deep-sea environment—marked by poor visibility, extreme pressure, and complex hydrology—presents unique detection challenges while simultaneously facilitating concealed military operations and surprise attacks. These conditions are being strategically exploited by maritime powers.

Unlike traditional doctrines that primarily relied on submarines for pinpoint strikes or asymmetric deterrence, contemporary underwater warfare increasingly exhibits networked and systemic characteristics (Hu, 2017). In recent years, UUV technology has matured significantly. It is projected that by 2030, UUVs will be capable of executing missions such as minelaying, surveillance, and munitions delivery, while collaborating with manned platforms to enhance sensor coverage, weapons capacity, and countermeasures in anti-submarine warfare operations (CNO, 2016).

Additionally, AI is transforming the patterns of maritime strategic competition and combat operations. Should UUVs achieve large-scale deployment, the form of underwater warfare will be fundamentally altered. The role of submarines will shift from direct attack platforms to command-and-control hubs for unmanned systems, sensors, and standoff weaponry. This transformation mirrors the mid-twentieth century evolution of naval warfare, when operations shifted from coastal assaults by gun-armed battleships to expeditionary strike forces led by carrier groups and amphibious platforms deploying aircraft, troops, and missiles (Clark, Haynes, Sloman, and Walton, 2017).

Today, maritime unmanned systems are transitioning from experimental phases toward widespread operational deployment. Among these developments, the integration of artificial intelligence, machine learning, autonomous systems, data management, and other advanced technologies will become a critical factor in shaping future maritime strategic competition (Davis, 2020).

Artificial Intelligence and the Basic Concept of Sea Power: From Its Origins to the Present Day

AI has, for the first time, enabled the comprehensive perception, development, and governance of the world's oceans. Rather than diminishing or replacing the strategic role of sea power, AI is poised to enhance its influence and deepen its meaning. Latest technological developments aside, the primary geopolitical significance of the oceans still lies in their function as global passageways. Oceanic connectivity has dramatically increased human mobility—expanding access to markets for labor and technological innovation, facilitating exchanges among civilizations, and significantly enriching the practice of international politics.

Historically, the balance of power in the Mediterranean and surrounding seas played a decisive role in the rise and fall of ancient Greece and Rome. In this context, navies have long served as both the vanguard and the guardians of Western civilization. Since the early modern era—particularly with the onset of the Age of Explo-

ration and the expansion of European colonialism and imperialism —the strategic importance of the oceans as vital corridors has only grown. Control over maritime routes became a key instrument for imperial powers in their competition for colonies and spheres of influence. As a result, the understanding, exploration, and control of the oceans evolved from a regional European concern into a central issue in global politics.

During the ancient Greek period, historians had already begun documenting sea power. However, sea power as a complete theoretical system has only existed for just over a hundred years. In 1890, Mahan systematically proposed the theory of sea power and command of the sea, stating that "sea power means all those things that enable a nation, by means of the sea or through the sea, to become great (Mahan, 1890)." He enumerated six key elements: geographical position, physical conformation including the resulting productivity and climate, extent of territory, number of population, character of the people, and character of the government (Mahan, 1890). He also emphasized the importance of sea power from the perspective of grand national strategy, asserting that "Britain's prosperity stemmed from its unconstrained control of the seas, while France's decline must likewise be attributed to its neglect of sea power (Mahan, 2016)." Therefore, Mahan's principal contribution lies in his pioneering comprehensive examination of sea power as an instrument of grand national strategy, wherein he systematically synthesized previously disparate concepts into a rigorous philosophical framework, while methodically articulating fundamental strategic tenets and principles pertaining to maritime dominance (Wu, 2008; Gürcan, 2021).

Around the same time as Mahan, and drawing on similar historical episodes, Britain's Sir Julian Stafford Corbett and others developed an alternative theory of sea power—often referred to as the "British School". This school of thought emphasized the inseparable link between maritime and land operations, viewing naval actions as integral parts of broader military campaigns. Moreover, it argued that command of the sea is not absolute but relative, typically existing in a state of contestation between rival powers. Both

Mahan's and Corbett's theories reflect conceptualizations of sea power shaped by the conditions of the industrial era (Handel, 2000; Gürcan, 2021).

In the strictest sense, the world entered a "post-Mahan era" of sea power development following World War II. Although postwar maritime strategy still retains traces of Mahanian influence, these have become increasingly attenuated as sea power has evolved into the post-industrial—or information—age. Since the end of the Cold War, both the theory and practice of sea power have undergone more complex and multifaceted transformations. According to British maritime strategist Geoffrey Till, the navies of major powers such as China and the United States now represent hybrid systems that blend elements of the "modern navy" and the "postmodern navy". The former continues to focus on traditional missions aimed at securing exclusive and competitive command of the sea. In contrast, the latter emphasizes broader maritime security by promoting good order at sea, rather than engaging in direct contests for sea control (Till, 2009). In this context, sea power has increasingly been exercised through deterrence and peaceful competition, while the prospect of large-scale naval warfare between major powers has become virtually unimaginable. Indeed, such conflicts have not occurred since 1945—not even at the height of the Cold War. While the famous maxim "Whoever controls the sea controls the world" may have always seemed exaggerated, it is now clear that no nation can ascend to great power status—or sustain it—without robust maritime capabilities. In this respect, Mahan's insights remain deeply relevant. In the era of artificial intelligence, the integration of unmanned systems and autonomous weapons into naval operations has not only expanded the conceptual horizons of sea power but also accelerated its development and real-world application.

At the turn of the 20th and 21st centuries, an increasing number of Chinese scholars have participated in the innovation and debates regarding the concept of sea power. For instance, Ye (2007) defines sea power as "a country's capabilities and influence in maritime space", which may assume both military and civilian char-

acteristics. Essentially, it serves as a tool that can be used both to safeguard legitimate rights and interests and to dominate the world. According to Shen Weilie (2005), "sea power refers to the overall capability of a nation to use military and non-military forces to safeguard national territorial sovereignty extending to maritime areas (including their airspace), protect maritime interests, and exert influence on the willful behavior of maritime actors and other political entities." For Zhang Wenmu (2002), "China's sea power is a form of maritime right subordinate to China's sovereignty, not maritime might, still less maritime hegemony." Liu (2013) argues that, in contemporary terms, sea power refers to a nation's overall maritime strength and serves as a key benchmark for assessing its capabilities at sea. This concept spans multiple dimensions of national development, including political, economic, military, cultural, and scientific-technological spheres. He further asserts that China's advancement as a sea power should follow a path rooted in comprehensive development across all these domains (Liu, 2013).

The conceptual contributions of Chinese scholars to the study of sea power reflect distinctively Chinese characteristics and have meaningfully enriched its theoretical framework. However, it is also evident that some of these contributions have contributed to further conceptual ambiguity or overgeneralization, often conflating sea power with broader notions such as "maritime power". It is important to reaffirm that the core of sea power remains sea control, even if its substance, expressions, and objectives differ across historical periods and national contexts. One should resist the impulse to dismiss sea control simply because it has historically been associated with maritime hegemony. Nor should one attempt to construct forms of sea power that exclude the element of control—such as so-called "rights-based sea power" or "comprehensive sea power". While it is true that the factors shaping sea power are increasingly diverse, and that a growing number of scholars acknowledge sea power cannot be reduced to a purely military construct, it remains the case that sea power continues to rest on a multidimensional foundation. A powerful navy alone does not define a sea power; in contemporary contexts, economic capacity, diplomatic effectiveness,

and policy coherence are playing an increasingly important role in shaping a nation's maritime influence. As Geoffrey Till (2007) rightly notes, the functions of modern navies have become more diversified, and postmodern naval forces must operate with a global outlook oriented toward collaboration and collective action.

Drawing from the literature, sea power can be understood through at least three conceptual dimensions: physical strength, power relations, and capability. As physical strength, sea power refers to the physical assets that can operate at sea, including fleets, merchant vessels, fishing boats, aircraft, and other maritime platforms. This encompasses not only naval and coast guard forces but also civilian maritime assets and even support from other military branches such as air and space forces. As a power relationship, sea power reflects a state's relative advantage at sea in comparison to others—its ability to influence or coerce behaviors at sea or even on land through maritime superiority. In this sense, sea power is inherently relational and often confrontational, depending on a nation's position within the global maritime order. As a capability, sea power represents an essential element for maritime states—akin to air or water—and includes the full range of elements necessary to achieve naval dominance, particularly those that contribute to strategic supremacy at sea, including the ability to use resources and relations effectively.

Importantly, regardless of interpretation, sea power is fundamentally a political concept, distinct from legal categories such as maritime rights or interests. While enhancing sea power helps protect a nation's maritime rights and interests, sovereignty over islands, exclusive economic zones, and other legal entitlements do not in themselves constitute sea power. Rather, sea power provides the strategic foundation for becoming a maritime power but does not encompass all dimensions of that status.

Despite its conceptual ambiguity and the evolving conditions in which it is exercised, two aspects of sea power remain constant. First, it operates within a defined maritime space, making the delineation of its geographic scope essential to any meaningful analysis. Second, sea power cannot be equated solely with the navy or with

sea control; it involves an interplay of military, political, diplomatic, and economic capabilities. In essence, sea power is the capacity to project influence—military, political, diplomatic, and economic—within a given maritime space, commanding recognition or respect from the international community.

Moreover, technological advancements have expanded sea power from a one-dimensional (surface) capability prior to the 20th century to a multi-dimensional one. By the time of the World Wars, it included surface, underwater, and air domains; today, it encompasses five dimensions—surface, air, space, undersea, and electromagnetic. As the international system and regulatory frameworks have evolved, diplomacy, international law, and maritime norms have become increasingly important in the projection of sea power. Command of the sea now involves not only physical command of maritime zones or key chokepoints, but also normative authority—particularly in shaping the rules governing maritime security.

The Essential Elements of Sea Power in the Age of Artificial Intelligence

The systematic classification of factors shaping sea power began with Alfred Thayer Mahan, who identified six fundamental elements influencing a nation's maritime strength: geographic location, physical configuration, territorial extent, population size, national character, and the nature of the government. Notably, Mahan derived these criteria primarily from the historical experience of Britain, particularly during the 17th and 18th centuries. As a result, his framework suffers from a degree of overgeneralization, as it is based on a narrow set of cases, both geographically and temporally. Additionally, Mahan's model is historically bounded: the evolution of sea power is deeply conditioned by the material realities, prevailing modes of production, and broader sociopolitical contexts of his time. Over time, shifts in political, economic, and technological dynamics have altered the relevance of Mahan's elements—some have gained in importance, others have diminished, and a few have ceased to be relevant altogether (Yang, 2013).

In the wake of Mahan's work, numerous maritime theorists have refined and expanded the concept of sea power, typically distinguishing between naval forces and other contributing factors. As Brodie (1943) famously observed, sea power "has never meant merely warships," but rather encompasses the full spectrum of military assets, infrastructure, and geographical conditions that enable a nation to control maritime transportation during conflict. Paul Kennedy (1976) similarly categorized sea power into two components: a formidable naval fleet and a set of auxiliary elements that collectively shape maritime strength.

Since the late 20th century, the concept of sea power has become increasingly generalized, with its components growing more complex and multifaceted. British theorist Eric Grove (1990) expanded the framework to include economic capacity, technological advancement, socio-political culture, geographical position, dependence on maritime trade, and the government's strategic outlook. In China, scholars such as Lü Xianchen and Yang Zhen have also made significant contributions to refining this concept. Lü argues that modern sea power should be viewed as a complex system composed of both material elements—naval forces, maritime administration, marine industries, and technological capacity—and non-material dimensions such as legal frameworks, maritime values, and public consciousness (Lv, 2007). Yang Zhen, focusing on the post–Cold War context, identifies key components of sea power as naval capabilities, maritime governance institutions, marine industrial systems, legal regimes, and scientific-technological development (Yang, 2013). Among these scholars, Geoffrey Till has produced perhaps the most systematic and balanced synthesis for the information age. His framework includes categories such as population, society, and governance; technological and operational means; naval forces; and the maritime environment, encompassing geography, resources, and marine economics (Till, 2009).

Sea power is inherently a relative concept, requiring both longitudinal comparison—tracking a nation's own development over time—and cross-national comparison with other maritime powers. In Mahan's day, the metrics were relatively simple: naval tonnage,

trade volumes, and colonial holdings sufficed to gauge sea power. Today, however, in the age of artificial intelligence, AI has emerged as a transformative factor. It not only enhances the effectiveness of naval command-and-control systems but also enables the deployment of advanced maritime platforms, including unmanned and autonomous systems, thereby reshaping naval force structures. In parallel, AI significantly influences national economic performance, which remains the foundation of maritime strength. Accordingly, there is growing recognition that "the navy that masters AI and cyber warfare will control the seas of the 21st century" (Greco, 2024). Building on both classical theories and recent developments, it is now possible to organize the determinants of sea power into four major categories.

The first category is maritime force. Maritime force capability remains the most critical indicator for evaluating a nation's sea power status. Assessing relative maritime strength involves two fundamental dimensions: hardware and software. Hardware refers to platforms, weapons, and sensors, with key metrics focusing on the scale and technological sophistication of principal combat platforms. Software encompasses military systems, professional expertise, traditions, and institutional experience, which can be gauged through C5ISR (Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance, and Reconnaissance) system capabilities and the types and frequency of naval operations. *In this light, a nation's maritime strength may be measured through three primary indicators: the scale of advanced principal combat vessels, the capabilities of its C5ISR systems, and the diversity and operational frequency of its mission portfolio.* Importantly, modern maritime forces are no longer limited to conventional navies but also include maritime law enforcement entities such as coast guards and may incorporate land-based air power and missile systems capable of engaging in maritime operations.

Navies worldwide possess combat platforms of varying levels and standards, rendering superficial comparisons of ship, aircraft, or missile quantities largely meaningless. Since the Age of Exploration, naval development has followed an intensive trajectory, with ever more sophisticated sensors and weapons integrated into fewer but

more complex platforms—driving up both the cost and strategic value of modern fleets. Constructing a state-of-the-art navy today can require investments in the hundreds of billions of dollars. While recent developments, including anti-access/area denial (A2/AD) doctrines and the rise of artificial intelligence, have promoted a trend toward more distributed force structures (O'Rourke, 2025), major powers continue to prioritize high-value platforms such as aircraft carriers, nuclear-powered submarines, and large destroyers or frigates. Consequently, meaningful cross-national comparisons can focus on elite maritime assets—large principal combat vessels that embody a state's key military hardware capabilities. These include aircraft carriers, destroyers or cruisers with regional air defense capabilities, blue-water frigates, large amphibious assault ships, extra-large unmanned underwater vehicles (XLUUVs), air-independent propulsion (AIP) submarines, and nuclear-powered submarines. These platforms serve as benchmarks for measuring the operational scale and technological sophistication of national fleets.

C5ISR—standing for Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance, and Reconnaissance—forms the central nervous system of modern military forces and functions as a force multiplier that reflects a nation's military software capabilities. At the turn of the century, naval analyst Norman Polmar identified space systems, C3I (Command, Control, Communications, and Intelligence), and personnel quality as the three decisive factors in determining naval strength (Polmar, 1999). In the contemporary era, these factors are largely subsumed under the broader C5ISR framework. Artificial intelligence and algorithmic proficiency now play a decisive role in determining C5ISR effectiveness. However, the operational specifics of these systems are typically classified, making systematic international comparison difficult. Moreover, the absence of high-intensity warfare among major powers limits opportunities for evaluating performance under combat conditions. Still, setting aside human factors and focusing on technological indicators, preliminary assessments may consider national capacities in computing and information technology, space capabilities, AI model development, and the geographic range of

sensor and platform deployment. The maturity of a country's computing and information sectors generally reflects the underlying sophistication of its C5ISR systems, while space technology and platform coverage indicate their operational reach. As maritime forces increasingly adopt decentralized, networked configurations, the strategic importance of advanced C5ISR capabilities continues to grow.

Institutional experience and strategic traditions also constitute a vital dimension of maritime force assessment. Peter Haydon (2001) categorized naval missions into six tiers, ranked from most to least demanding: strategic deterrence and coercion, power projection, sea control, naval diplomacy, maritime security, and humanitarian assistance. The higher the tier, the more advanced and capable a navy must be to fulfill its missions. Only a select few navies—such as those of the United States, Russia, the United Kingdom, and France—possess the capacity to perform high-end missions like strategic deterrence and coercion. In contrast, nearly all navies are equipped to carry out lower-tier tasks such as maritime security and humanitarian assistance. Additionally, the frequency of mission execution is a key metric. For example, while several navies may be capable of conducting strategic deterrence operations, the U.S. Navy performs these missions with far greater regularity than any of its counterparts, reinforcing its unique operational depth and global reach.

The second category is maritime geography. Maritime geography continues to shape the fundamental geopolitical environment of coastal states—a reality that holds true even in the era of artificial intelligence. Although advances in missile technology, space capabilities, and cyber warfare have somewhat reduced the constraining effects of geography, large-scale power projection still requires careful geographic consideration. Technological progress has not eliminated the significance of distance in military operations; indeed, operational efficiency tends to decline as the distance from a nation's homeland increases. In East Asian littoral waters, for example, the United States faces reduced projection efficiency compared to China. Thus, while certain geographic factors emphasized by Mahan may have diminished in prominence, they have not become

obsolete and must now be analyzed through more nuanced, multidimensional frameworks. *Broadly speaking, a nation's maritime geographical conditions are fluid and can be assessed through four core indicators: geographical location, maritime area, number of maritime neighbors, and overseas base presence.*

Geographical location remains a decisive factor. Two classical principles retain their relevance: first, maritime states generally outperform land-sea composite states of equivalent national strength; second, states bordering strategic maritime chokepoints or waterways possess inherent advantages over other coastal nations. In terms of sea power projection, Britain and Japan—both island nations—along with peninsular India and the "continental island" of the United States, have historically enjoyed superior geographical advantages compared to China. While China, France, and Russia are land-sea composite states, China benefits from its position on the western Pacific rim—the focal point of contemporary maritime geopolitics—along with more strategically positioned coastal waters and ports than Russia.

A nation's maritime area also plays a significant role. Countries with larger maritime jurisdictions possess greater strategic space for naval development, and this spatial advantage can amplify the effects of favorable geographic location. States that combine extensive maritime zones with advantageous positioning are inherently more capable of developing into maritime powers.

The number of maritime neighbors also affects geopolitical complexity. Maritime neighbors are generally defined as states located within approximately 400 nautical miles across a shared body of water; beyond this distance, they are no longer considered immediate maritime neighbors. A higher number of such neighbors often indicates a more challenging geopolitical environment, characterized by increased risks to sea lane security, more frequent maritime boundary disputes, and intensified regional competition for influence.

Overseas military bases are another critical component of maritime geography. These installations help offset the logistical, intelligence, and infrastructural limitations that great powers face in

distant regions. No sea power can rely solely on domestic assets to support global naval operations; all must depend, to varying degrees, on overseas bases and allied support. The number and geographic distribution of these bases are directly linked to a nation's capacity for expeditionary operations and sustained global presence.

The third category is economic strength. Overseas trade and the maritime economy serve not only as key objectives of sea power development but also as vital determinants of its long-term sustainability. Among the many economic dimensions relevant to maritime strength, *two indicators stand out as particularly significant: the overall scale of the economy and its level of technological sophistication*.

In terms of aggregate scale, the development of sea power demands far greater financial investment and significantly longer time horizons than land power. As such, a nation aspiring to become a sea power must possess a substantial economic base, supported by durable and resilient growth. Sea power cannot be sustained without the fiscal and industrial capacity to fund extensive maritime infrastructure, advanced shipbuilding programs, and global logistical operations.

However, scale alone is not enough—technological sophistication is equally crucial. A large economy without corresponding technological advancement is unlikely to translate its wealth into maritime strength. Historical examples underscore this point. In the early 19th century, Qing China accounted for nearly 30% of global GDP, far exceeding that of Britain, yet it suffered a decisive defeat in the First Opium War (Mayles, 2019). Similarly, during the First Sino-Japanese War, China's GDP was substantially larger than Japan's, yet it sustained devastating losses. These examples demonstrate that true maritime strength depends not merely on economic size but on the quality of the underlying economic system. Economies dominated by agrarian sectors or speculative real estate markets contribute little to the development of sea power. Instead, the foundation must rest on advanced productive forces, including high-value manufacturing, technological innovation, and integrated

maritime industries capable of supporting complex naval operations.

The fourth category is political capability. Unlike the three previously discussed categories of factors, political capability operates primarily at an instrumental level—that is, it determines how effectively a state can mobilize and utilize available resources and potentials to advance its sea power. *Political capability encompasses two main dimensions: the efficiency of government institutions and the state's international prestige and influence*. The latter can be observed through various indicators such as the robustness of alliance systems, international political standing, and diplomatic competence.

Governmental efficiency refers to a government's capacity to mobilize financial and material resources and allocate them effectively. While sea power theorists like Mahan expressed a preference for democratic systems, such as those in Britain and the United States, there is little empirical evidence to suggest that democracies are inherently more capable than non-democracies in cultivating sea power. Thus, frameworks based on dichotomies like centralization versus decentralization, or authoritarianism versus democracy, offer limited analytical value in this context. More relevant are indicators reflecting the performance of maritime-related institutions and their efficiency in resource extraction and policy implementation. Since the ratification of the United Nations Convention on the Law of the Sea (UNCLOS), many coastal states have undertaken institutional reforms to align with its provisions—demonstrating a broad international convergence in administrative adaptation and regulatory capacity in maritime governance.

The role of alliance systems is also central. Nearly all sea power states are embedded within alliances, and such partnerships are essential for extending maritime reach. Allies offer logistical and operational support for overseas deployments as well as political legitimacy in times of crisis. A robust alliance network is, in effect, a hallmark of modern sea power. The United States, for example, owes a significant portion of its maritime dominance to the global scale and integration of its alliance structure, which underpins both its military footprint and diplomatic reach.

Diplomatic competence in maritime affairs is another crucial political asset. This includes not only the formulation and execution of maritime foreign policy strategies but also legal acumen, negotiation techniques, and expertise in international law—especially the law of the sea. Diplomatic skill should be distinguished from diplomatic power, as it is not strictly correlated with the size or strength of a state. Smaller nations can outperform larger powers in diplomatic effectiveness, particularly in legal and institutional arenas. Countries like the Netherlands and New Zealand often exert influence in maritime diplomacy disproportionate to their material capabilities. Evaluating diplomatic skill thus requires controlling for national strength and isolating variables more directly linked to legal and diplomatic performance. For instance, the number of citizens serving as judges, arbitrators, or international civil servants in maritime-related organizations can provide some indication of a country's legal influence. However, because such appointments often reflect considerations of regional balance and procedural fairness, they may be less telling than more dynamic indicators—such as the activity levels of a country's legal teams in maritime disputes or its frequency of engagement in shaping international maritime norms and precedents.

Methods for Acquiring and Maintaining Sea Power

The force structure of modern navies—the primary instrument of sea power—is undergoing profound transformations not seen in over a century. Navies of major powers are shifting from a purely intensive model to a hybrid model that combines intensiveness with distribution. Artificial intelligence has accelerated this shift by enabling the deployment of numerous smaller platforms and sensors across wider areas, thereby enhancing resilience and combat effectiveness. For major powers, the imperative is not to choose between these models but to pursue both: large, intensive platforms such as aircraft carriers, nuclear-powered submarines, and advanced destroyers or frigates must be maintained and developed alongside smaller, especially unmanned, systems. For instance, the United

States Navy continues to prioritize *Distributed Operations* concepts and invests heavily in unmanned systems, yet it has not abandoned the construction of large-scale platforms. For the foreseeable future, successful maritime strategies will require balancing the dual imperatives of concentration and dispersion in force structure.

At the same time, shifts in military technology and international norms are contributing to a transformation of the maritime order toward multipolarity (Kennedy & Wilson, 2021; Hu, 2023). Sea power, and its application, now faces growing constraints. The relatively peaceful global environment narrows the strategic options available to major maritime powers, making it difficult to identify clear winners in maritime competition over the short term. In parallel, the widespread deployment of anti-access/area denial (A2/AD) systems and the rise of distributed naval forces have significantly restricted the freedom of maneuver traditionally enjoyed by dominant maritime powers. Under these conditions, the maintenance of a unipolar maritime order has become untenable, and the emergence of a long-term multipolar maritime structure is increasingly evident. Unlike the extended period of unipolar dominance in the past, the future maritime order will be defined by structural multipolarity, with peaceful transformation supplanting large-scale war as the primary mechanism of systemic change. This shift has made the attainment of absolute sea control progressively more elusive, and in practice, maritime powers are adapting to a framework of relative sea control. This new strategic landscape presents both opportunities and constraints for states seeking to enhance their sea power. It enhances the feasibility and strategic relevance of secondary sea powers and middle-ranking navies, while also delineating the limits within which all major powers must operate (Hu, 2023).

The rise of AI has given rise to a form of technological determinism, with popular slogans proclaiming that "whoever controls AI controls sea power". While such statements highlight the strategic relevance of emerging technologies, they risk oversimplifying the complex nature of sea power, which remains the product of a wide range of interrelated factors. The international AI landscape—though clearly dominated by China and the United States—

does not, in and of itself, dictate the shape of the maritime order. Technological advantage is a crucial variable, but it operates within broader geopolitical, economic, and legal contexts that ultimately determine outcomes.

Simultaneously, the processes and pathways through which states pursue sea power are undergoing significant transformation. The presence of nuclear weapons and the logic of nuclear deterrence, coupled with deepening economic interdependence and the influence of global civil society, have significantly diminished the efficacy and legitimacy of war as a tool of international politics. As Gilpin (2007) observes, contemporary global change is increasingly defined by gradual, peaceful transformation rather than violent upheaval. In this context, decisive maritime battles are giving way to prolonged strategic competition, strategic stalemates, and incremental attrition. Major powers are now engaged in sustained probing of each other's red lines—often operating below the threshold of open conflict—which has introduced a high degree of volatility into maritime affairs. While artificial intelligence may exacerbate this volatility and complicate risk management, it is unlikely to reverse the underlying trend toward gradual and non-violent transformation. Under these circumstances, the dual tasks of sustaining presence and exercising deterrence have become central to the maritime strategies of major powers.

That maritime powers now refrain from resolving disputes through large-scale naval conflict does not imply that establishing a stable maritime security order has become easier. On the contrary, the negotiation of rules and norms governing maritime conduct has grown more protracted and complex. The Russia-Ukraine conflict and the operational dynamics in the Black Sea illustrate the stark differences between peacetime and wartime applications of sea power. In peacetime, sea power is maintained through deterrence, forward presence, and diplomacy. In wartime, by contrast, outcomes hinge on battlefield performance and the traditional logic of sea control. Peacetime sea power emphasizes quantity—especially in terms of maintaining presence and visibility—whereas wartime sea power prioritizes quality and combat effectiveness (Erickson, 2018).

In today's era of renewed geopolitical rivalry, competition over sea power remains intense, yet it unfolds largely within the boundaries of peacetime, necessitating equal attention to the instruments and strategies suited to this environment.

In this peacetime context, beyond military presence and deterrence, maritime diplomacy has gained increasing prominence as both a critical tool and a strategic arena for competition. The negotiation and eventual signing of the United Nations Convention on the Law of the Sea (UNCLOS) marked a historic turning point—the first major transformation of the international maritime order achieved through diplomatic negotiation rather than war. Diplomacy thus functions not only as a means but also as an objective of maritime competition. In the 21st century, underpinned by strong economic and technological foundations, the effective and coordinated use of military, diplomatic, and legal tools constitutes the most viable and balanced path to achieving and sustaining sea power.

Conclusion

AI is transforming sea power by enhancing naval operations, reshaping force structures through autonomous systems, and redefining strategic competition at sea. While traditional factors such as geography, economic strength, and political capacity remain foundational to sea power, AI is emerging as a decisive force multiplier—particularly in command systems, unmanned platforms, and surveillance capabilities. However, rather than rendering older paradigms obsolete, AI reinforces the multidimensional and relational nature of sea power, which now unfolds through a complex blend of military strength, diplomatic negotiation, technological innovation, and normative influence.

With each major technological revolution, debates resurface about the continuing relevance of geopolitics—particularly in the digital age and now in the era of artificial intelligence. Claims that "cyber dominance" and "information dominance" have rendered traditional geopolitical logic obsolete have become increasingly prevalent. Yet empirical realities suggest otherwise. Over the past decade,

rather than fading, geopolitics has experienced a notable resurgence. This is evident in the geopolitical dynamics surrounding the Russia-Ukraine conflict, the United States' renewed focus on restoring "sea control", and the deepening of strategic rivalry among great powers. Since the earliest stages of human civilization, technological advancements have consistently broken through the boundaries of geography and redefined geopolitical parameters. Nevertheless, they have never fully displaced or invalidated geography's enduring influence. Historical experience, in fact, indicates that great powers and alliances that succeed in fusing technological innovation with geopolitical advantage are those most likely to prevail in strategic competition.

In reality, humanity's knowledge, utilization, and control of the oceans remain in a nascent stage. Over 90% of the deep ocean remains largely uncharted and poorly understood. While the era of artificial intelligence will undoubtedly enhance our ability to perceive, access, and develop maritime spaces, fundamental physical laws and geographical constraints will continue to exert a significant and unavoidable influence. The advent of AI may extend our reach, but it does not eliminate the friction of distance, the challenges of terrain, or the spatial logics that underpin geopolitical strategy.

In the 21st century, sea power is poised to gain renewed momentum in the domain of the deep sea. Rapid advances in marine technology are ushering in a new era of comprehensive oceanic exploration and exploitation, with breakthrough capabilities in deep-sea sensing, undersea system deployment, and subsea warfare on the horizon. These developments are set to transform maritime military competition, expanding it beyond the surface and near-shore underwater zones into a three-dimensional, full-spectrum contest across vast oceanic depths. Future undersea conflict will likely involve complex system-level engagements integrating submarine, surface, aerial, and even land-based forces. In response, major powers will be compelled to address critical deficiencies in their current capabilities for deep-sea sensing, maneuver, and operational readiness, while also unlocking the vast, yet still latent, strategic and military potential of the deep sea.

As the last largely ungoverned and inaccessible frontier on Earth, the deep ocean urgently demands the establishment of robust governance frameworks and regulatory institutions. Its development trajectory will play a pivotal role in shaping the future of global governance and the evolving international order. At present, much of deep-sea exploration and resource extraction occurs in legal gray zones or regulatory vacuums, raising pressing questions about ownership, access, environmental protection, and strategic control. The formation of new norms and rules in this domain will have direct implications for the material interests of states and their geopolitical standing. The latent strategic significance of deep-sea spaces cannot be overstated: the manner in which their governance is institutionalized will exert a profound and lasting impact on the global maritime order and the balance of power in the decades to come.

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