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CHARTING SMART SEAS

India's AI-Driven Indo-Pacific Maritime Strategy

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Executive Summary

India's maritime policy is experiencing a robust transformation that now emphasises technological innovations, smart diplomacy, and regional leadership.

India's maritime policy is experiencing a robust transformation that now emphasises technological innovations, smart diplomacy, and regional leadership. India is expanding its reach from coastal defence to the entire Indo-Pacific region through contemporary definitions of maritime power grounded on Artificial Intelligence and multilateralism. India's maritime policy reflects its maritime aspirations with doctrines like SAGAR and the Indo-Pacific Oceans Initiative (IPOI) demonstrating India as a net security provider and development partner.

In the 21st century, AI technologies in maritime domain awareness, surveillance, autonomous systems and disaster management are enhancing the scope of operations in the seas. Strategic collaborations through multilateral partnerships such as QUAD, ASEAN, and IORA and with littoral African states, is resulting in the adoption of AI capabilities toward port management, reef focus, and vessel interactivity. Alternatively, Indian start-ups and public-private partnerships are ushering in a technological transformation characterised by innovations such as autonomous underwater vehicles, AI-based threat detection products like TRIDENT, iDEX, SPRINT, and the Maritime Development Fund.

These initiatives have been critical enablers of India's transition into a self-sufficient maritime technology. Despite all these opportunities, critical challenges still remain due to data deficits, vulnerabilities arising from cybersecurity, and a lack of skilled workforce, limiting the potential benefits from AI. Nevertheless, by merging technology with diplomacy and innovation, India is positioning itself not just as a maritime power but as a forward-looking AI-driven leader in the Indo-Pacific.

Indo-Pacific

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INDIA'S MARITIME VISION AND THE EVOLVING MARITIME DOCTRINE

The maritime framework has transformed from a longstanding defensive coastal posture to a proactive policy that strengthens capability and security in the broader Indo-Pacific region.

Introduction

India's maritime strategy has been rebuilt in the last few decades, moving away from its traditional lens. The maritime framework has transformed from a longstanding defensive coastal posture to a proactive policy that strengthens capability and security in the broader Indo-Pacific region. This evolution recognises not only the significance of sea routes and trade, but also the growing strategic value of technology in the maritime domain. The Indo-Pacific region contributes to nearly 65% of global trade and has globally more than 60% of the world's population, making it a key geo-economic and geopolitical nerve centre.[1] The strategic doctrine India has in this arena is established through a vision of SAGAR (Security and Growth for All in the Region), introduced by the Indian prime minister Narendra Modi in 2015.[2] As maritime threats are evolving to be more complex and transnational, including piracy, illegal fishing, undersea cable damage and grey zone warfare, India is transforming towards integrated maritime domain awareness (MDA), technological independence, and coalition-building diplomacy. The first chapter addresses how India's maritime strategy is changing to take into account the growing importance of technology, including AI, in the larger Indo-Pacific area.

India's Indo-Pacific Aspirations

India's maritime strategy is a result of a systematic use of multiple aspects of state power - diplomacy, economic engagement, and military capability. The strategy is framed to focus on strategic deterrence, maritime security, and regional engagement. India also enjoys a great geostrategic placement due to its coastline bordering the Indian Ocean. Its geostrategic position is viewed in this regard as a balance of power in the South China Sea as well as the Indian Ocean

SAGAR

The strategic doctrine India has in this arena is established through a vision of SAGAR (Security and Growth for All in the Region), introduced by the Indian prime minister Narendra Modi in 2015.

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Region, particularly with China's growing footprints. India's maritime diplomacy and presence in the Indo-Pacific realm originates from the aim of security leadership and cooperation with regional partners. The SAGAR doctrine (2015) re-affirms India's position as a first responder and net security provider in the Indian Ocean Region. The Indo-Pacific Oceans Initiative IPOI, initiated in 2019, reinforces India's approach to regional cooperation in the domains of security, economy and ecology.[3] India's MAHASAGAR Vision (2023), which translates into great ocean, captures India's broader ambition in the global maritime domain to deepen India's ties with island partners such as Mauritius, Seychelles, Sri Lanka and Maldives.[4] In addition, platforms such as the Indian Ocean Naval Symposium (IONS) and Indian Ocean Rim Association (IORA) contribute to India's consistent leadership aspirations in the area of sustained security and developmental collaboration.[5] India's increasing engagements with African coastal nations, ASEAN states, and island states reinforce India's maritime stakeholder presence. Exemplified further through regional capacity-building maritime exercises by the Indian Navy such as MILAN and other joint exercises, this ultimately enhances multilateralism.

Technological Change in India's Maritime Thinking

India's maritime objectives have mostly focused on growing its fleet and conducting coastal surveillance. Though today, the scope of maritime threats in the Indo-Pacific have evolved as the region has now become the theatre of global strategic competition. Cyber threats and disruptions of sea cables, climate change risks, illegal fishing and global power competition have prompted a reorientation in the strategy. And hence, over the past years, there have been demonstrable shifts from having robust naval capabilities to developing smarter, technologically enabled maritime capabilities. As the

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The Indo-Pacific Oceans Initiative IPOI, initiated in 2019, reinforces India's approach to regional cooperation in the domains of security, economy and ecology.

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maritime landscape evolves, the transition to using technology is the key to transformation. Artificial Intelligence (AI) provides a range of solutions from managing shipping routes, predicting future threat scenarios, and implementing better contributions within humanitarian relief workflows.[6] The use of AI is helping India steer its maritime strategic development towards strategic and operational efficiency, marking India's entry into tech-driven maritime leadership. Recognising the need for tech-enabled solutions and real-time situational awareness, India has significantly ramped up its Maritime Domain Awareness (MDA) initiatives. The Information Fusion Centre – Indian Ocean Region (IFC – IOR) has now been established as a centre to share intelligence amongst other nations, connecting to over 21 nations.[7] The expansion of the NAVIC satellite system is yet another example of enhancing satellite-based monitoring capabilities.[8] These capabilities are critical for India's coastal security and the operational awareness it maintains across the Indo-Pacific.

The Link Between SAGAR and AI: A Conceptual Framework

India's SAGAR doctrine embeds India's aspiration to become a net security provider and development partner in the Indo-Pacific. The vision of the doctrine stretches from the Persian Gulf to the Western Pacific and underpins India's diplomatic, economic, and geostrategic aims in the maritime domain. Increasingly, technology, in particular artificial intelligence, is a key enabler in accelerating the SAGAR doctrine. In the domain of disaster response, for example, AI provides real-time mapping of areas affected by disasters and provides guidance to relief vessels. The blue economy (the sustainable use of ocean resources) is also bolstered through using AI for developing GIS of ocean topography, as well as monitoring fish stocks and illegal activity. By inculcating artificial intelligence into the vision of the SAGAR framework, India is reorienting maritime leadership through technological empowerment, global partnership, and self-reliance in the Indo-Pacific.[9]

Maritime Leadership

The use of AI is helping India steer its maritime strategic development towards strategic and operational efficiency, marking India's entry into tech-driven maritime leadership.

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Conclusion

India’s vision for the sea does not end with naval power; it can now leverage its technological capabilities and strategic vision to secure, connect and influence an enormous maritime space. The success of initiatives such as SAGAR (Security and Growth for All in the Region), the Indo-Pacific Oceans Initiative (IPOI), and others will hinge on India's ability to balance its geopolitical ambition and technological execution. In this process, artificial intelligence (AI) is not being offered as an add-on tool but as a core strategy that is central to India's transformation from a regional maritime player to a key stakeholder in the Indo-Pacific.

Artificial Intelligence

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INDIA'S AI DIPLOMACY AND MULTILATERAL MARITIME COOPERATION

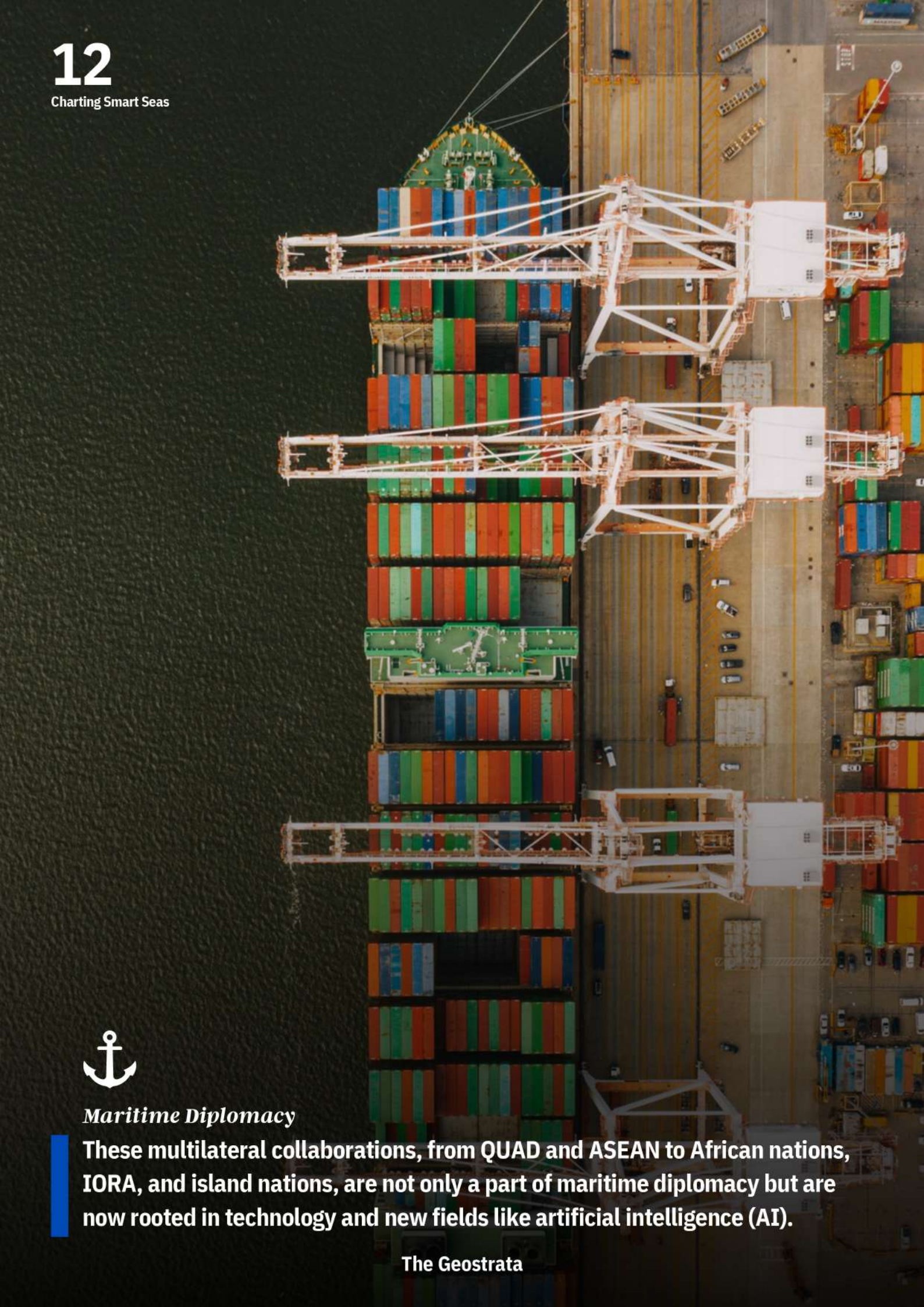
Technology has emerged as a core set of capabilities within India's Indo-Pacific strategy.

Introduction

India's increasing maritime interests in the Indo-Pacific are developed through dynamic partnerships that seek to sustain a stable and open regional order. These multilateral collaborations, from QUAD and ASEAN to African nations, IORA, and island nations, are not only a part of maritime diplomacy but are now rooted in technology and new fields like artificial intelligence (AI). Technology has emerged as a core set of capabilities within India's Indo-Pacific strategy. As AI optimises maritime security elements (through real-time surveillance, predictive logistics, and domain awareness), India is identifying ways to incorporate new capabilities within multilateral engagements, while simultaneously being cautious of overreliance on foreign technology. This chapter examines how India seeks to manage its multilateral engagements to further its AI-based maritime strategy. It will assess both strategic and technological priorities of various partnerships, while also accelerating the need to balance collaboration with indigenous capabilities.

The Importance of Multilateralism in the Indo-Pacific

The Indo-Pacific region has been facing a number of concerns, including geopolitical disagreements, maritime challenges, grey-zone operations, and climatic issues. Given that no single country can address these challenges alone, multilateralism is essential in the region. For India, multilateralism serves many frameworks; enhancing Maritime Domain Awareness (MDA), operational coordination, and access to AI-based surveillance and autonomous systems. However, deeper tech-based cooperation carries risks in the context of data sharing, technological sovereignty and cybersecurity. As India collaborates with a variety of foreign players, there is a requisite to also weigh these interactions against long-term national imperatives and potential dependencies.



Maritime Diplomacy

These multilateral collaborations, from QUAD and ASEAN to African nations, IORA, and island nations, are not only a part of maritime diplomacy but are now rooted in technology and new fields like artificial intelligence (AI).

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India's AI-Driven Multilaterals

(I) QUAD: Giving Impetus to AI-Centric Maritime Awareness

Since its formal inception in 2007, consisting of India, the US, Japan and Australia, QUAD has evolved into a major technologically skilled form of partnership in the Indo-Pacific. The Indo-Pacific Partnership for Maritime Domain Awareness (IPMDA, 2022) of QUAD uses AI-assisted systems of satellite surveillance to keep track of illegal continued activities.[10] India, through its Information Fusion Centre - Indian Ocean Region (IFC-IOR), is building the regional foundation for information sharing.[11] Meanwhile, QUAD has also established a Critical and Emerging Technologies Working Group to jointly develop solutions for AI, quantum, and cybersecurity.[12] In the case of naval drills, such as Malabar 2023, joint exercise by the grouping tested AI-assisted communications and decision-making tools.[13] These engagements highlight how India is balancing alliance-building in the face of self-reliance in technology.

(II) ASEAN: Navigating Tech Diplomacy in the South China Sea

India's increasingly close-set ties with ASEAN nations gives impetus to its Act East Policy and the Indo-Pacific Oceans Initiative (IPOI), crucial for building stability in the South China Sea and the Indo-Pacific.[14] The India–ASEAN Maritime Exercise AIME in 2023 put to test various AI-supported protocols for navigation and communications. Lateral communications through data sharing and joint development tools between the Indian Navy and ASEAN states such as Indonesia and Vietnam, is helping build AI-based predictions on congestion and domain monitoring applications.[15] Tech transfers, including digital surveillance platforms and hydrographic mapping tools, are being procured alongside traditional defence assistance.[16] Importantly, all of these initiatives suggest a tacit shift in India’s tech-led maritime cooperation across the region.

Technology

Since its formal inception in 2007, consisting of India, the US, Japan and Australia, QUAD has evolved into a major technologically skilled form of partnership in the Indo-Pacific.

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(III) Digital Capacity and Africa–IORA Synergy

India's Maritime Vision stretches to involve the African nations under its MAHASAGAR vision and the Africa-India Key Maritime Engagement (AIKEYME) initiative.[17] India is aiding the African and Indian Ocean Rim Association (IORA) countries to inculcate technology like artificial intelligence in their maritime systems by installing Coastal Surveillance Radar Systems (CSRS) in countries like Seychelles, Mauritius, and Comoros.[18] Through bilateral naval programmes such as AFINDEX 2023, India is training its African partners on digital navigation and systems such as threat alerts.[19] Further, EEZ (exclusive economic zone) monitoring tools based on AI are being piloted by the Indian Navy in the western Indian Ocean nations.[20] Such a further movement of capacity building embeds AI-enabled tools into security collaboration, while projecting India as a responsible tech provider. This onward shift to capacity-building ensures that AI-enabled tools are embedded in security collaborations, while projecting India as a responsible tech provider.

(IV) AI for Climate and Connectivity in the Indo-Pacific

India is partnering with European countries and island nations to harness the full potential of AI in advancing maritime technologies and climate emergency responses. France, UK, and India are implementing a powerful tech arsenal for tracking marine pollution and monitoring the health of reefs.[21] In countries such as Sri Lanka and Fiji, projects such as e-SMART are supporting AI-based port management and climate resilience systems.[22] There are also cooperative efforts to create satellite-assisted disaster response platforms, which would be especially useful for island states that remain in danger of the rise in sea levels. These activities attest to India's technological prowess to promote sustainable regional development in addition to defence in the larger remit of the Indo-Pacific region.

Coastal Surveillance

India is aiding the African and Indian Ocean Rim Association (IORA) countries to inculcate technology like artificial intelligence in their maritime systems by installing Coastal Surveillance Radar Systems (CSRS) in countries like Seychelles, Mauritius, and Comoros.

Towards Strategic Technological Sovereignty

As much as India's ability to access modern maritime AI technology through multilateral cooperation is increasing, so are the risks such as data ownership, foreign system reliance, and long-term technology ownership. India is conscious in realising that attaining strategic autonomy cannot be based on foreign solutions alone. In this regard, the SeaVision system was developed in the United States and is being augmented with indigenous data sources to facilitate Maritime Domain Awareness (MDA) in the Indian Ocean.[23] This illustrates a calculated step in autonomous and sovereign technological infrastructure. At the core of this evolution are the emergence of public-private innovation platforms. Homogenous Indian start-up initiatives like iDEX and SPRINT are designing solutions like autonomous underwater vehicles, predictive logistics and AI-enhanced communication networks.[24] The TRIDENT, a collaboration between Bharat Electronics Limited and Blurgs Innovations, which is currently operational in the Indian Ocean, offers near-real-time threat assessment and situational awareness using AI.[25] These efforts are not just moving India beyond dependency on foreign surveillance but are also placing the country in a position to be a net exporter of AI maritime solutions. By merging collective diplomacy with home-grown innovation, India is expanding its maritime domain strategy to full use.

Conclusion

India's vision for the Indo-Pacific is augmented with strategic multilateralism and technological collaboration. While artificial intelligence is creating new models of maritime relationships, India is using its Indo-Pacific partners, such as QUAD, ASEAN, and IORA, etc., to shape security dynamics as well as the virtual domain within the region. The partnerships however have to be augmented with pursuits of self-reliance. Indigenous AI development through public-private partnerships, guided through strategic foresight, would be critical to India's long-term growth in the maritime domain.

Net Exporter

These efforts are not just moving India beyond dependency on foreign surveillance but are also placing the country in a position to be a net exporter of AI maritime solutions.

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ARTIFICIAL INTELLIGENCE IN THE MARITIME DOMAIN: OPPORTUNITIES AND IMPERATIVES

Technological advancement in creating smart port infrastructures, performance tracking, and the National Logistics Portal (Marine) can be advantageous for this sector.

Introduction

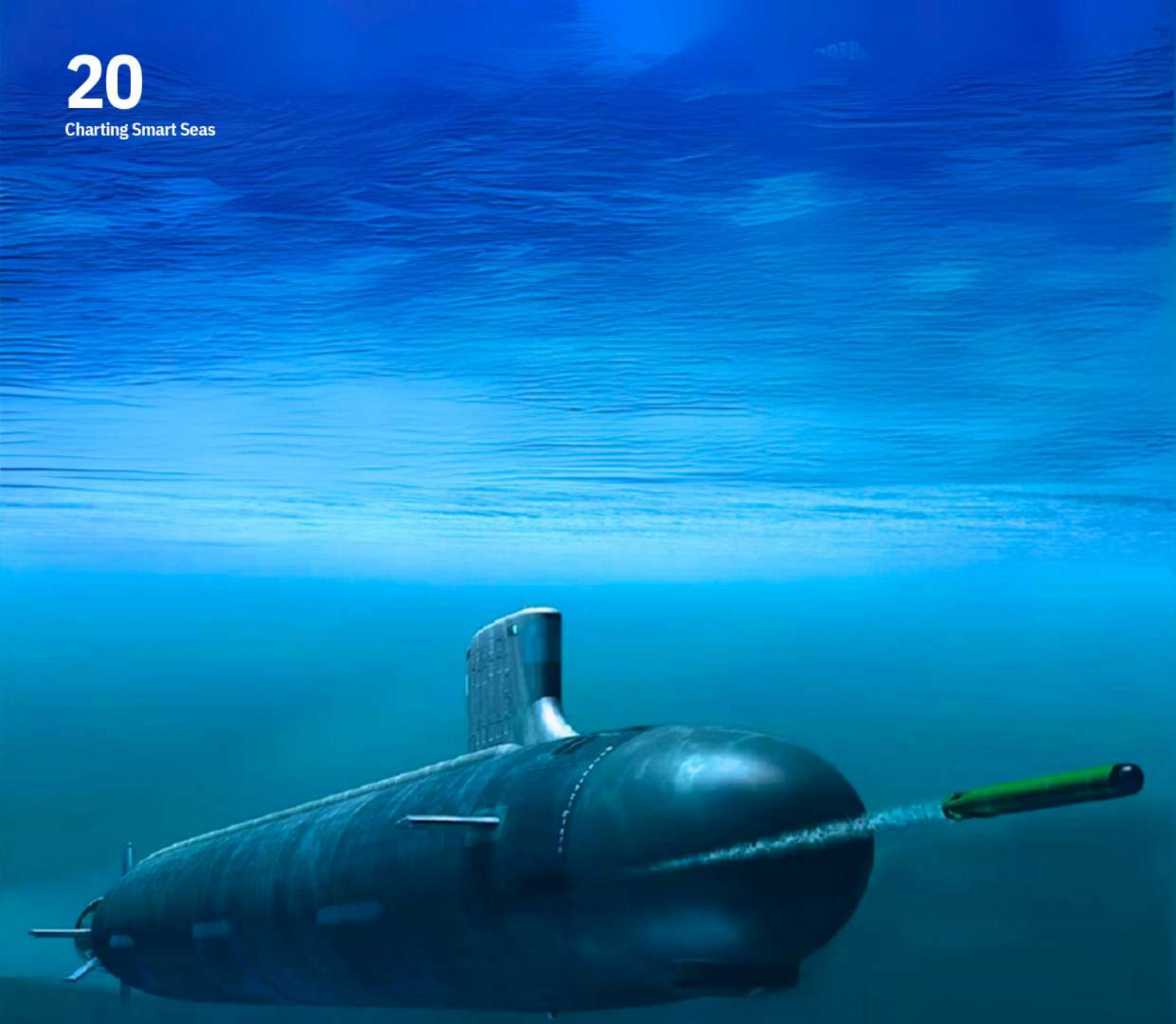
With a coastline of 11,099 km-long, India fuelling its capabilities to integrate AI in the maritime sector.[26] This will help India gain a technological edge, credibility, and influence across the Indo-Pacific and beyond. To turn the 'Maritime India Vision 2030' into a reality and accelerate the growth of our maritime sector, there are certain gaps that India needs to fill in. Several domains under the vast maritime sector, like surveillance, navigation, maintenance, security, etc., need more proficiency and speed. This chapter focuses on the key areas where AI is essential and how India can leverage working in those areas.

Artificial Intelligence integration in various prospects

While India aims to increase its exports, targeting a 5% global market share, the digitalisation in the maritime sector becomes more important.[27] Technological advancement in creating smart port infrastructures, performance tracking, and the National Logistics Portal (Marine) can be advantageous for this sector.[28] Such initiatives will not only enhance efficiency in marine operations but also provide safety by simplifying complex processes.

(I) Autonomous Navigation and Collision Avoidance Through AI

Introducing AI technology can help ships navigate, dock, and make voyage-dependent decisions, minimising the chances of human error and improving safety. An AI system can integrate tools such as radars, Automatic Identification System (AIS), and cameras to predict and prevent accidents or mishaps by analysing real-time data.[29] In this line, India's Defence Research and Development Organisation (DRDO) has developed Advanced Underwater Vehicles (UAVs), which integrate AI for several uses such as mine countermeasures, intelligence gathering, and surveillance.[30]



Advanced Underwater Vehicles

Introducing AI technology can help ships navigate, dock, and make voyage-dependent decisions, minimising the chances of human error and improving safety

(II) Enhancing Predictive Maintaining And Fleet Management

Maintenance and safety of fleets in the maritime sector dependent on data, are often quite complex and require urgency. Monitoring equipment through AI can foretell machinery failures, enable timely maintenance, and reduce costs. Analysis gained through onboard sensors such as temperature, vibration, pressure, etc., can extend the lifespan of the vessel and improve operational reliability by identifying potential faults before they escalate.[31] Automating the maintenance aspect of this industry necessitates significant investments to gather the data required to generate better results.

At the forefront of this effort, India's Bharat Electronics Limited (BEL) has developed its indigenous Predictive Maintenance application that provides the operator with[32] critical insights to avoid unanticipated downtime for a system. The application is deployed in various Indian Navy ships that help improve the system's reliability, availability, and maintainability.

(III) AI-Enabled Route Optimisation For Smart Seas

Maritime navigation faces the challenge of selecting the most appropriate and safest route to avoid risks and potential collisions. This often leads to delayed shipments and concerns about fleet safety. Analysing real-time data along with previous data through AI-driven tools can provide an optimised route, leading to shorter distances, lower fuel consumption, and thus reducing costs.[33] The use of AI in optimising routes is used as a tool to monitor the movements of vessels and forecast traffic congestion, which helps in improving overall safety and efficiency.[34]

(IV) Surveillance And Security Of The Seas

India has a vast stretch of sea area that needs to be covered under surveillance to detect suspicious activities, unauthorised vessels, piracy, and illegal fishing. Thus, several initiatives under public-private partnerships, such as TRIDENT, developed by Blurgs Innovations Private Limited and BEL, AI-enabled warships, and Sagar Defence Engineering, are designed to detect and respond to the threats raised by such activities.[35]

Smart Routes

The use of AI in optimising routes is used as a tool to monitor the movements of vessels and forecast traffic congestion, which helps in improving overall safety and efficiency

The intensity of the threat is analysed by machine vision, radar, sonar, and satellite imagery and accordingly acted upon in real-time. AI integration becomes very crucial in monitoring high-risk areas to provide accurate and continuous awareness for a quick response.

(V) Efficient Supply-Chain Management

India, with a vision to optimise its global exports, needs to have an efficient docking system. At this point, Artificial Intelligence becomes relevant in automating cargo handling, optimising dock utilisation, predicting demand, and reducing human error, along with the waiting time. Predictive analysis tools such as Terminal Management Systems (TMS) and predictive AI are used to monitor the condition of the infrastructure of ports and vessels and coordinate the arrival and departure of vessels.[36] Additionally, AI integration makes it efficient to manage and ensure real time monitoring by tracking the movements of vessels and cargoes.

(VI) Application Of AI In Environmental Monitoring and Rescue Operations

A rapid advancement in the maritime sector often faces challenges in the role and impact of ports in the sustainable development of coastal areas. India is increasingly relying on the maritime sector for trade and commerce.[37] However, it has a rich biodiversity both on land and under the sea, exposed to increasing pressure that needs to be addressed. AI-driven technology has the ability to detect oil spills, marine litter, and other pollutants rapidly, through aerial and satellite imagery. Further, AI tools can also be used to classify seabed types and monitor fish populations.[38]

Charting Skill Development And Human Capital

While there is a crucial need for technological advancement, its success depends on an efficient and adaptive workforce. Currently, the Indian maritime workforce majorly consists of traditional navigation and port management techniques. However, a rapid shift to advanced digital technologies like AI, data analytics, and robotics will require a new generation of professionals trained in both maritime operations and artificial/generative intelligence. The government of India is enhancing skill development and human capital through targeted institutional frameworks, academic institutions, and digital infrastructure.

Vigilance

AI integration becomes very crucial in monitoring high-risk areas to provide accurate and continuous awareness for a quick response

(I) Laying The Foundation For Institutional And Digital Infrastructure

Under the Ministry of Ports, Shipping and Waterways, a collaborative effort of Digital Centre of Excellence (DCoE) and C-DAC in AI, IoT, and Blockchain is working towards the modernisation of port operations and logistics.[39] Furthermore, the SAGAR SETU platform launched by the Indian government, digitises export-import logistics connecting more than 80 ports and 40 stakeholders, reducing the processing time.[40]

(II) Defence-Led Artificial Intelligence Skilling

Institutions like the Indian Maritime University and naval institutes are continuously updating and introducing AI-centric modules. Centre of Excellence for AI at INS Valsura, under the Indian Navy, operates more than 30 AI projects that incorporate predictive maintenance, autonomous systems, and maritime surveillance.[41] The institute conducts specialised workshops with noted IT firms like Infosys, TCS, Google, and IBM, and educational institutes like IITs and NYU.[42] The dedicated courses train over 500 personnel in AI/ML applications.[43]

(III) Academic and Policy Integration

A well-trained workforce can enhance real-time application of data in the maritime domain and help in the efficient use of AI systems and troubleshooting. To bridge the skill gap in this sector, the government has introduced efficient training modules, assessment, and certification processes, especially in the ports and maritime sector. The Ministry of Skill Development and Entrepreneurship and the Ministry of Shipping signed a Memorandum of Understanding in 2020 to upskill and support the workforce dependent on traditional methods of operation in this sector.[44] Apart from this, several academic institutions like the Delhi Skill and Entrepreneurship University (DSEU) have introduced 40 new AI-centric certificate courses.[45] Further, there are certain state-led initiatives, such as the introduction of AI education programs in more than 53 government schools by the Madhya Pradesh government.[46] Under the 'IndiaAI Future Skills' initiative, the government of India is aiming to train around 1 million professionals by 2026.[47]

New Foundations

Under the Ministry of Ports, Shipping and Waterways, a collaborative effort of Digital Centre of Excellence (DCoE) and C-DAC in AI, IoT, and Blockchain is working towards the modernisation of port operations and logistics

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Conclusion

Integrating artificial intelligence in various sectors of the maritime industry can improve capability, efficiency, and timeliness. For India, developing the technology and using data would not just protect its data, but would also position India as a major player in the future of maritime security and naval operations in the Indo-Pacific region. Strengthening India's massive workforce will not only make India's maritime transition effective but will also ensure long-term sustainability and strategic autonomy in this sector.

Indo-Pacific Strategy

For India, developing the technology and using data would not just protect its data, but would also position India as a major player in the future of maritime security and naval operations in the Indo-Pacific region

INDIA'S AI-DRIVEN NAVAL FUTURE: THE WAY FORWARD

Immediate and collaborative effort by domestic firms in the tech and maritime sectors, along with the support of the Indian government, is essential for rapid growth in the maritime sector.

Introduction

The maritime sector is very crucial for India, as it is for any coastal state. The vast coastline not only caters to the economy of this country but also asserts the nation's soft power in the region. China's rising dominance in the region poses serious concerns for India and its aim to achieve the 'Maritime Amrit Kaal Vision 2047'. Thus, integrating AI-driven technology is a strategic necessity, rather than just a shift to modernisation. Further, technological expertise in the sector with combined effort from indigenous AI-driven startups and public-private partnerships provides strategic leverage to India in exporting cost-effective AI surveillance information to other nations in the region. However, this industry faces major challenges, which are addressed in this part of the report. Integrating AI technology on such a large scale, in this huge sector, requires efficiency and data security measures. Thus, an immediate and collaborative effort by domestic firms in the tech and maritime sectors, along with the support of the Indian government, is essential for rapid growth in the maritime sector.

AI-Driven Startups And Public-Private Partnerships

To promote and support start-ups and tech companies in this sector and develop a homegrown, indigenous AI framework, the Government of India has allocated the Maritime Development Fund.[48] The best use case is the Sagar Defence Engineering, a Mumbai-based start-up, specialises in unmanned underwater vehicles and autonomous surface vehicles designed for Indian Naval Operations.[49] The firm also develops tools for data collection, surveillance, and tactical operations. And that's not it, Sagar Defence Engineering and Boeing's Liquid Robotics have collectively developed 'Wave Glider', which is an autonomous surface vehicle, developed for secure maintenance systems in the Indo-Pacific region. Additionally, Sagar Defence and DRDO have also developed India's first underwater Unmanned Aerial Vehicle (UAV).[50]

Emerging Technologies

To promote and support start-ups and tech companies in this sector and develop a homegrown, indigenous AI framework, the Government of India has allocated the Maritime Development Fund.

Similarly, Bharat Electronics Limited (BEL), a leading Defence Public Sector Undertaking, partnered with an Indian tech start-up of Bengaluru, Blurgs Innovation Private Limited, to develop their AI-powered Maritime Domain Awareness tool-TRIDENT.[51] The tool is capable of providing intelligence on suspicious activities and potential threats, enhancing situational awareness, facilitating faster decision making and optimising resources.[52] The integration of TRIDENT by BEL in the Indian Navy and Coast Guard leads to a successful integration of AI-driven solutions in India's Maritime Domain.

Credibility has to be awarded to DRDO's Naval Science and Technological Laboratory (NSTL) as it is working towards integrating AI in health monitoring, motion capturing, and abnormal activity detection systems in the naval operations.[53] Additionally, firms like IdeaForge and EyeROV are developing both aerial and underwater unmanned vehicles for the Indian army and navy's inspection operations.[54] Such initiatives by Indian startups and their collaborations with other global partners and the government have helped in upgrading AI, drones, and robotics technology in the Indian maritime sector.

Key Challenges In Integrating AI Technology In The Maritime Sector

Although integrating AI in the maritime domain is efficient, cost-effective and provides rapid solutions to the problems within the current traditional methods, it poses a concerning threat to several data security and national security issues.

(I) Addressing Data Availability Gaps

Integrating AI in the Maritime sector includes collecting data from satellite imagery, oceanographic sensors and records of the movements of vessels. The accurate and efficient functionality of this technology depends heavily on data availability, quality, continuity, and reliability. Thus, it is very challenging to collect data and ensure its continuity and quality in areas with inadequate satellite coverage, limited ocean sensor deployment and fragmented data sources. For instance, gathering data in the ice-covered, remote and complex regions like the Arctic is very difficult because of the extreme weather conditions and lack of infrastructure.[55]

Arctic Region

Gathering data in the ice-covered, remote and complex regions like the Arctic is very difficult because of the extreme weather conditions and lack of infrastructure.

Same issues persist in the vast Indian Ocean too, where there are areas where data collection is a huge task. Here, having an indigenous satellite network to monitor oceanic developments and collect information becomes important for India. A sovereign and homegrown satellite network dedicated to monitoring these inaccessible regions in the Indian Ocean, as well as the Indo-Pacific region, will help India in addressing the data availability gaps. This can further help India to strengthen its diplomatic ties with its neighbours in the region.

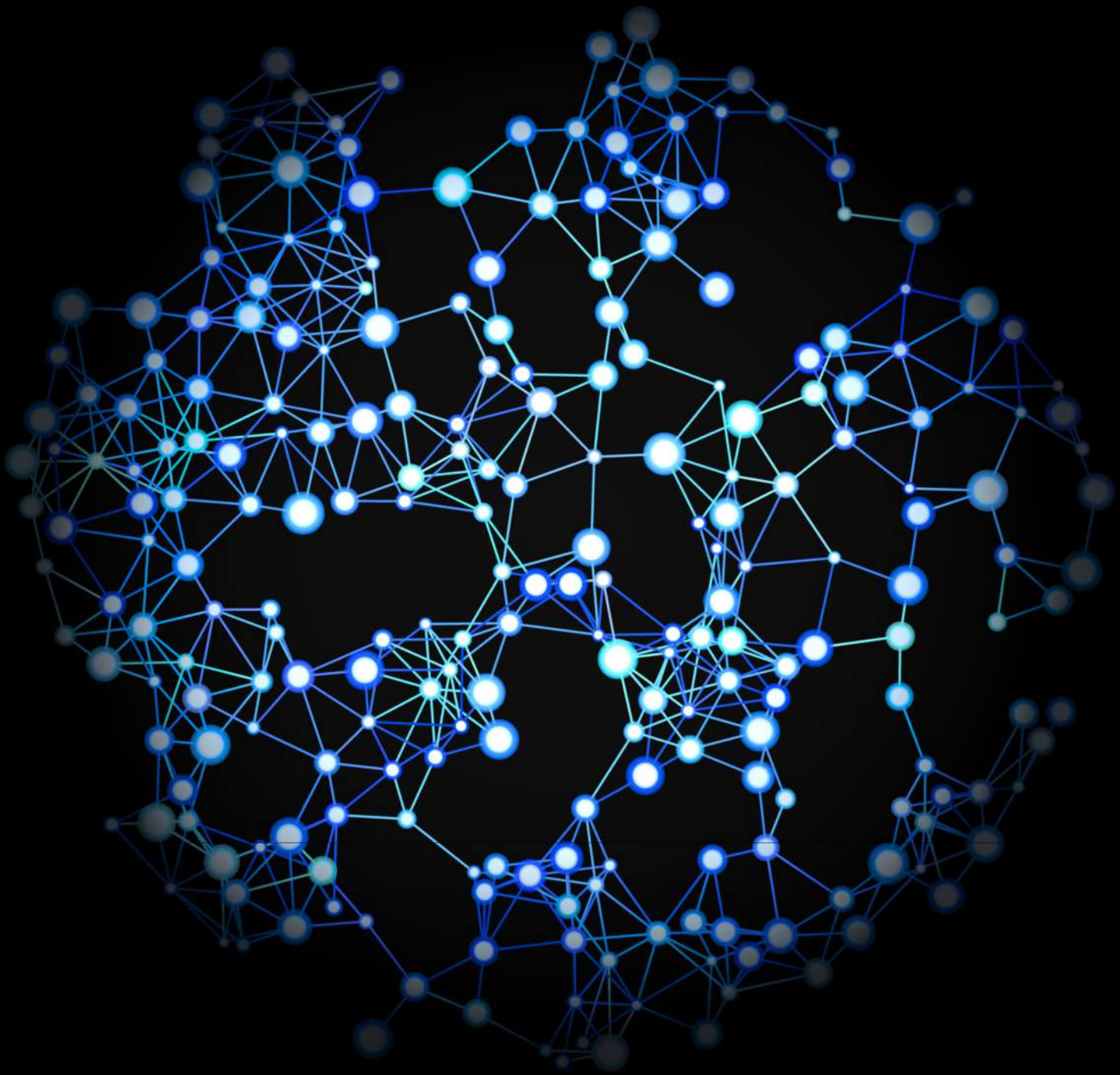
(II) Cybersecurity Threats In Maritime Domain

As mentioned above, the maritime sector is the backbone of the Indian economy because of heavy trade linkages. Relying entirely on digital technology raises huge concerns about data and cybersecurity. Channeling the source of AI for the maritime domain can be a free way for criminals to gain confidential information, causing grave security concerns, especially in the defence and naval sectors. Purposely falsifying data, creating false documents for cargo's origin, etc., are some of the loopholes India needs to focus on.[56] Any failure or lapse in keeping a check on such activities or securing the systems can provide cybercriminals and other state and non-state actors access to the entire maritime data. This makes the AI integration in the maritime sector prone to several vulnerabilities, but it can be countered with regular and efficient checks by homegrown technologies developed by Indian startups focusing on cybersecurity.

(III) Technical and Operational Gaps In AI Adoption

Integrating AI technology in older ships, port equipment, and operational platforms, which makes the most of the current maritime sector of India functional, requires skilled personnel, efficient in both traditional and modern maritime operations. Such a gap in skill requirements is a major challenge that complicates the efforts and can slow down the AI-driven operations.

Further, a huge concerning factor is the rising Chinese domination in the Indo-Pacific region. China is way ahead in integrating AI in its autonomous vessels, surveillance vehicles, and weapons systems.



Vulnerabilities

Any failure or lapse in keeping a check on such activities or securing the systems can provide cybercriminals and other state and non-state actors access to the entire maritime data.

This is further a matter of concern with the absence of clear international regulations on the use of AI in naval systems.[57] AI technology is a growing advancement in the technological domain, and thus, clear guidelines and the extent of use of this technology are still very uncertain. Establishing fixed usage guidelines for AI will be a long process because of the continuous updates and advancements. Thus, the use of AI in naval systems is under high risk of escalation, miscalculation, and technological competitiveness globally.

The Way Forward

India is rapidly investing in the maritime sector's R&D projects, influencing start-ups and naval research organisations to adopt technologies that benefit both trade and defence. The Government of India has provided ₹25000 crore for the Maritime Development Fund (MDF), aiming to boost this sector.[58] To foster AI integration in this domain, the Union Budget has allocated funds to the Centre of Excellence in Artificial Intelligence to accelerate advanced research on the use of AI in this sector.[59] The government and start-up initiatives together can modernise shipbuilding, digitise ports, and integrate sustainable growth in the maritime sector.

Collaborative efforts of public-private partnerships (PPP) like BEL and Blurgs' innovation can develop an advanced coastal surveillance system. These partnerships are important to scale the innovation and keep the data secure and confidential. The PPP initiative encourages modernisation in the shipbuilding cluster, attracting private investments and using green technologies.[60]

India is increasingly collaborating with partners such as the United States for more such initiatives like the Indo-Pacific Maritime Domain Awareness (IPMDA) to strengthen bilateral ties and enhance technological efficiency in the maritime sector.[61] However, it is very important to keep critical technologies and data under national jurisdiction, as India needs global expertise while safeguarding its security interests. The Maritime Sector in India requires more investments in skill development to build and strengthen its human capital.

Strategic Collaboration

India is increasingly collaborating with partners such as the United States for more such initiatives like the Indo-Pacific Maritime Domain Awareness (IPMDA) to strengthen bilateral ties and enhance technological efficiency in the maritime sector.

The ongoing initiatives include allocation of funds for training and human resource development, and establishing shipbuilding capabilities development centres, to create an efficient workforce that is proficient in required domains such as AI, data science, and digital maritime operations.[62] Such initiatives are very important to back this sector. Other such areas like infrastructure development and shipbuilding also need a similar approach to strengthen this sector.

Conclusion

Technological shift for India in the maritime domain is not just a choice, but a strategic necessity. Efforts and collaborations within startups and public-private partnerships have the potential to enhance national security, maritime diplomacy, and regional leadership. However, the government and private firms need to address the concerning challenges of data availability, cybersecurity, and operational limitations. Indigenous contributions, technological sovereignty and strong strategic alliances are pivotal in securing India's maritime interests and its aim of becoming a global AI leader, especially in the maritime sector.

Balance

The regional governments must balance the development of the Arctic with environmental protection and Indigenous sovereignty.

CONCLUDING REMARKS

In the current landscape of modern warfare, securing information is of utmost importance.

India's 'Maritime Amrit Kaal Vision 2047' aims to make a strategic shift in ocean governance, naval modernisation, and regional diplomacy. This report highlights that the evolving landscape of maritime diplomacy is baseless without information dominance and predictive capabilities, and thus needs continuous technological advancement. Securing an 11098 km long coastline at a critically geo-strategic location, with growing security concerns in the region, it is imperative for India to make a rapid shift to AI in the maritime sector.

Indian startups and government institutions like the Indian Navy, Ministry of Defence, Defence Innovation Organisation, DRDO, etc., together have paved the way for iDEX and SPRINT. Such projects have contributed to integrating AI in the maritime sector, starting from Maritime Domain Awareness, threat prediction, and autonomous systems to cybersecurity. These projects closely align with the primary aim of SAGAR-Security and Growth for All in the Region, ensuring that AI is a necessary diplomatic tool along with being a crucial modernisation requirement.

In addition, data sharing platforms like the IFC-IOR and coastal radar exports to neighbouring littoral nations, India is taking a lead in being the responsible regional security partner and provider. Although a sovereign and indigenous AI infrastructure, countering cyber threats and technological dependencies, is vital to achieve the set targets, especially in the naval operations to ensure national security. AI integration in naval operations, navigation, threat detection, logistics, and surveillance systems poses a significant threat due to its heavy reliance on foreign tools and data gathering. In the current landscape of modern warfare, securing information is of utmost importance. Thus, having complete control over maritime AI infrastructure and reducing dependency on external sources should be the top priority for India.

The future of India's maritime power depends not just on a shift to modernising its fleets and port infrastructures, but also on how strategically it acts faster and more precisely than its adversaries. All indicating the potential India holds in shaping a secure, tech-enabled, and autonomous maritime future by heavy and calculated investment in indigenous AI capabilities and multilateral maritime partnerships.

Securing Borders

Securing an 11098 km long coastline at a critically geo-strategic location, with growing security concerns in the region, it is imperative for India to make a rapid shift to AI in the maritime sector.

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