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AUTONOMOUS SHIPPING IN INDIA: NAVIGATING LEGAL, ECONOMIC, AND STRATEGIC CHALLENGES

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ABSTRACT

The article explores the impact of autonomous shipping on India's maritime sector, focusing on legal, economic, and strategic aspects. It identifies gaps in the regulatory framework and emphasises the need for updated policies to integrate autonomous vessels while maintaining sovereignty and security. While automation enhances efficiency, it also raises concerns about job losses, particularly in nations reliant on maritime employment. The article critiques UNCLOS for its inadequacies in addressing issues like autonomous underwater vehicles and foreign military activities in India's waters. Additionally, it examines the environmental impact, highlighting risks such as increased underwater noise pollution and disruptions to marine ecosystems. The discussion extends to India's strategic maritime ambitions, weighing global norms against national security concerns. The article concludes that while autonomous shipping presents opportunities, its successful adoption will require regulatory reforms, environmental protections, and workforce reskilling to ensure India remains competitive in the evolving maritime landscape.

Keywords: Autonomous Shipping, Maritime Regulations, UNCLOS Limitations, National Security, Economic Impact, Workforce Adaptation, Environmental Impact.

INTRODUCTION

The emergence of autonomous shipping represents a revolutionary transformation in the marine industry, posing both possibilities and difficulties for international trade and security. India, a country with a long coastline and a developing maritime economy, has complex legal, financial, and strategic issues when integrating autonomous ships into its shipping sector. Automation presents serious issues with regard to regulatory gaps, security flaws, and possible job losses, even as it also offers higher efficiency, lower operating costs, and better safety. In light of India's strategic location along international shipping lanes and its desire to develop its marine capabilities, it is critical to evaluate the legal frameworks pertaining to

autonomous vessels, the potential economic disruptions they may cause, and their wider national security implications. This essay critically analyses these elements, highlighting significant flaws in India's current maritime legislation and emphasising the policy changes which are required to provide a fair response to technological developments in the shipping sector.

INNOCENT PASSAGE AND INDIA'S MARITIME ZONE ACT

The genesis of international maritime law can be traced back to a debate in the early modern era, which revolved around whether the seas could be governed as sovereign territory (*mare clausum*), or if they were a global commons (*mare liberum*). The Portuguese pioneered a system of managing maritime commerce in the Indian Ocean through superior naval forces and a system of customs, taxes, and vessel licensing. Initially, even Britain adhered to the *mare clausum* approach, as the term itself was coined by the British author John Selden. However, the concept of *mare liberum* was proposed later by Hugo Grotius and others, but was resisted by the major powers in their struggle for dominance.

India's political leaders had prioritised sovereignty and internal development for a long time. Due to this perspective, the freedom of navigation—particularly concerning foreign warships—was something to be restricted to safeguard India from foreign powers. Recently, a growing "maritime consciousness" has emerged in India, stemming from various sources, including naval officers, political commentators, and political-economic initiatives. India perceives sea power as crucial to sovereignty.[2] Westerners, such as Vasco da Gama, utilised ships to dominate Asia ("Vasco da Gama Epoch"), a term coined by Indian historian KM Panikkar. This naval advantage facilitated the establishment of empires, much to the loss of freedom of Asian nations. In 2007, the then Minister for External Affairs Pranab Mukherjee echoed Panikkar, when he stated,

> *"The realisation that this gross neglect of maritime security eventually led to the colonisation of the subcontinent and the consequent loss of India's very independence for nearly three centuries should make a repetition of this strategic error utterly unaffordable."*

Many postcolonial nations like India perceived the world as divided between the large industrial powers, which possessed navies and that sought freedom of navigation to protect the global commons and to project power, and the developing nations, which aimed to restrict access to waters off their territory to

guard against power projection and to secure economic resources in and under those waters. With decolonisation, an increasing number of new states joined the international system and sought to challenge the existing norms. O'Connell observed that as the arrangement of States shifted to include more actors, the push for *mare clausum* intensified. The developing world sought to shift the norms of the ocean's regime away from valuing freedom of the seas and narrow coastal jurisdiction, giving greater economic rights to ocean space off the territorial waters of States beyond the customary three-mile limit and restricting freedom of navigation into territorial sea—and later the EEZs. As James Kraska notes,

> *"The relative ascent of the Third World South and Russia presages a reformation of international law, including well-settled tenets of the law of the sea. In particular, the emerging powers are renewing a push for expanded coastal state authority, jurisdiction, and even sovereignty, in the EEZ."*

India sought to restrict extra-regional powers from having military forces in the Indian Ocean region (IOR), which often referred to as India's 'Monroe Doctrine'. When India defeated Pakistan in the 1971 India-Pakistan War, the Nixon administration dispatched the carrier USS Enterprise from the Pacific to the Bay of Bengal as a token show of force that seemed like a return to imperial gunboat diplomacy.

After the establishment of a presence at Diego Garcia by the US, the Soviet Union's invasion of Afghanistan in 1979, and the proclamation of the Carter Doctrine, the Indian political leaders started perceiving South Asia as a potential new theatre of the Cold War. In recent years, New Delhi has consistently objected to U.S. surveillance and intelligence-gathering vessels operating off India's coast, leading to formal protests in the years 2001, 2004, and 2007. As noted by various Indian naval officials, India is also identified as a country where the U.S. conducts Freedom of Navigation Operations (FONOPs) to contest "excessive maritime claims."

India made it mandatory for foreign warships to notify and obtain permission before entering Indian territorial seas. The initial United Nations Convention on the Law of the Sea (UNCLOS) did not include a specific requirement, leading India to refrain from ratifying the four Geneva Conventions on the Law of the Sea (which make up UNCLOS I) in the 1960s. In a similar context, India aimed to limit the entry of foreign military powers into the Indian Ocean Region (IOR), as demonstrated by its 1971 proposal for an Indian Ocean Zone of Peace (IOZP). In 1976, India enacted the Maritime Zones Act, granting the Central Government

the authority to require foreign warships, including during innocent passage, to either notify or seek prior permission before entering India's territorial waters. This requirement has been implemented as part of India's official maritime policy. The 1976 Maritime Zones Act stipulates that

> *"Foreign warships including submarines and other underwater vehicles may enter or pass through the territorial waters after giving prior notice to the Central Government: Provided that submarines and other underwater vehicles shall navigate on the surface and show their flag while passing through such waters."*

With over 170 state parties, UNCLOS is widely regarded as the "*constitution of the oceans*." India's Maritime Zones Act is largely consistent with UNCLOS, and its requirement for prior notification from foreign warships during innocent passage reflects its interpretation of the "*due regard*" principle, which aims to safeguard the rights and legitimate interests of coastal states. India's apprehensions about maritime security and Sea Lines of Communication (SLOC) have been amplified by China's growing naval and economic relationships with many of India's neighbouring countries, such as Pakistan, Bangladesh, Sri Lanka, and Myanmar, through China's Belt and Road Initiative (BRI). These developments encourage India to maintain the norms of freedom of navigation, as interpreted by Western maritime powers, and the peaceful transit of warships through Exclusive Economic Zones (EEZs) in Southeast and Northeast Asia, especially in the South China Sea. A China that dominates the South China Sea is a China that can control the Straits of Malacca and securely project power into the Indian Ocean. As the maritime affairs analyst Abhijit Singh warns, "*More importantly, India must be aware that a consolidation of Chinese maritime power in Southeast Asia has a direct bearing on the People's Liberation Army Navy's (PLAN) power projection plans in the Indian Ocean*." The Modi government has emphasised maritime themes in several of its initiatives, such as the Security And Growth for All in the Region (SAGAR[3], which also means "sea" in Hindi), Blue Revolution, Neighborhood First, and Act East. In 2015, Prime Minister Narendra Modi launched the SAGAR initiative and embarked on a series of visits to IOR countries, outlining his "maritime vision" and the Blue Revolution. A significant example of this was India's chairing of the UN Security Council's (UNSC) open debate on maritime security in August 2021, marking the first time an Indian prime minister chaired an open UNSC debate, in which five principles were laid down. The first principle focused on the free flow of maritime trade, as challenges in this area could hinder the entire global economy. The second principle emphasised building peace and stability. The third principle addressed natural disasters and maritime threats

posed by non-state actors. The fourth principle focused on the preservation of the maritime environment and resources. The fifth principle highlighted the importance of connectivity and infrastructure.[4]

UNCLOS AND ITS LIMITATIONS FOR INDIA

The United Nations Convention on the Law of the Sea (UNCLOS), though legally binding for its state parties, has often been critiqued for its limited enforceability in practice, particularly when influential states act inconsistently with its provisions. The argument put forth by adherents is that UNCLOS principles are customary law that should be followed by all states. They quietly convey this argument by using words like "every state" rather than "state parties." However, the *doctrine of reasonableness*, a fundamental principle that has guided legal thought since time immemorial, would suggest the tried and tested method of referring to the states that have ratified a particular treaty as 'state parties'. Concerning UNCLOS, the application of it on an *Ejusdem Generis* basis, states that have not ratified the agreement are thus non-parties to UNCLOS.

Adherents often cite the binding dispute resolution mechanism as a groundbreaking development under international law. Based on this, they conclude that the 'legal and binding nature' of UNCLOS should not be questioned, even while acknowledging that the practicality of the binding nature is something that can be debated based on past events. They often add that the problem is endemic to international law itself, and some of the more mature scholars among the group of adherents have stated that the challenge is to ensure that States abide by the rules that they have agreed to respect. Most of them agree that UNCLOS and international law in general provide States with a range of tools, rules, and procedures to stand against an act of non-compliance by another State. However, they concede that the real problem is that overall, there is not much cooperation, and states lack a full understanding of the rules and procedures.

The binding nature of UNCLOS is often challenged in practice, especially when influential states, including permanent members of the UN Security Council, act in contravention of its provisions with little to no accountability. If pragmatism is absent, it simply means and denotes the lack of enforceability, and when a regulation or, for that matter, a rule of law is unenforceable (in any situation and case and against any violating member state), it cannot be dubbed any other way but the perfunctory itemisation of a code of conduct. The instances that the

adherents often cite have been mainly from the developing world, and given the huge faux pas of both the US, vis-à-vis, the ISA, and China on several counts, what kind of message would an average bystander get? In a relevant example, China uses the nine-dash line to justify actions which any rational bystander would dub to be in contradiction with the tenets of UNCLOS. Given that there has been no retributive action or enforceability for that matter, a seminal query would arise in that any discerning researcher worth his salt would simply ask if the UNCLOS is truly a binding instrument?[5].

The term 'Maritime security' lacks a universally accepted definition and is considered a fluid concept. The United Nations Convention on the Law of the Sea, 1982 (UNCLOS or UNCLOS III) does not explicitly address this issue. According to Professor Natalie Klein, 'maritime security' encompasses '*the safeguarding of a state's terrestrial and maritime territory, infrastructure, economy, environment, and society from certain detrimental acts occurring at sea*'. In this context, 'detrimental acts or threats' are understood in a comprehensive sense, encompassing not only all threats outlined in the 2008 report of the UN Secretary but also potential future threats.

In addition to the challenges already documented, UNCLOS may face difficulties in addressing emerging issues in the maritime domain. The growing prevalence of autonomous underwater vehicles (AUVs) prompts questions about their categorisation and potential military uses within Exclusive Economic Zones (EEZs). The framework of UNCLOS, primarily centred on traditional vessel navigation, may not be sufficiently equipped to handle these innovative technologies. Furthermore, the escalating significance of seabed mining for critical minerals calls for a robust regulatory framework that UNCLOS, particularly Part XI on deep seabed mining, may not fully offer.[6] The International Maritime Organisation (IMO) is presently working on a regulatory framework for Maritime Autonomous Surface Ships (MASS), which aims to provide uniform international standards to address the legal uncertainties surrounding autonomous shipping.

In the Indian legal framework, several statutes such as "*the 1989 International Convention on Salvage*[7]*"*, incorporated under Part XIII of *"the Merchant Shipping Act of 1958*[8]*"*, "*the Merchant Shipping Rules of 1974*[9] *(revised in 1975)"*, and "t*he 2007 Nairobi International Convention*[10] *on the Removal of Wrecks"*, govern the matters of salvage and wreck removal. Furthermore, "*the Ports Act of 1908*[11]*"*, "*the Merchant Shipping (Limitation of Liability for Maritime Claims) Rules of 2015 — Amendment Rules of 2017*[12]*"*, and "*the Carriage of Goods by Sea Act of*

1925[13]*"* are the legislative instruments addressing cargo claims. Nevertheless, none of these statutes provides explicit guidance on India's entitlements to wrecks situated beyond its national jurisdiction as per the United Nations Convention on the Law of the Sea (UNCLOS). The United Nations Convention on the Law of the Sea (UNCLOS) was formulated to establish a legal order for maritime governance. However, in practice, its application has presented challenges for India, particularly in the areas of enforcement, security, resource exploitation, and strategic autonomy. While UNCLOS provides a legal framework for maritime activities, it lacks effective enforcement mechanisms, leaving states vulnerable to violations by major powers that choose to disregard its provisions. This is particularly evident in India's experience, where enforcement of its maritime rights has been constrained by the structural weaknesses of UNCLOS.[14]

One of the fundamental challenges India faces under UNCLOS is the divergence in interpretation and implementation of the treaty's provisions by different states. A key example is the principle of freedom of navigation. While UNCLOS grants coastal states sovereign rights over their Exclusive Economic Zone (EEZ), it simultaneously permits foreign military operations within these zones, a clause that has been exploited by major naval powers. The United States, despite not being a signatory to UNCLOS, frequently challenges India's maritime claims through Freedom of Navigation Operations (FONOPs). In 2021, the US 7th Fleet conducted a FONOP near India's Lakshadweep Islands without prior consent, directly contesting India's interpretation of its maritime rights under UNCLOS.[15] This incident underscores how the treaty, rather than strengthening India's sovereignty, has instead created ambiguities that external powers exploit to justify naval presence in Indian waters.[16]

Furthermore, UNCLOS has been inadequate in preventing strategic encroachments in the Indian Ocean. China's increasing maritime assertiveness, particularly through the deployment of autonomous underwater vehicles (AUVs) and disguised research missions in India's EEZ, highlights the treaty's inability to address evolving maritime security threats. UNCLOS does not explicitly regulate the military use of AUVs in foreign EEZs, leaving India with limited legal recourse to counter these activities.[17] The Chinese presence in the Indian Ocean, including survey vessels operating near the Andaman and Nicobar Islands, poses a direct challenge to India's strategic autonomy. While India has lodged diplomatic protests, the lack of strong enforcement provisions under UNCLOS renders these measures largely ineffective.[18]

Another major limitation of UNCLOS for India is its approach to dispute resolution. Although the treaty mandates compulsory dispute settlement through bodies such as the International Tribunal for the Law of the Sea (ITLOS), its rulings often lack enforceability.[19] The 2016 Permanent Court of Arbitration ruling against China's expansive claims in the South China Sea, which Beijing outright rejected, is a testament to this weakness. Given such precedents, India cannot rely on UNCLOS mechanisms to resolve its ongoing maritime disputes, such as those involving Sri Lanka over fishing rights or the Kalapani territorial issue with Nepal.[20] The treaty's dispute resolution framework is thus more of a diplomatic tool than a binding mechanism for enforcement.

India's economic interests are also constrained by UNCLOS, particularly in the domain of deep-sea resource exploitation. The International Seabed Authority (ISA), which governs seabed mining beyond national jurisdictions, imposes extensive regulations that favour technologically advanced nations.[21] India, despite its significant deep-sea mining potential, faces bureaucratic and financial obstacles in accessing resources from its licensed exploration zones. Meanwhile, nations with superior technology, such as China and the United States, benefit disproportionately from these regulations.[22] The restrictive framework of the ISA thus limits India's ability to independently harness its maritime resources, undermining its economic prospects in oceanic resource extraction.[23]

Moreover, India's domestic maritime laws conflict with certain UNCLOS provisions, leading to additional friction in implementation. India's Maritime Zones Act, 1976, requires prior consent for foreign military vessels to enter its territorial waters, a stance similar to China's domestic maritime regulations[24]. However, UNCLOS does not mandate such prior consent, which has resulted in repeated FONOP challenges by the US Navy.[25] India, despite aligning geopolitically with the US on regional security matters, has thus found itself on the receiving end of legal ambiguities created by UNCLOS. This inconsistency underscores the treaty's inability to reconcile national security priorities with its universalist framework.[26]

The inadequacies of UNCLOS for India are further exacerbated by the shifting maritime power dynamics in the Indo-Pacific. The treaty was formulated in a vastly different geopolitical era, and it has failed to evolve to address contemporary maritime challenges.[27] As nations increasingly deploy hybrid strategies involving lawfare, economic coercion, and military manoeuvres, UNCLOS remains

insufficient in addressing these modern realities. The increasing militarisation of artificial islands, challenges to India's naval dominance in the Indian Ocean, and the lack of enforceability of maritime rulings all indicate that UNCLOS, in its current form, does not adequately serve India's strategic, security, and economic interests.[28]

MARITIME WORKERS IN THE ERA OF AUTOMATION

Presently, the focus of all existing solutions is on enhancing efficiency and transparency through the application of various technologies such as Blockchain or IoT. These solutions highlight the positive transformation the industry will undergo post-technology implementation, yet they fail to address the potential drawbacks or the associated implementation costs. The digitalisation of the maritime industry represents a significant investment that will revolutionise the entire infrastructure once a ship is operational. However, there are no proposed solutions to mitigate the costs associated with shipbuilding or the financing required for purchasing a new vessel.

Moreover, the advent of technology brings with it the risks of security breaches and job losses. The introduction of autonomous ships is likely to disrupt the crew market and, consequently, the economy. Economies of countries like Indonesia, the Philippines, and Bangladesh, where citizens depend on remittances from seafaring jobs, will be particularly affected. Yet, these solutions do not address how the displaced crew will be managed post-job losses.

Furthermore, these solutions do not mention the security threats posed by technology and the strategies to counter them. Operating in a mixed navigational environment—where traditionally manned, remotely operated, and unmanned vessels interact within the same maritime areas—presents a substantial barrier to the adoption of autonomous ships.[29] Despite the proposed solutions, this issue remains unresolved. The maritime sector's importance to India's security, stability, economic growth, and sustainable development is undeniable, and is highlighted by its extensive maritime heritage that extends over 5000 years. The world's oldest dry dock, which dates back to the Harappan civilisation, has been unearthed at Lothal. As India stands on the brink of becoming a global economic force in the 21st century and aims to reach a USD 5 trillion economy by 2025, it aims for

a USD 25 billion contribution from the maritime zone, in accordance with the global average of about 5%. To achieve a USD 10 trillion economy by 2032, the maritime sector is anticipated to play a crucial role. While 90% of trade is carried out via the seas, India's contribution is merely 8%[30]. India's development story is riddled with a multitude of socio-economic challenges. India's manufacturing capabilities have been trailing in recent years, and it has yet to establish itself as a major global manufacturing centre. There has always been an innovation gap in India.[31] India's development narrative is fraught with numerous socio-economic challenges. India's manufacturing prowess has been lagging in recent years, and it is yet to emerge as a significant global manufacturing hub.

As Chanakya has rightly put it, "*Shaastra cha Shastra Virodhena – Vijayi bhavati rajan*" [32] or "*Through conflict of new and old knowledge, the king emerges victorious.*" In short, it explains how Chanakya stresses the value of conflict between new and old knowledge, with the king (or leader) standing to gain from this intellectual confrontation. In India, there has always been an innovation gap. For instance, computers were not as popular or widely used in India due to the advent of smartphones. This can be attributed to various factors, but a key reason is the late entry of computers. By the time computers were gaining traction, smartphones entered the market, and due to their convenience, they were preferred over computers. India lags behind many developed countries, but it has the advantage of being able to choose the right resources and learn from the mistakes of other countries. Thus, AI can be utilised in a manner that may eliminate routine work, but at the same time, it can provide alternative employment opportunities. The Indian maritime industry has started to grow at an unprecedented rate, attracting technology, finance, and human resources on a large scale. This presents immense opportunities for investors to participate in the industry's growth story. The driving force behind India's evolving narrative is the Maritime Vision—2030[33], announced by Prime Minister Shri Narendra Modi. It is a bold declaration of India's ambitions in the sector.

As per the statement, India is earnestly committed to expanding its maritime sector and emerging as a global leader in the Blue Economy. The primary areas of focus include upgrading existing infrastructure, creating next-generation infrastructure, and accelerating the reform process. India is open to adopting global best practices. As stated by Hon'ble Prime Minister Shri Narendra Modi, India, with its focus on trade and economic ties with BIMSTEC and the Indian Ocean Rim nations, plans to increase infrastructure investment and facilitate mutual agreements by 2026.

Another priority is to initiate the comprehensive development of island infrastructures and ecosystems. These lessons will be instrumental in assisting the islands of the Indian Ocean in combatting the effects of climate change while pursuing economic growth. As India strives to compete with global mega ports, providing financial certainty to investors has become indispensable for attracting investment for the set targets. The primary goal is that by 2030, more than 85 per cent of the cargo handled at the major ports should be by Public Private Party operators or concessionaires, essentially implying companies, whether private or public.

At the recently concluded G20 Leaders' Summit in New Delhi, eight G20 members—the European Union (EU), France, Germany, India, Italy, Saudi Arabia, the United Arab Emirates (UAE), and the United States (US)—joined forces to announce the opening of the India-Middle East-Europe economic corridor (IMEC). The geo-economic and geostrategic potential of the corridor has attracted a lot of interest. The IMEC will extend to West Asia and the Middle East by connecting India to the UAE and Saudi Arabia, and further to Jordan and Israel. This part of the IMEC, known as its eastern corridor, connects India and the Middle East through the Arabian Gulf, also commonly referred to as the Persian Gulf. The second component of the IMEC, the northern corridor, connects the Arabian Gulf to Europe. The connection will extend from Israel westward, through the Mediterranean Sea, into Greece, Italy, France, and further to Germany.

The proposition of an alternative route to the Suez Canal is indeed an attractive one. India's trade volumes with Europe are anticipated to increase significantly upon the completion of its ongoing free trade agreement negotiations with the European Union (EU) and the United Kingdom (UK). These upcoming FTAs will be supplemented by the FTA that India has already signed with the UAE and the one expected to be negotiated in the future with Israel. The increased volume of trade will present a diverse range of opportunities to Indian businesses, particularly the MSMEs, for closer integration in global supply chains. It is imperative to protect supply chains, particularly those of key character, whose disruptions could have significant effects on national economic security, such as food, energy goods, precious metals, and pharmaceuticals, to guarantee that this vision comes to pass.

The creation of excellent employment opportunities for youth is the vision of Amrit Kaal, led by Prime Minister Shri Narendra Modi. India has to put in a lot

of effort to help the shipping industry grow quickly in order to lead the world in both the maritime economy and maritime infrastructure. According to the latest Staffing Annual Review and Forecast report, published by Drewry in June 2023, the shortfall in the supply of officers has reached a record high.

A research study analysing marine accidents from 2010 to 2019, using global accident investigation reports, found a positive correlation between the severity of marine accidents and natural factors. It was observed that seafarers with inadequate theoretical knowledge and limited sea experience are more prone to be involved in serious accidents. There are opportunities for collaboration between industry and academia in maritime education and research, with AI serving as a tool for assistance. The establishment of Centres of Excellence for Skilling, investment in industry-relevant research projects enabling lab-to-land applications, consideration of a sustainable mentoring system for cadets and young professionals, and ensuring a consistent flow of professionals dedicated to imparting knowledge and skills in the classroom are some of the potential initiatives.

The Maritime India Vision 2030[34] document outlines the prospects and action points to guide us beyond 2050[35]. Over the past nine years, the Ports, Shipping and Waterways Ministry has initiated several measures to automate Indian Major Ports under the Sagarmala programme, aiming to position Indian Major Ports among the most efficient systems globally. These initiatives have yielded significant benefits. By automating tasks like transportation, cargo handling, and terminal operations, ports are reducing human error and increasing efficiency. This is done by utilising cutting-edge technologies. Additionally, they are integrating state-of-the-art technologies like blockchain, artificial intelligence, and the Internet of Things (IoT) to enhance security, optimise data management, and enhance port operations. IoT, robotics, automation, cloud computing, AI, and robotics are some of the key technologies used at ports worldwide. These technologies enable ports to operate more efficiently and enhance their capacity to manage large cargo volumes.

Green port initiatives aim to promote the operation of Roll-on-Roll-off/Ro-pax ships, to shift domestic cargo transportation from road to sea. This will foster coastal shipping and reduce carbon emissions per cargo-carrying truck, thereby mitigating climate change implications. The development of a transhipment hub in India, capable of accommodating the largest container ships currently in operation and equipped with automated terminal infrastructure, is a pressing need. Once accomplished, this will yield multiple benefits such as forex savings,

job creation, retention of Indian EXIM data, improved logistics efficiency, and increased tax collection.

AI AND THE POTENTIAL CONFLICTS IN MARITIME AUTOMATION

An Autonomous Vessel refers to a ship that can execute navigation, or machinery control operations, or both, with minimal or no crew intervention. This does not necessarily imply the absence of human presence. Autonomous Surface Vessels (ASVs) are a type of surface-operating vessel. Any construction intended to float on water for commercial or military uses and driven by steam, wind, or oars is called a vessel[36]. Courts have ruled that a craft, which will undoubtedly become a vessel, is not considered a definitive vessel at any specific time before its completion. In the case of *Muntz v. A Raft of Timber*[37], a raft was deemed a vessel as it carried a pilot, crew, and a cook who resided and were sheltered during an extended voyage.

If AI is correctly implemented, it will revolutionise the marine industry in three ways – by providing self-sufficiency to automated entities, evaluating and optimising processes, and predicting future trends. This will undoubtedly lead to enhanced performance and the easy attainment of sustainability goals. The Shipping Industry requires shared data to make high-quality decisions. The implementation of AI technologies has been delayed due to the quality of data in this sector. The lack of reliable information throughout the entire supply chain process hinders the industry's development. Therefore, analytics require consistent and accurate data. The shipping sector must promptly implement AI, the Internet of Things (IoT), sensor technology, etc. Employees must learn the new techniques implemented in their workplace. The digitisation process will enhance the methods of working smarter, simpler, and more effectively. However, there will be time constraints and increased development costs.

Currently, India is significantly below global standards in nearly all aspects of maritime power. The Indian Navy is one of the many elements that characterise maritime power, even if it may be among the strongest in the world and is essential to India's maritime ambitions. India's development story is characterised by a wide range of socio-economic difficulties. Despite a high volume of national trade, India's manufacturing capability has been lagging, and it is yet to emerge

as a significant global manufacturing hub. In the maritime sector, India's global shipbuilding share is less than 1%, falling short of the 5% target outlined in the Maritime Agenda 2010-2020. Not a single Indian port, including the Jawaharlal Nehru Port Trust (JNPT) in Mumbai, ranks among the world's top 25 ports or even the top 10 in Asia. The ship repair industry in India is uneconomical and lags behind global best practices, leading to a preference for foreign ship repair yards even for Indian-flagged vessels.

As per the 2019 statistics from the Shipping Ministry, India's Merchant Fleet comprises 1,429 vessels with a total tonnage of 12.746 million tons. However, these numbers are somewhat misleading as only 9.7% of India's foreign trade and 59% of its coastal trade is carried on Indian ships. In addition to creating a huge foreign exchange loss (estimated at USD 50 billion), this also presents a strategic weakness.[38] Moreover, most of these ships are over twenty years old, which means that operating them in the current technologically advanced environment is not cost-effective.

India's fishing fleet remains outdated, relying on conventional methods with limited government support for modernisation. As AI-assisted security technologies enter the maritime sector, resistance is expected, particularly from veteran sailors concerned about job displacement. To integrate AI effectively, a robust testing framework and updated training programs are essential to develop a technologically skilled workforce. Additionally, new operational strategies will be needed to support AI-driven marine security and multi-vehicle management.

Another challenge in developing these systems is their vulnerability to countermeasures. Adversaries are likely to develop counter-strategies alongside AI-assisted systems still in design. For example, submarines already use acoustic stealth and noise reduction technologies, and future advancements could enable AI-driven sound identification to detect and track these vessels.

Without a crew to deter attacks, autonomous ships become easier targets for pirates, increasing the risk of hijacking. These vessels rely on AI-driven navigational sensors linked to a control room, but once pirates board, they can disable the sensors, cutting off remote access. While fewer crew-related kidnappings may occur, the risk of ships being held for ransom or used for smuggling remains high.

AI-enabled defence systems primarily use SONAR for underwater communication, which poses significant risks to marine life. Species like whales, sharks, and

dolphins, many already endangered, rely on sound for navigation, and exposure to SONAR waves can disrupt their sensory organs, causing disorientation or even death. Corals are also affected, further impacting marine ecosystems. Given that many of these species are classified as 'critically endangered' or 'endangered' by the IUCN Red List, the long-term ecological consequences of such technology must be carefully considered.[39]

Threats like signal interception and diversion from any AI-enabled autonomous underwater vehicle or base could come from underwater terrain, such as trenches, rocks, mounds, ridges, etc., and underwater activities, such as installing optical fibre cables and oil and gas pipelines. For the mechanism to operate smoothly and to maintain the environment, several factors must be considered before implementing it. Cybersecurity involves more than just stopping hackers from accessing data and networks. Moreover, it entails ensuring business continuity, protecting digital assets and data, and fortifying the maritime industry against both internal and external threats. Maintaining the integrity of the supporting systems and protecting the ship's systems from physical threats are vital. High-value cargo vessels are particularly susceptible to high-impact attacks due to the complexity of the numerous types of merchant vessels. By getting into a ship's OT network, a hacker may take control of the navigation systems, operate vital valves, adjust the propulsion, rudder, or ballast controls, implant malware, or even take over the entire administrative system.[40] Hours, days, or weeks can pass during a cyber event. When a ship becomes infected, the virus can frequently spread to other ships through the port network or even the network of the ship's owner or management business. Furthermore, since all vessel movements would be impacted, a ship becoming grounded or stranded in the port shipping channel as a result of an attack on its control systems might have an effect on port operations as a whole. The cybersecurity frameworks and standards are typically very extensive and difficult to fully execute. Frameworks and recommendations that are appropriate for one's area and particular systems must be chosen and put into practice. Because of the widespread cyber occurrences in these sectors during the past ten years, various significant public industries/sectors, including banking and finance, energy, and public health, have taken significant action in this area. The maritime sector can benefit from these sectors' cybersecurity measures. It is evident that while greater digitisation in the maritime sector has improved safety and efficiency, it has also introduced new security dangers that require ongoing attention. There can be new legal difficulties with the XLUUVs[41]. There is an ongoing debate raging over regulating lethal autonomous weapon systems (LAWS), including a call to ban

fully autonomous weapon systems, centred on the Principle of Non-Delegation of the Authority to Kill by non-human mechanisms. A global campaign – Coalition to Stop Killer Robots – has called for an international ban on 'killer robots', and "*a treaty for emerging weapons*." There is a belief that morality and generally accepted ethics need to be injected into the use of AI-enabled weapon systems, given that "*inanimate machines cannot understand or respect the value of life*." If the XLUUVs are put to combat operations, it would result in the weaponization of AI, and this empowers humans to absolve themselves of any moral consequences of killing or using these for self-defence, and not only this, positioning and designating such unmanned underwater vessel is difficult, moreover, concerning maritime enivornment particularly marine life such as whales, sharks, dolphins and other migratory species. Sonar transmissions by XLUUVs can cause potential damage to mammals' sensory organs, resulting in disorientation or death. Whales may even misunderstand sonar waves as those of an attacker, and panic can drive them towards the platform.

CONCLUSION

Although autonomous shipping has the potential to completely transform international maritime trade, considerable legislative and policy changes are needed to incorporate it within India's maritime system. Even though international agreements like UNCLOS offer general principles, they fall short in addressing the particular difficulties presented by autonomous vessels, especially with regard to sovereignty, security, and liability. India needs to take the initiative to update its marine regulations to reflect new developments while maintaining economic stability and national security. Furthermore, in order to guard against possible risks like hacking, piracy, and data breaches, the implementation of autonomous shipping will need strong cybersecurity measures. It is also necessary to carefully handle the economic ramifications, including the possibility of job displacement in the maritime workforce, by promoting new employment prospects in maritime technology industries and implementing worker reskilling initiatives. India will need to take a forward-thinking, technologically advanced, and legally sound approach in order to maximise the advantages of autonomous shipping while reducing its risks and maintaining its competitiveness in the rapidly changing global maritime market.

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41 XLUUVs, or Extra Large Unmanned Underwater Vehicles, are large, autonomous underwater vehicles that can perform missions for several months.

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