Technological Advancement and Pakistan's Maritime Security Strategy in the Indo-Pacific Ocean Region: Challenges and Prospects

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Abstract

The Indo-Pacific Ocean Region (IPOR) is one of the busiest oceanic spaces for trade, commerce, and other socioeconomic activities besides political and military interests. The region faces increased maritime security threats due to modernization and shifting capabilities of rational actors in terms of technology, making security provision ~~is~~ a challenging task for the states. Pakistan is situated in the Indo-Pacific Ocean Region (IPOR) at very prime coordinates due to which its importance for safe navigation and uninterrupted global flows becomes crucial. Pakistan's role and its efforts in ensuring security within its maritime zones make it inevitable for its survival. However, technological advancements including IOT, blockchain, artificial intelligence, advanced cyber security, robotics and automation, monitoring systems, artificial and augmented intelligence, cloud and SaaS, autonomous ships, green shipping are speculated as increasingly grave threats to

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developing states. The objectives of the research are to highlight the technological advancements in the maritime sector, to describe the emerging challenges and futuristic trends in IPOR, to define the technological advancements as threats to all developing states including Pakistan, to enhance the maritime security strategy of Pakistan, and to recommend maritime security policy directions for Pakistan. The qualitative research methodology is used in this case study. Data has been collected from secondary includes books and research articles, and tertiary resources which are official websites of supreme institutions. The argument is being established in the context of realist approach further following analytical and descriptive approaches.

Keywords: Indo-Pacific Ocean Region, Maritime Security Strategy, Pakistan, Technological Advancements.

Introduction

The concept of maritime security among rational actors is not new; however, the concept has been taking dominance with passing time and states become more conscious about their rimming and oceanic activities due to emerging critical technologies including internet of things (IOT), blockchain, artificial intelligence, advanced cyber security, robotics and automation, advance monitoring system, artificial and augmented intelligence, cloud and SaaS, autonomous ships, green shipping, renewable marine energy, and big data and analytics which have been invincibly transforming the world and which have increased the chances of data breach, information manipulation, and communication disruptions. Real-time weather data and routing, remote repair, and engine monitoring are all possible through automated procedures

and using big data in maritime operations. Big data is responsible for providing information to practitioners and agents along the supply chain exchange. The core argument is the following: The pace of technological advancement in the world in general and in the Indo-Pacific Ocean Region in particular has given birth to numerous opportunities as well as serious threats and challenges for Pakistan's maritime security which requires impetus to reformulate state's maritime strategy for addressing contemporary challenges related to modernization in maritime domain. Benefits on one hand, advancements in maritime technologies have been perceived as a threat worldwide because it has a direct impact on the national interest of the nation states (Marsh, 2022).

It has a tendency to challenge the confidentiality, sovereignty, defense, and survival of the states and are used for espionage such as reveal secrets of states, hijack boats and ships, disclose missions, predict actions and activities which does not only affect the security of the state but impacts on human security, economic security, and cyber security, etc. In addition to that, it disturbs maritime affairs of the state by affecting supply chain, trade, navigation, offshore and onshore activities, business, and assets which are directly linked with economic and national security of the states. The United Nations Security Council (UNSC) also perceives critical technological advancements as an emerging threat to the states and the United Nations (UN) (Council on Foreign Relations, 2021). Therefore, it's the time for upgradation of maritime security strategy for all rational actors including Pakistan to ensure its defense and survival.

Maritime security has been a serious concern of actors for ages, however, in the current scenario (rapid development in technology field), the

struggle and competition among states added into the anarchy of the system and this anarchy has been creating an environment of fear in the international system in terms of balance of power. The United States of America (USA), China, Russia, India, France, the United Kingdom (UK), and Australia have been inventing and advancing maritime technology and modernizing onshore and offshore assets including ships, ports, and surveillance which terrifies the nation states and creates an environment of proliferation of technology and the new race of 'advance and modernize technology' among nation-states not only in the Indo-Pacific Ocean Region (IPOR), but all across the world (Lolita C. Baldor, 2023).

As far as the Indo-Pacific Ocean is concerned, it is a hub of regional and international major powers' economic activities and political pursuits. Not only this, the region is full of historical rivalries and proxy wars, moreover, non-state actors activeness in the region enhances the competition to modernize naval defense, ports, and ships within the region to secure their rimmimg and area of responsibility to protect their national interests (Jaishankar, 2016.)

Therefore, the objectives of the research are to highlight the technological advancements in the maritime sector, to describe the emerging challenges and futuristic trends in IPOR, to define the technological advancements as threats to all developing states including Pakistan, to stress on to enhance the maritime security strategy of Pakistan, and to recommend maritime security policy directions for Pakistan in light of threat perception. The emerging technologies are the threats to the global economic activities including global shipping and flows, supply chain, trade and commerce, and

Sea Lines of Communication (SLOCS).

The qualitative research methodology has been used in this study to explain the challenges and prospects of maritime security of the IPOR. As the research being developed on deductive reasoning, data is collected from secondary and tertiary resources. Secondary resources include books, news articles, and research articles, and tertiary resources include official websites of supreme institutions, videos, blogs, and reports. Furthermore, the argument is being established in the context of realism theory further following analytical and descriptive approaches. Thomas Hobbes, Hans Morgenthau, and Niccolo Machiavelli are proponents of realist approach (Villanueva, 1997). The theory came into existence in the twentieth century in contradiction to liberalism theory. It argues that the state is a unitary actor, war is inevitable, and states struggle for power to maximize their national interest because of their belief in self-help and self-interest (Villanueva, 1997). States are more concerned about survival and security and which is possible through strategic and critical thinking and the importance of strategic thinking in negotiating the complexity of international relations in era of technological advancements is emphasized by realism approach. Maritime security faces complex interplay in the Indo-Pacific Ocean Region and reveals challenges and prospects for all coastal and littoral states. The variables of the research are the following, technological advancements and IPOR are independent variables, and states and maritime security strategy are dependent variables.

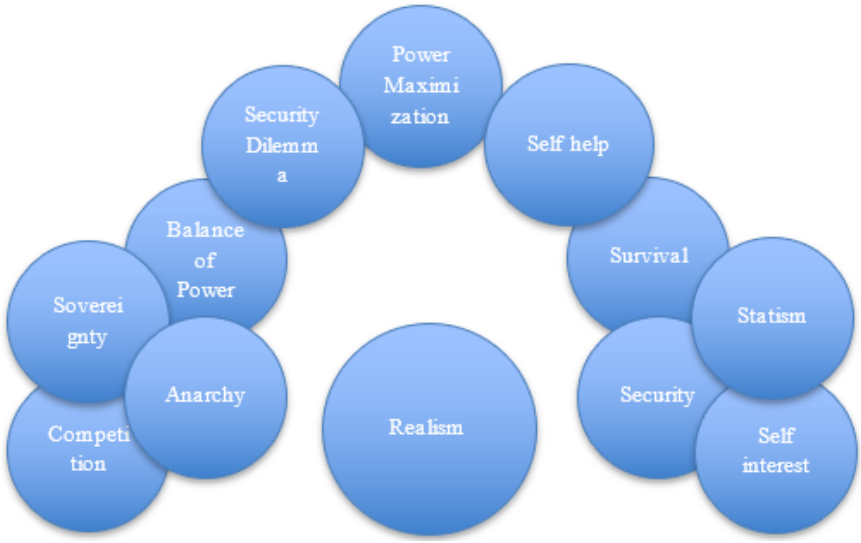

Fig 1: Main Elements of Realism

Furthermore, nation states are more vulnerable and concerned for the balance of power in IPOR including Pakistan. Technological advancements enhance the competition among states to gain more and more technology to enhance their power and sustain their survival in the international system. Technological advancements are necessary for Pakistan to protect and safeguard from the existing maritime offshore and onshore technology from advanced threats. The research is the need of the time and is relevant to contemporary era's maritime security strategy threats, challenges, and future of maritime security has followed the deductive approach and conclusion drawn on the bases of analysis of data.

The paper is divided into five parts: i) Technological Advancement in the Maritime Sector, ii) Challenges for Pakistan iii) Prospects for Pakistan, iv) Recommendations for Maritime Security Strategy v).

Conclusion

1.1 Technological Advancement in the Maritime Sector in IPOR

Emerging technologies are deeply integrated into the production, management, and services within maritime sector in IPOR. Therefore, the competition in the technology field has gained prominence because it is merely important for the sustainability of national interest of the nation states in oceans and seas. According to the 2022 report of the Fast Track Action Subcommittee on Critical and Emerging Technologies. There are nineteen areas in which technologies have been emerging rapidly (National Science and Technology Council, 2022).

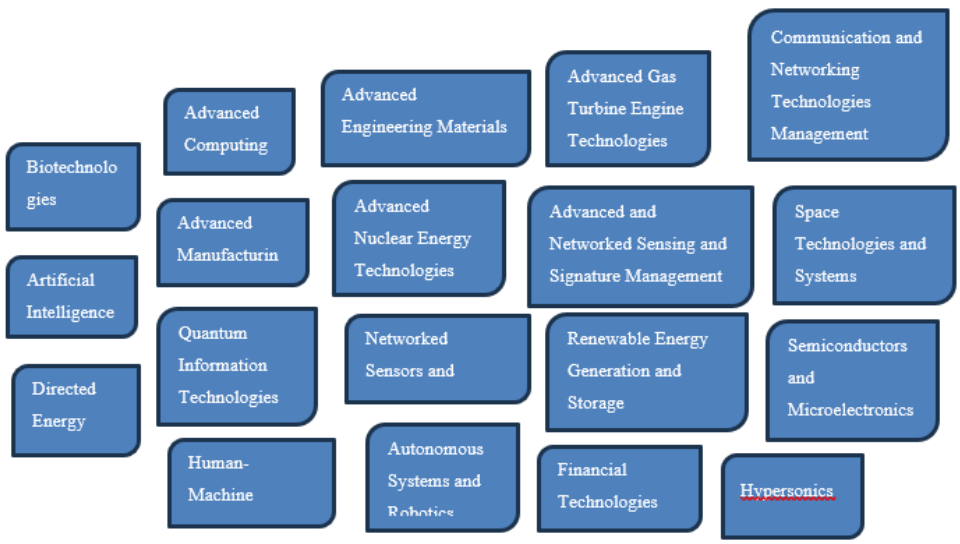

Fig 2: Nineteen Critical Technologies of the Current Age

According to the Khan and Sadiq, "automatic transport, robotics, artificial intelligence (AI), big data, virtual reality, augmented reality, the internet of things (IOT), cloud and edge computing, edge security, 3-D print,

and additive engineering are fields in which technology is progressing in maritime domain (Khan & Sadiq, 2023)." Furthermore, GPS and AIS systems, road sensing, advanced monitoring systems, such as weather conditions and vessel traffic, Artificial and Augmented Intelligence include Estimated Time of Arrival (ETA), Cloud and SaaS for smooth communication and operations, autonomous ships such as sensors, cameras, and advanced algorithms, green shipping includes biofuels, hydrogen, and ammonia, Renewable marine energy includes wind tribunes, solar panels, and hydrogen fuel cells, and blockchain technology includes supply chain, vessel registration, and cargo tracking are also the crucial technological advancements in IPOR (Evans & Galani, 2020).

There are Underwater Wireless Optical Communication (UWOC) systems having specialty of remotely operated vehicle (ROV) and autonomous underwater vehicle (AUV) are technologically advanced that have grabbed attention worldwide and create fear of data breach, security, confidentiality, and survival among nation nations (Khalighi et al., 2014). For a variety of underwater applications, such as offshore field oil drilling, oceanographic data collecting, marine archaeology, environmental monitoring, disaster avoidance, and port security, these systems are thought to be suitable and effective, however, they are also vulnerable and have a capability to theft of information and environmental exploitation.

The United States, China, Singapore, India, the UK, France, and Australia have been rapidly increasing the technology in their ports, ships, and boats and other on shore and offshore developments in IPOR to execute their agendas and achieve their interests. For example, China has been strengthening its Belt and Road Initiative (BRI) through sea digitalization and enhancement

of intelligence of ports and converting the vital terminal ports to automated ports to sustain and ensure its dominance to achieve its goals within the region.

In the Tianjan Port of China, there are 76 robots which are used only for transportation and the Huawei intelligent fleet system ensures the smooth driving of them. Moreover, cloud adjust the dynamic tasks in real time with high precision maps, Bei Dou navigation, and full coverage of 5G networks which seems beneficial for nation states but also posing a threat of data breach, data exploitation, and espionage, etc. According to the Australian Strategic Policy Institute, China has been leading 37 technologies out of 44 (Hurst, 2023). There are 5G and 6G technologies (advanced frequency communication), hypersonics and electrical batteries part of these evolving modern technologies (Garry Kranz & Gerry Christensen, 2021). Moreover, China and India are in competition to enhance maritime technology in the IPOR to enhance their influence in the region (Albert, 2016).Therefore, both have been advancing their ports, enhancing deep water ports, and technology.

The Foot Intelligence Transport systems have been installed in ports including Hamburg which is the world's first automated port; moreover, smart container terminals are used as intelligent transport system, and driving automation has advanced up to level four. Seventy-six artificial intelligence robots of transportation are working in orderly, efficient, and collaborative, and active manner based on global path planning algorithm in Chinese Ports which again compels other rational actors of the IPOR for balance of power by adopting new technology and advancing existing technology.

India has also a maritime agenda of 2030 in which technological advancements have prime focus. This agenda has prioritized the modernization

of technology which supports ports development, enhances the efficiency of ships, and improves the security of the ports. Not only this, the 3D modeling adopted by India adds into the efficient manufacturing processes in shipyards. India's IT industry has been playing a crucial role in maritime sector and advancing the onshore and offshore operations (Jai Singh, IN, 2021).

The USA has been advancing and leading the world in advanced technologies which includes vaccines, quantum computing, and space launch systems (Hurst, 2023). China and the USA have been advancing technologies having multifaceted competition including economic, military, and political (Schmid, 2023). The winning of technological warfare depends on conventional markers of scientific progress. Furthermore, China has more grip on AI than any state in the world (Schmid, 2023). According to Elon Musk, "(*A)rtificial intelligence (AI) could one day outsmart humans and endangers us, citing AI as the biggest threat to civilization* (Gibbs, 2014)."

France has been doing continuous development of various ports in Reunion including Le Port and st-pierre-dela. These ports are directly linked with SLOC and shipping routes (SEAIR, n.d.). Australia and India are in collaboration on variety of advanced technologies (www.ETTelecom.com, n.d.). Not only this, India is also working with the UK on various AI resources (Uday Nagaraju & Ruchi Ghanshyam, 2021). there is an increase in robots in WIOR for performing research (Palmer et al., 2021). Advance computing in maritime zones have been used by the drones, Unmanned Aerial Vehicle (UAVs), etc. (Mohsan et al., 2023).

There are autonomous cranes deployed in the crucial ports in the United States, China, Singapore, India, the UK, Germany, France, Spain, and

Australia in the IPOR (United Nations, 2021). The technologically advance actors have been operating via remote controls rather than manual operations in the maritime zones which is alarming the nation states having least technology (Huawei Cloud Core, 2020). Consequently, the authorizing and installing emerging technologies in ships and boats, and maritime infrastructure which is alarming for the entire world including Pakistan.

1.2 Challenges for Pakistan Maritime Sector

Every region is unique due to its seas, choke points, strategic location, and historical rivalries. However, Pakistan has a strategic significance in the IPOR, its maritime part is comprised of 25-degree North latitude and 67-degree East longitude at world globe. It has a very strategic location in the IPOR as the threshold of different continental and maritime areas. Most of the areas in IPOR are called the arc of crisis or arc of instability because of political instability, conflicts and competition (Hussain, 2014). Therefore, Pakistan has been facing numerous challenges in its oceanic spaces and areas of responsibility including transnational crimes and environmental crimes along with traditional rivalry with neighbouring states (Afghanistan and India) and major powers of the region keeps an eye on it because of its friendly tilt towards China. However, the technological advancements in the region have been creating a number of challenges for Pakistan.

Pakistan has been dealing with multiple challenges including transnational crime, non-traditional maritime security (NTMS) threats, historical rivals and competitors in IPOR. Therefore, technological advancements and revision of maritime security strategy in perspective of realism is necessary for its survival and sustainability. Moreover, there is a

rapid increase in existing challenges of technological advancements in the maritime sector in the sub domains of mentioned areas which are mentioned above.

Due to technological advancements, there are more chances of vertical and horizontal maritime terrorism, cyber-attacks, depletion of resources, lack of confidentiality of important information, increase in NTMS in maritime zones and Area of Responsibility of Pakistan. Advanced technologies can be a stimulator in maritime terrorism, because it assists terrorists in more precise navigation, calculation, surveillance and communication. Furthermore, cyber threats are increasing in intensity and spread in oceanic spaces. They have the ability to jeopardize maritime industry and businesses, disrupt SLOSC and trade, result in financial losses, and defense of Pakistan. Robots have been used for sea bed operations and explorations. Therefore, it becomes imperative for Pakistan to advance the maritime sector by inventing and adopting latest technologies because the confidential data could be stolen, exploited, manipulated by the enemies any time. Moreover, it is posing a threat to the food and minerals by disturbing the ecology of the maritime zones of Pakistan.

Non-traditional maritime security challenges (NTMS) such as looting of ships, smuggling, narcotics, and illegal unreported unregulated fishing (IUUF) are also facilitated by the technologies and the asymmetry in military power between Pakistan and its neighbours in the region is one of the country's biggest problems which ultimately impacts the economy, development and growth, political stability and environment of Pakistan. Hence, technological advancements have been a posing threat to the survival and national security of Pakistan.

1.3 Prospects for Pakistan

The main traditional issues in the IPOR are balance of power among rival states, strategic competition for hegemony, deterrence, uncertainty and the technological advancements enhance the security dilemma in the IPOR. Prospects emerge on the horizon as Pakistan navigates these challenges. Realism perspective recognizes the significance of anarchy, national interest, and survival in the international system. Pakistan has the potential to enhance its maritime capabilities through realistic endeavors in light of the international system and its capacities. This aligns with classical realism's emphasis on states seeking allies to enhance their relative power in the anarchic international environment. However, the technological advancements have a capacity to ignite all traditional and non-traditional security challenges in the maritime sector and have prospects in the economic, security, and environmental sector which are embedded with political and military sectors as well. Therefore, Pakistan is in a dire need of advancing maritime strategy to balance between emerging threats and ensure national interests. Pakistan's crucial geo-strategic location, vulnerable geo-economic conditions, and critical socio-political dynamics lead it to a more complicated path. Therefore, the Maritime Security Strategy is a challenge for not only for strategists and policymakers of Pakistan but all coastal and littoral states.

1.3.1 Economic Prospects

Moreover, there is a close relationship between economic factors and the pursuit of scientific advancement. The basis of the military is economic strength, as recognized by realism school of thought. The strategy for maritime security in Pakistan may be impeded by economic difficulties that slow down

technological advancement. Budgetary restrictions and resource allocation issues may prevent the purchase of cutting-edge naval technologies. The realism approach viewpoint emphasizes how Pakistan must strategically handle these economic difficulties while making sure that scientific developments serve the interests of the country as a whole.

1.3.2 Security Prospects

The maritime sector is becoming more dependent on digital technologies day by day, which increases its susceptibility to cyberattacks. Understanding the prospects is the need of the time. In future, there are more chances of enhancement in cyber-attacks. AIS and GPS in ships and boats of Pakistan can easily be exploited. The human error while using technology is another big threat, the cyber-attack detected, and preventive software are the solutions to the evolving attacks which are cyber in nature. Data Breaching and espionage has become easier due to the advanced technology. Surveillance, cloud and SaaS, etc. are going to be strong and advance in the coming future. So, it is difficult for Pakistan to monitor and handle situations without advanced technology.

1.3.3 Environmental Prospects

There is a chance of an increase in illegal exploitation of marine resources including minerals, fish, dredging, illegal extraction of sand and gravel which is the exploitation of marine biodiversity and ecology. Furthermore, upsurge in sea-bed exploration and offshore operations through robots, etc. and use of multiple gases in ships and engine boats cause damage to marine environment. ~~And~~ Pakistan's coastal communities have been largely

relying upon the sea food, therefore, the outcome of depletion of ocean resources drags Pakistan into severe food and economic crisis.

1.4 Recommendations for Maritime Security Strategy

Technological advancements have been added to the increasing security challenges in IPOR and pushing coastal and littoral states to advance their ports and ships to secure ocean activities in their jurisdictions and Areas of Responsibility. Nation states are more in a pressure to advance the maritime security strategy in IPOR to cope with emerging and existing challenges effectively. Not only this, it influences the behaviour of nation states in the international system. Therefore, nation states need to pay more attention towards adopting the critical technologies which have been emerging rapidly and result as game changer of the international system.

Not only this, great powers have installed advanced technologies in maritime infrastructure, ships, and boats and ambitions to gain supremacy over the IPOR because of its choke points, SLOSC, and rich and warm ecosystem. There is no doubt in it that the emerging technologies define the future of rational actors in the international system. So, there is a threat to the states which are lacking in technology, their role minimizes or completely vanishes. Therefore, it is necessary for all rational actors to enhance technological capabilities and capacities, advance maritime security policies, and reconsider national interests in maritime domain to ensure comprehensive security within the state. The comprehensive security in maritime zones of Pakistan can be safeguarded by ensuring state's interest in maritime domain and national maritime objectives of state and advance maritime security strategy. Freedom from all kinds of threats is called security (Buzan, Wve,De Wilde, 2019). Due

to technological advancements, states have been entering a new phase of threats and insecurities and this phase demands to be more realistic and maximize the power and preserve national interest for survival in the international system. It not only escalates the historical rivalries but facilitates the expansion of non-traditional security challenges in IPOR. Furthermore, it impacts the military and non-military nature of challenges globally. Therefore, all developing states including Pakistan need to redesign their maritime policies and strategies. Here are few suggestions;

- Pakistan must reevaluate its strategic priorities at sea in order to redefine its maritime interests. In order to ensure efficient protection, surveillance, and administration of Pakistan's maritime assets and borders, this entails rethinking the duties of the Naval Forces and law enforcement agencies to correspond with current problems and opportunities in the maritime domain.
- For maintaining maritime security, national interest, maritime diplomacy, and foreign policy, Pakistan should enhance its budget, and give chance to engineers and entrepreneurs to bring innovative ideas to invent new technology at cheap amounts because of its political and economic conditions.
- There is a need of strategic thought to resolve power asymmetry in the IPOR when reevaluating the maritime doctrine. This entails being aware of and sensitive to the various interests and capacities of regional players in order to make sure Pakistan's maritime plans are flexible, well-balanced, and efficiently utilise its advantages within the established power structures.

1.5 Conclusion

Technological advancements in the maritime sector are the real threat to the rational actors in IPOR. States need to enhance their defense capabilities by adopting contemporary trends and advancing technologies to preserve the national interest of the state. Pakistan Maritime Security Strategy in IPOR also needs upgradation as per advancements in maritime sector. Moreover, technological advancements compel states to enhance military capabilities and secure power and national interest. However, there are multiple challenges in the way of advancements in the field of technology for Pakistan. The emerging challenges are adding in the advancements of non-traditional security. It impacts not only the security of the oceans and seas, but transforms the patterns of the entire international system. The emergence of technologies has an ability to change state and human behaviour patterns by impacting geo-politics, geo-economics, and future war scenarios which are directly and indirectly related to maritime zones in terms of connections, trade, businesses, and revenue generation.

Pakistan is in a dire need to advance maritime critical technology and maritime security strategy because of regional and historical dynamics of the IPOR. In addition, due to these maritime installations there are numerous economic, political, and environmental challenges which prevent Pakistan's from achieving latest technologies and upgrading technologies to tackle increasing and evolving contemporary threats due to technology. International system is entering into the technology age and again the nature of warfare, and threats have been shifting into a different domain. In this regard, Pakistan must contend with threats from the region's more technologically sophisticated

marine nations. India's substantial investments in navy modernization, for example, pose a threat to Pakistan's aspirations for maritime security due to their power asymmetry. Seeing through the lens of realists emphasizes how crucial it is to recognise these power dynamics and modify tactics appropriately. Furthermore, a more sophisticated grasp of Pakistan's geopolitical situation in the IPOR can help its maritime security policy. A realism strategy must acknowledge the influence of big powers and calibrate its reactions to regional changes accordingly. Pakistan needs to ensure safeguarding its maritime interests and tackle the obstacles caused by technological asymmetry by development and execution of security strategy as per current international political and security circumstances.

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