MILITARY DYNAMICS

OF INDIAN OCEAN REGION'S MARITIME SECURITY:
IMPERATIVES FOR PAKISTAN

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CISS Roundtable Report

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Military Dynamics of Indian Ocean Region's Maritime Security: Imperatives for Pakistan

Center for International Strategic Studies
Islamabad

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Group Photo of the Participants

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Preamble

The Indian Ocean Region holds immense strategic significance due to its vital maritime trade routes, resource-rich waters, and geopolitical dynamics. Ensuring security and stability in this region is crucial for global economy and peace of the nations that border the Indian Ocean. Sea-based deterrence plays a pivotal role in maintaining stability and deterring potential threats. The CISS roundtable session brought together experts and researchers to discuss the concept of sea-based deterrence in the Indian Ocean Region (IOR). The participants sought to foster a comprehensive and informed dialogue on the critical issue of maritime security. Critical matters including the role of emerging technologies, naval modernization, cyber capabilities, undersea warfare, and uncrewed underwater vehicles in enhancing or challenging sea-based deterrence, were critically analyzed.

Executive Summary

The Center for International Strategic Studies (CISS) Islamabad organized a roundtable discussion on the 'Military Dynamics of the IOR's Maritime Security: Imperatives for Pakistan' on 16 August 2023. The discussion brought forth the altering strategic environment of the IOR with a focus on exploring implications for the South Asian security complex. The Executive Director of CISS Ambassador Ali Sarwar Naqvi, Director General of National Institute of Maritime Affairs (NIMA) Vice Admiral (R) Ahmed Saeed, Director at India Ocean Study Center NIMA Babar Bilal Haider, and members of CISS research team including Associate Director Research Anum A Khan and Research Officer Abdul Moiz presented their insightful thoughts on the subject.

The key takeaways from the interactive roundtable are as follows:

- The Indian Ocean (IO), often called the 'economic lifeline' of the world, carries the lifeblood of international trade and harbors diverse challenges ranging from traditional security threats to emerging non-traditional concerns.

- Pakistan is situated strategically within a dynamic environment and must navigate these complex waters with a clear understanding of the military factors at play to safeguard its interests and contribute to the stability and prosperity of the region.

- A complex web of geopolitical tensions and conflicts characterizes the IOR, including the burgeoning US-India partnership, simmering India-China disputes, the evolving role of Saudi Arabia, intricate dynamics of Pakistan-India relations, ongoing US-Russia engagements, and the presence of complex issues in Yemen, Somalia, and Afghanistan. New entrants like Israel have also established bases in the region. The proliferation of nuclear arms, substantial naval buildups, and the evolving global leadership dynamics further contribute to the multifaceted landscape.

Pakistan is situated strategically within a dynamic environment and must navigate these complex waters with a clear understanding of the military factors at play to safeguard its interests and contribute to the stability and prosperity of the region.

- It is important to continue maintaining peaceful navigation, harness continental shelves, and exploit marine resources. Criminal activities, narcotics, human smuggling, piracy, and illegal fishing are persistent challenges. These challenges are classified under traditional and non-traditional categories, reflecting the multifaceted security landscape of the region.

- Pakistan's maritime interests extend across the Arabian Sea, the Gulf of Oman, the Gulf of Aden, and key strategic chokepoints. These areas of operation and influence are critical to Pakistan's economic well-being and security.

> **India's pursuit of emerging technologies, including the development of cyber warfare capabilities, holds the potential to reshape the dynamics of deterrence between India and Pakistan.**

- The process of India introducing nuclear and emerging technologies to the IO holds the potential to provide it with a heightened offensive advantage.

- India's pursuit of emerging technologies, including the development of cyber warfare capabilities, holds the potential to reshape the dynamics of deterrence between India and Pakistan.

- To establish a stable deterrence framework, both parties need to possess an assured second-strike capability.

- Sea-based nuclear capabilities are a critical component of a state's second-strike capability, providing strategic stability. These capabilities operate in opaque and non-detectable environments, making them difficult to locate, especially in the IO. Countries with this capability can effectively retaliate with nuclear weapons even after absorbing an initial nuclear strike. Such capabilities enhance a state's security.

- India is one of the world's largest arms importers, spending over USD 100 billion between 2018 and 2022. India's foreign policy and diplomacy helped in its engagement with various countries, including the Soviet Union, now Russia, the United States, and France. India is benefiting from technological advancement in the wake of increasing bonhomie with some Western states and this land-based problem is now spilling over to the seas.

- Pakistan will not be given nuclear submarine technology soon. Hence, it must depend on its resources and potential to develop sea-based deterrence and assured second-strike capability. This path requires political will.

- South Asia, with its complexities and historical context, has long been characterized by a precarious equilibrium. Nuclear deterrence has played a pivotal role in maintaining stability and preventing large-scale conflicts. The accelerating pace of technological innovation is introducing new dimensions to this equation. Hypersonic weapons, advanced sensors, disruptive situational awareness technologies, drone swarms, robotics, lasers, 5G, quantum computing, big data analytics, and network centric cyber-attacks have revolutionized warfare.

- The impact of Artificial Intelligence (AI) can extend to the strategic sphere, altering power dynamics, shifting attitudes towards risk and defense strategies, promoting a proactive approach to offense, molding conflicts, and overseeing military operations. AI holds sway at tactical, operational, and strategic levels.

- In the near to mid-term, AI advancements are poised to yield substantial benefits in two crucial domains: Nuclear Command, Control, and Communication (NC3) and autonomous systems for nuclear weaponry. Although AI might find a place in the forthcoming conventional operations of India and Pakistan, it is improbable that both countries will depend on AI for aiding decision-making in the immediate future.

  Pakistan will not be given nuclear submarine technology soon. Hence, it must depend on its resources and potential to develop sea-based deterrence and assured second-strike capability. This path requires political will.

- The emergence of Lethal Autonomous Weapons Systems (LAWS) prompts concerns regarding escalation management within a nuclear framework. Quantum technology might jeopardize the security of nuclear secrets, making them susceptible to breaches. Quantum radars could penetrate stealth modes of SSBNs by utilizing magnetometers, quantum clocks, and gravity gradiometers for detection.

- Through its National Quantum Mission (NQM), India is working on these technologies. Considering the nascent stage of quantum technology in India, its reliability could be compromised, potentially leading to inaccurate warnings or inadequate responses to perceived threats. Such uncertainties could inadvertently escalate crises between India and Pakistan.

- The enhanced efficiency, precision, and rapidity the emerging technologies bestow upon military systems

will likely distress the effectiveness of traditional deterrence and strategic stability in the IOR.

- While cyberspace has its benefits, it increases the challenges and vulnerabilities of systems. Navies are expanding their reliance on digital technology. However, it increases the threat of cyberattacks on digitalized assets.

- In the IOR, the growing US-India partnership in cybersecurity can strengthen India's capabilities. Both countries have committed to cooperating on a range of cyber issues, including preventing and responding to cyber threats, promoting cybersecurity education and awareness, and building resilient cyber infrastructure.

- Pakistan has to take measures for air-gapping the systems, locating insider threats, ensuring that there are no data leaks or cyberespionage attacks that can provide adversaries with secret information, and guaranteeing that there have been no cyber lapses during procurement or maintenance.

Significance of Indian Ocean Region

Ambassador Ali Sarwar Naqvi[i]

In an era characterized by rapid globalization, increased connectivity, and evolving geopolitical landscapes, maritime security has emerged as a paramount concern for nations situated along the vast expanse of the Indian Ocean (IO). We must examine the military dynamics that shape the security paradigm of this region, with a specific focus on Indian advancements, thereby affecting Pakistan's security calculus.

The IO, often called the 'economic lifeline' of the world, carries the lifeblood of international trade and harbors diverse challenges ranging from traditional security threats to emerging non-traditional concerns. Pakistan is situated strategically within this dynamic environment and must navigate these complex waters with a clear understanding of the military factors at play to safeguard its interests and contribute to the stability and prosperity of the region.

The changing strategic situation in the IO has wide-ranging

i. Executive Director, CISS

effects on strategic stability between India and Pakista. While submarines have been present in the IO for a considerable time, the fact that India has now brought nuclear weapons into this area significantly influences the security calculations of Pakistan.

Such Indian ambitions, along with the country's expanding economic, industrial, and naval strengths and advancements like missile canisterization, Multiple Independently-targetable Re-entry Vehicle (MIRV)

While submarines have been present in the IO for a considerable time, the fact that India has now brought nuclear weapons into this area significantly influences the security calculations of Pakistan.

technology, and hypersonic missiles, present significant obstacles to Pakistan's conventional and strategic capacities.

The process of India introducing nuclear and emerging technologies to the IO holds the potential to provide it with a heightened offensive advantage. Furthermore, India's pursuit of emerging technologies, including the development of cyber warfare capabilities, holds the potential to reshape the dynamics of deterrence between India and Pakistan. Such technologies introduce complexities and risks, thereby increasing the likelihood of an escalatory nuclear dynamic between India and Pakistan in the event of a conflict.

To establish a stable deterrence framework, both parties need to possess an assured second-strike capability. However, the current scenario presents an uneven playing field, as India enjoys a head start in developing this capability and benefits from access to advanced foreign technologies

through defense deals. Given these circumstances, it becomes a rational action for Pakistan to undertake measured steps to ensure a balanced deterrence.

The traditional model of deterrence is rooted in Mutual Assured Destruction (MAD), where the fear of catastrophic retaliation is a deterrent against aggression. However, emerging technologies can challenge the MAD model by creating new pathways for coercion and disruption.

The CISS roundtable sessions serve as a forum to share insights, perspectives, and research. This one will shine light on the nuanced interplay between military strategies, regional partnerships, and the broader context of maritime security. Over the course of this discourse, the intricate geostrategic landscape, Indian nuclearization of IOR, implications of technological advancements, and strategies essential for Pakistan to ensure maritime security will be the center of focus.

Nuclearization of Indian Ocean Region

Vice Admiral (R) Ahmed Saeed[ii]

Preamble

There are several key concepts, historical developments, and contemporary dynamics related to nuclear deterrence, nuclear technology, maritime security, and India's evolving maritime strategy. The role of sea-based nuclear capabilities, the changing landscape of alliances, and the challenges posed by India's nuclear ambitions are significant matters to be highlighted in the context of regional security.

Historical Context

The genesis of nuclear weapons can be traced back to the 1930s when research began in this field. Initially, nuclear weapons were developed for military use. In 1939, nuclear research was placed under the codename 'Maritime Project.' The United States conducted the first nuclear test, codenamed the Trinity Project, on 16 July 1945. Subsequently, within twenty days, two atomic bombs were dropped on Hiroshima and Nagasaki, marking the introduction of nuclear deterrence.

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ii. Director General National Institute of Maritime Affairs (NIMA), Islamabad

The concept of nuclear deterrence has since played a crucial role in international relations. It is considered the ultimate weapon of national security, as demonstrated by the survival of nuclear-armed states like North Korea.

Nuclear Deterrence Concepts

Key concepts related to nuclear deterrence include highly credible deterrence, the nuclear triad (land, sea, and air-based nuclear capabilities), and distinctions between first use, first strike, and second-strike capabilities. The grand strategy of a state is at the core of deterrence, aiming to harness a state's military and economic power to advance its interests and maintain stability. The strategies of conventional warfare, diplomatic efforts, and strategic asset immobilization are employed in the event of deterrence failure. The first five nuclear weapon states, i.e., the United States, Russia, China, United Kingdom, and France, have full-fledged assured second-strike capability.

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Sea-Based Nuclear Capabilities

Sea-based nuclear capabilities are a critical component of a state's second-strike capability, providing strategic stability. These capabilities operate in opaque and non-detectable environments, making them difficult to locate, especially in the Indian Ocean. The composition of the IO raises suspicions due to its low detectability. Another term to consider is 'continuous at-sea deterrence,' wherein submarines are maintained at sea, ready to respond rapidly if required.

This strategy creates significant firepower. For example, there are fourteen Ohio-class submarines in the US, each equipped with twenty-four missiles. With twenty warheads on each missile, one submarine can potentially target twenty-four cities. In total, these submarines could target three hundred and twenty-six (326) cities worldwide, showcasing their firepower. To put it in perspective, the nuclear bombs dropped on Hiroshima and Nagasaki were 15 and 20 kilotons, respectively.

In contrast, these submarines carry missiles with warheads ranging from 100 to 475 kilotons, making them far more destructive. Regarding the nuclear triad, there is an increasing trend of warheads being positioned at sea. Initially, these warheads were primarily on land, but there is a shift towards sea-based platforms. This shift is due to their undetectability, assured readiness, and ability to be used when needed.

There are two main strategies to consider: first-use and first-strike. First-use is about attacking the adversary first, with the condition that there is no assurance all the enemy's assets will be annihilated, i.e., they might still have a second-strike capability. In contrast, the first-strike strategy aims to eliminate the adversary's chances of a second strike.

Current Trends

Recent trends show an increasing shift towards sea-based nuclear capabilities due to their non-detectability and assured second-strike capability. Countries with this capability can effectively retaliate with nuclear weapons even after absorbing an initial nuclear strike. Such capabilities enhance a state's security. States prioritizing assured second-strike capability, such as those with ballistic missile submarines (SSBNs), can survive under various circumstances. Assured

second-strike capability is the country's ability to retaliate effectively with nuclear weapons after absorbing an initial nuclear strike. For this to work, the platform should have survivability, reliability, and the capacity for massive firepower, making it the preferred choice for deterrence missions. The SSBN is crucial in providing this security to nations.

It is essential to understand the difference between Nuclear Attack Submarines (SSNs) and SSBNs. SSNs typically escort and protect SSBNs. They lack nuclear weapons but are equipped with nuclear propulsion. On the other hand, SSBNs possess both nuclear propulsion and nuclear weapons. SSBNs aim to avoid battle, stay hidden underwater, and only surface and launch missiles when necessary. As a historical example, during the attack on Afghanistan, the US launched cruise missiles from submarines, specifically converting four Ohio-class submarines into Guided Missile Submarines (SSGNs). These submarines were deployed in the Mediterranean and the IO and simultaneously fired Tomahawk cruise missiles, some of which landed in Balochistan.

Indian Maritime Strategy

Indian maritime strategy began in 1974 with 'Smiling Buddha.' Initially, only two countries developed nuclear propulsion for submarines – the US and the Soviet Union. Other countries, such as the UK and France, received assistance from these two states. India has also received support from Russia in this regard. The US 'Pivot to Asia,' 'Rebalance in the Asia-Pacific,' and now the Indo-Pacific Strategy have significantly impacted the security structure of the region.

India is one of the world's largest arms importers, spending over USD 100 billion between 2018 and 2022. India's foreign

policy and diplomacy helped in its engagement with various countries, including the USSR and now Russia, the US, and France. This engagement, however, has raised concerns in Pakistan about aligning too closely with one side or the other, potentially damaging national policy.

The formation of AUKUS, a security partnership that did not include India, raised significant concerns. AUKUS focuses on technology transfer, particularly submarine technology, from the US and UK to Australia. This could serve as a template for India, which is not a signatory of the Nuclear Non-Proliferation Treaty (NPT). For NPT signatories, obtaining nuclear submarines plants is allowed under the International Atomic Energy Agency (IAEA) guidelines.

Pakistan's quest for peace, stability, and security drives its policies in the face of evolving regional dynamics. The nuclearization of the IOR presents both challenges and opportunities, requiring careful consideration and strategic responses to ensure lasting peace and prosperity.

However, India is navigating certain challenges, particularly within the Nuclear Suppliers Group (NSG). India sought special concessions from the US to gain entry into the NSG. The ensuing debate by some other member states on getting similar treatment for Pakistan led to the blockage of India's NSG membership.

Indian initiatives contribute to instability in South Asia. As we delve into the doctrines and their implications, India aims to become a major regional power. India's doctrinal choices have varied, but it consistently prioritizes net security. Regarding its nuclear doctrine, it officially adheres to a 'No First Use' policy. Nevertheless, debates within India

suggest that it may reconsider this stance if critical information becomes available, potentially moving towards a pre-emptive approach.

'Atma Nirbhai' is Prime Minister Narendra Modi's vision for India to achieve self-reliance by 2047. In line with this vision, India is actively developing and upgrading ports and harbors and revamping its navy. It plans to increase the number of ships, submarines, and platforms from 150 to 200, along with introducing a free carrier. Furthermore, India intends to acquire approximately five SSBNs and SSNs among 24-25 submarines and around 500 maritime aircraft by 2030. India aims to achieve 80 percent indigenous production by 2030 and complete self-reliance by 2047. This program is well underway and is closely guarded.

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Regional Implications

The IOR holds significant strategic importance, as demonstrated by India's efforts to secure its maritime interests. India has established fusion centers and integrated many radars, disrupting Chinese trade routes in the region. China has expressed displeasure about this development. This land-based problem is now spilling over to the seas, as India is benefiting from technological advancement in the wake of increasing bonhomie with some Western states.

Challenges in the form of technological proliferation and international agreements like the NSG and Missile Technology

Control Regime (MTCR) complicate the situation. Additionally, Pakistan faces security threats due to India's aggressive posturing.

A state's ultimate function is to provide a peaceful environment for its citizens. Pakistan's quest for peace, stability, and security drives its policies in the face of evolving regional dynamics. The nuclearization of the IOR presents both challenges and opportunities, requiring careful consideration and strategic responses to ensure lasting peace and prosperity.

Geo-strategic Environment of Indian Ocean Region

Commodore Baber Bilal Haider[iii]

Global Dynamics

The term 'Indian Ocean' has undergone a historical evolution from being called Shendo, Sindu, Indu, and finally Indian. Its roots lie in the Indus River and Sindh. It has played a pivotal role in the subcontinent's early civilization. A rich historical heritage is reflected in the diverse names associated with the region over time, culminating in the term Indian Ocean.

A complex web of geopolitical tensions and conflicts characterizes the IOR. Notably, these include the burgeoning US-India partnership, simmering disputes between India and China, the evolving role of Saudi Arabia, intricate dynamics of Pakistan-India relations, ongoing US-Russia engagements, and the presence of complex issues in Yemen, Somalia, and Afghanistan. New entrants like Israel have also established bases in the region. The proliferation of nuclear arms, substantial naval buildups, and the evolving global leadership dynamics further contribute to the multifaceted landscape.

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iii. Director, India Ocean Study Center at NIMA

The region faces challenges and concerns, with active discourse centered around controlling advanced technology, poverty, governance challenges, and resource control. The role of non-governmental organizations (NGOs) in the region is under scrutiny, and military alliances, interstate conflicts, and the preservation of global power interests all weave into the intricate fabric of IO's geopolitics.

It is important to continue maintaining peaceful navigation, harness continental shelves, and exploit marine resources. Criminal activities, narcotics, human smuggling, piracy, and illegal fishing are persistent challenges. These challenges are classified under traditional and non-traditional categories, reflecting the multifaceted security landscape of the region. In the non-traditional security category, climate change poses a pressing concern in the IOR. The associated repercussions, including rising sea levels and temperature fluctuations, demand proactive measures.

Pakistan's maritime interests extend across the Arabian Sea, the Gulf of Oman, the Gulf of Aden, and key strategic chokepoints. These areas of operation and influence are critical to Pakistan's economic well-being and security. Pakistan must ensure its energy supply chain and reduce its reliance on foreign carriers.

Undersea Cables and Financial Transactions

The IO is a hub for critical undersea cables that daily facilitate more than 15 million financial transactions. Disruption of these critical cables can have far-reaching consequences, whether due to natural disasters or nefarious actions. This vulnerability extends to cyber threats, where a well-placed

virus could wreak havoc on the entire financial system that relies on these undersea networks.

Indian Maritime Thinking

Indian maritime thinking emphasizes the importance of the IO. India views the IO as vital to its economic security and understands that any disruption could have severe consequences. India is also expanding its maritime capabilities significantly and aims to have a formidable naval fleet, including carriers, submarines, and maritime aircraft. The cumulative strength of the Indian Navy could outweigh the combined strength of the navies of all littoral states.

Indian influence in the IOR has expanded significantly. It has established strategic partnerships and military agreements with numerous countries, including Myanmar, Singapore, Malaysia, and Indonesia, solidifying its regional presence. India's maritime strategy closely aligns with its Indo-Pacific approach, emphasizing its role in the broader super region.

India and the US have strengthened their maritime cooperation, notably in the Malacca Strait. India's acceptance as the net security provider for the IO has far-reaching implications. It signifies India's access to the North Arabian Sea, which brings Indian naval operations, including aircraft and ships, close to Pakistan's waters and the Gulf. This development requires a robust response and narrative from Pakistan, considering the security dynamics in the region.

India and China share a complex relationship marked by cooperation and competition. Border disputes, such as the Dokhlam standoff in 2017, have sometimes escalated into conflicts. The two countries have engaged in naval build-ups, with India and China expanding their naval capabilities in the IO. India has sought to balance Chinese influence

by enhancing its partnerships with other regional powers, including the US and Japan.

To counter the so-called Chinese influence, India has launched the 'Necklace of Diamonds' strategy in the IO. It goes beyond India's traditional areas of interest and extends to the Atlantic, Pacific, and South Pole. This signifies India's aspiration to be a global superpower that can operate far beyond its borders.

Pakistan's Position

Pakistan's maritime interests extend across the Arabian Sea, the Gulf of Oman, the Gulf of Aden, and key strategic choke-points. These areas of operation and influence are critical to Pakistan's economic well-being and security. Pakistan must ensure its energy supply chain and reduce its reliance on foreign carriers.

Pakistan's energy security is closely tied to the maritime domain. Disruptions in the flow of coal, LNG, and gas to Karachi's ports can have significant consequences. Any interruption could lead to power shortages and impact daily life. Therefore, ensuring the uninterrupted flow of energy resources is essential for national security.

Pakistan faces the challenge of maneuvering within this evolving geopolitical landscape, given India's expanding presence and its own historical and territorial conflicts. Previously, Pakistan and India were within the ambit of US CENTCOM and Asia-Pacific Command, respectively. With its renaming as US Indo-Pacific Command, Pakistan-US relations are witnessing a transitional phase. Their bilateral relations have experienced fluctuations over the years, often influenced by regional dynamics and security concerns.

The US has relied on Pakistan for logistical support vis-avis its military operations in Afghanistan, making Pakistan strategically significant. All these imperatives are vital for the geo-strategic environment of the IOR.

Impact of Emerging Technologies on Nuclear Deterrence in South Asia and Greater Indian Ocean Region

Anum A Khan[iv]

Introduction

In an era marked by rapid technological advancements, our understanding of traditional security paradigms is being reshaped, particularly in nuclear deterrence. It is pertinent to explore the intricate relationship between emerging technologies and the delicate balance of power (BoP) that defines the security landscape in this critical part of the world.

South Asia, with its complexities and historical context, has long been characterized by a precarious equilibrium. Nuclear deterrence has played a pivotal role in maintaining stability and preventing large-scale conflicts. However, the accelerating pace of technological innovation is introducing new dimensions to this equation. Hypersonic weapons, advanced sensors, disruptive situational awareness technologies, drone swarms, robotics, lasers, 5G, quantum computing, big data analytics, and network centric cyber-attacks have revolutionized warfare. As we navigate this changing landscape, it is vital to assess how these innovations impact

iv. Associate Director Research, CISS

the strategic calculus of Pakistan, alter crisis stability, and introduce elements of unpredictability.

The convergence of these disruptive technologies has the potential to render crises unpredictable. Many of these technologies possess dual-use attributes, which can obscure the distinction between conventional and nuclear applications. Nevertheless, the enhanced efficiency, precision, and rapidity that these technologies bestow upon military systems are likely to affect traditional deterrence.

The transformative power of technology is not confined to national borders. Developments in one country's defense capabilities can reverberate across the region, influencing security postures and recalibrating the deterrence strategies of

Emerging technologies encompass a range of advancements that are revolutionizing the defense landscape. Their influence is profoundly altering traditional approaches to nuclear deterrence.

neighboring nations. This is the complex interplay between India and Pakistan, where Pakistan is striving to maintain deterrence equilibrium.

The greater IOR – at the crossroads of economic, political, and security interests – is particularly susceptible to the ripple effects of these technological advancements. As maritime trade routes intersect with regional power dynamics, understanding how emerging technologies affect the BoP becomes a matter of global importance.

As the world undergoes rapid technological transformation, emerging technologies are altering the dynamics of nuclear deterrence in the IOR. The following analysis

delves into the multifaceted impact of emerging technologies, including machine learning (ML), AI, Lethal Autonomous Weapons (LAWs), and the use of swarm drones on SSBNS, on the intricate balance of nuclear deterrence between India and Pakistan.

Emerging Technologies and Nuclear Deterrence: A New Paradigm

Emerging technologies encompass a range of advancements that are revolutionizing the defense landscape. Their influence is profoundly altering traditional approaches to nuclear deterrence. The IOR, with its overlapping economic interests, security concerns, and maritime trade routes, serves as an apt backdrop to explore these shifts. The presence of these capabilities in the hands of a radicalized Indian leadership poses a dual threat – one to regional stability and the other to India's security.

Machine Learning and Artificial Intelligence: Redefining Decision-Making

AI involves the creation of intelligent machines, where intelligence refers to the capacity for critical thinking and logical reasoning. Meanwhile, ML pertains to developing machines capable of learning and adapting without explicit instructions. Learning involves transitioning from rote memorization to broad conceptualization. Memorization entails committing information to memory without analysis, whereas generalization involves comprehending fundamental principles and applying them to novel situations.

While deep learning (DL) is a subset of ML, it distinguishes itself by its swifter processing capabilities. The applications of AI are wide-ranging, encompassing areas such as autonomous weaponry and social engineering. The latter

involves the application of scientific methods to influence the perspectives and actions of a large populace to achieve desired traits. These advancements can significantly impact global security.

AI's significant impact can extend to the strategic sphere, altering power dynamics, shifting attitudes towards risk and defense strategies, promoting a proactive approach to offense, molding conflicts, and overseeing military operations. Currently, AI holds sway not only at tactical and operational tiers but also at strategic levels.

As states incorporate AI into their decision-making processes, the speed of analysis and response increases. While this may mitigate misunderstandings, it could also accelerate crisis escalation, leaving less time for diplomatic off-ramps.

In the near to mid-term, AI advancements are poised to yield substantial benefits in two crucial domains: Nuclear Command, Control, and Communications (NC3) and autonomous systems for nuclear weaponry. Within the realm of NC3, AI holds the potential to expedite responsive launches, augment decision-support processes, and bolster the effectiveness of reliable communication and alert mechanisms during critical situations, especially concerning maritime-based nuclear deterrence.

Employing AI to elevate judgment precision and establish trustworthy communication mechanisms offers a range of advantages with minimal associated risks when fortifying nuclear deterrence strategies. Particularly in the context of autonomous nuclear weapon systems, AI proves invaluable for intricate tasks such as obstacle recognition, maneuvering

finesse, automated target identification, and persistent surveillance capability.

Nonetheless, when weapon systems attain complete autonomy, the risk of potential catastrophic malfunctions increases, heightening the likelihood of inadvertent conflicts. This outcome stems from the fact that the comprehension and execution of such command choices necessitate the utilization of 'abductive logical reasoning,' a cognitive process beyond the current capabilities of AI that predominantly relies on inductive logic for its computational operations.

Although AI might find a place in the forthcoming conventional operations of India and Pakistan, it is improbable that both countries will heavily depend on AI for aiding decision-making in the immediate future.

As states incorporate AI into their decision-making processes, the speed of analysis and response increases. While this may mitigate misunderstandings, it could also accelerate crisis escalation, leaving less time for diplomatic off-ramps.

Lethal Autonomous Weapons: Rethinking Escalation Dynamics

The emergence of LAWs prompts concerns regarding escalation management within a nuclear framework. These weapons could function autonomously, potentially blurring the distinction between conventional and nuclear conflicts. It becomes crucial to establish effective command and control mechanisms in South Asia to avert unintended escalation.

Uncrewed Underwater Vehicles (UUVs)

Using UUVs to secure underwater strategic advantage marks a trend of 'dronification' in maritime warfare. In a

potentially offensive stance, nuclear-capable nations might also incorporate swarms of underwater drones that will function as fully autonomous weapon systems and execute intricate coordinated maneuvers that defy easy tracking.

Such technologies, including the Tactical Boost Glide (TBG) system, could be employed to locate and neutralize SSBNs. Pakistan may find maritime swarming technology appealing due to its versatile applications, encompassing large or medium UUVs, all at a relatively modest production cost.

Quantum Technology

Quantum technology is said to play a significant role in future warfare. Some experts suggest that disruptions in quantum communication could compromise the integrity of nuclear weapon control codes. This technology might also jeopardize the security of nuclear secrets, making them susceptible to breaches. Quantum radars could penetrate stealth modes of SSBNs by utilizing magnetometers, quantum clocks, and gravity gradiometers for detection. Through its National Quantum Mission (NQM), India is also working on such technologies.

> **Recognizing the transformative power of these technologies, India has sought to augment its naval capabilities through strategic partnerships with other states possessing expertise in these domains.**

Conversely, quantum technology holds promise for enhancing navigation and computational speed, which will bolster submarine stealth capabilities. It could also facilitate secure communication with SSBNs through advanced encryption and decryption methods.

Considering the nascent stage of quantum technology in India, its reliability could be compromised, potentially leading to inaccurate warnings or inadequate responses to perceived threats. Such uncertainties could inadvertently escalate crises between India and Pakistan.

Quantum technology applications hold substantial technological significance. Despite advancements in sensor sensitivity, it is unlikely that quantum sensors will render oceans completely transparent and jeopardize the established near-invulnerability status of SSBNs, at least within the short to medium term.

Indian Defense Partnerships

Recognizing the transformative power of these technologies, India has sought to augment its naval capabilities through strategic partnerships with other states possessing expertise in these domains. For instance, through the Logistics Exchange Memorandum of Agreement (LEMOA), Communication, Compatibility, and Security Agreement (COMCASA), Communication and Information Security Memorandum of Agreement (CISMOA), and Defense Technology and Trade Initiative (DTTI) between India and the US, India aims to promote joint research and co-development and co-production of advanced defense systems. Indo-US collaboration will grant India access to sensitive technologies and classified communication exchanges in times of conflict and enhance maritime domain awareness across the Indo-Pacific as a force multiplier in the IOR. This partnership strengthens India's indigenous capabilities and fosters interoperability with the US Navy.

Today's complexity lies not solely in maintaining assured second-strike capability but in the rapid technological progress that amplifies the risk of submarine detection. An illustrative

example is the P8I Poseidon anti-submarine aircraft, recently supplied by the US to the Indian Navy. Regarded as the foremost submarine hunter-killer globally, this aircraft's sensors and weaponry suite have been meticulously tailored for tracking submarines in the IO and beyond.

Conversely, the US Navy consistently collaborates with Indian counterparts in joint naval exercises, utilizing cutting-edge assets such as nuclear submarines, aircraft carriers, fighter jets, ASW aircraft, helicopters, and AEW aircraft. These engagements enhance interoperability and help hone operational and combat capabilities, notably in anti-submarine operations. Moreover, collaborative efforts between the US and India involve the implementation of sonar barriers, also known as SOSUS (a passive low-frequency sonar system optimized for anti-submarine warfare), strategically positioned at critical junctures within the IO.

India's defense ties with Russia have also been instrumental in acquiring cutting-edge sea-based technologies. The acquisition of the BrahMos supersonic cruise missile, jointly developed by India and Russia, has helped bolster its sea-based nuclear capabilities.

AUKUS will also cooperate in areas ranging from cyber capabilities to quantum technologies. The allies are now turning their attention to hypersonic missiles. Scholars believe that this may provide a template for India. Quad-led AI collaboration – of which India is a part – could also bolster India's disruptive behavior in the region.

Navigating the Technological Frontier

Disruptive technologies have the potential to render cr ses unpredictable. Most of these technologies possess dual-use attributes, which can obscure the distinction between

conventional and nuclear applications. Nevertheless, the enhanced efficiency, precision, and rapidity these technologies bestow upon military systems will likely distress the effectiveness of traditional deterrence and strategic stability in the IOR.

Cyberwarfare at Sea: A Threat to Strategic Stability
Abdul Moiz Khan[v]

Introduction

While cyberspace has its benefits, it increases the challenges and vulnerabilities of systems. Cyberwarfare can be described as 'the use of cyberattacks to disrupt the activities of a state or organization, especially the deliberate attacking of information systems for strategic or military purposes.' Navies are increasing their reliance on digital technology, which poses the threat of an increasing number of cyberattacks on digitalized assets.

Cyber Threat to Naval Warships

Naval warships have several computer networks that allow communications between the ship and shore establishments over the defense enterprise networks. They also control the machinery that enables a ship to float and move, ensure safe navigation, control the weapon systems, and maintain the recognized maritime and air picture for timely command and control.

v. Research Officer, CISS

Integrating radar systems, Automatic Identification System (AIS), and Electronic Chart Display and Information Systems (ECDIS) through digital technologies entails several benefits for maritime operations but also makes ships prone to cyberattacks.

The combat management systems (CMS) in warships are vulnerable to cyberattacks. In air-gapped warships, malware can be introduced through the supply chain or insider threats. After achieving access to the CMS of a warship through malicious code or by forcing the shutdown of radar systems, missiles can be prevented from being fired. Cyberattacks may confuse by turning friendly tracks into hostile ones, leading to friendly fire incidents.

Malware could be introduced to compromise the stealth capabilities of a submarine through either software, or some signal emitting beacon hidden in the hardware.

Cyber Threat to Nuclear Submarines

It is generally believed that since the submarine network system is air-gapped, it is not vulnerable to cyberattacks. However, the Stuxnet incident illustrated that even air-gapped systems are not invulnerable to cyber threats. A new code can inevitably be introduced in any electronic system, be it by a USB memory stick. Furthermore, security flaws can be introduced deliberately or inadvertently at the manufacturing, assembly, and maintenance stages to be potentially exploited in the future.

During communications to and from submarines, possible attacks include interception, spoofing, bit flipping, and jamming. To calculate precise readings, submarine systems need to be synchronized. Should the malware be introduced

during the development or maintenance of the navigation components, it could disrupt internal synchronization data, such as the time and date, bathymetry data, calculations, or sequence numbers. Ultimately, this could confuse navigation, divert the submarine from its original course, or cause collisions. Attacks on the nuclear power plant could be hazardous for an SSBN. Malware can propagate over the network of interconnected Programmable Logic Controllers (PLCs), corrupt sensor data, and even deny access to infected systems. Damage to any of these systems could have devastating consequences. An attack could result in changes to power generation or reactor overheating. Malware could be introduced to compromise the stealth capabilities of a submarine through either software, or some signal-emitting beacon hidden in the hardware.

Highly classified details of the submarine, its key systems (such as stealth or navigation), the missile, the warhead, or its general area of patrol (all likely stored on computers) can be stolen through cyber espionage. This could compromise the invulnerability of the submarine or allow adversaries to develop countermeasures, anti-missile defenses, or better anti-submarine warfare (ASW) techniques aimed at undermining the deterrent.

Implications for Strategic Stability

A sea-based deterrent ensures that the other side will not initiate a first strike because of the threat of retaliation. Even after a splendid first strike against land-based nuclear weapons of a state, a sea-based deterrent can still provide it with the ability to strike back. However, in a scenario where State A's cyberweapons can compromise the sea-based deterrent of State B, the former can be incentivized to initiate a nuclear attack, thereby negatively affecting strategic

stability. Submarines could be widely compromised in peacetime without anyone knowing, and threats can be operationalized during conflict. Any electronic interference during a crisis could be highly destabilizing, not least because a crisis involves stress, confusion, and often poor decision-making.

Indian Partnerships in the Cyber Domain

Besides defensive cyber capabilities, India aspires to acquire offensive cyber capabilities. New Delhi has already signed agreements with several countries, including Israel, the US, France, Singapore, the UK, Australia, Japan, and Russia. Moreover, the Quad group considers cybersecurity an important area of cooperation.

During his visit to India in January 2018, Israel's Prime Minister Netanyahu signed a MoU on cyber security aimed at enhancing cooperation to secure the cyberspace of both countries. Reportedly, India procured Pegasus spyware as part of the Indo-Israel weapons deal signed in 2017, which was used to spy on government officials of Pakistan.

In the IOR, the growing Indo-US partnership in cybersecurity can strengthen India's capabilities. Both countries have committed to cooperating on a range of cyber issues, including preventing and responding to cyber threats, promoting cybersecurity education and awareness, and building resilient cyber infrastructure.

Options for Pakistan

Pakistan has to take measures for air-gapping the sytems, locating insider threats, ensuring that there are no data leaks or cyberespionage attacks that can provide adversaries with secret information, and ensuring that

there have been no cyber lapses during procurement or maintenance. A more comprehensive approach can be to develop a National Institute of Standards and Technology (NIST) framework for improving critical infrastructure cybersecurity. AI can play an essential role in identifying and reacting to cyber threats. AI and ML are great tools for detecting anomalies in the system, given their speed to read millions of lines of code. Another critical step is to isolate the cyberattack. The whole network should not be shut down; instead, any kind of network attack should be fought, and teams should be able to segment the area where the suspicious activity occurs. The mission should be continued while restoring the integrity or the capability of any part of the system.

Lastly, Pakistan must ensure that its critical workforce, including the cyber workforce, cybersecurity workforce, engineers, and systems command workforce, are up to the task and understand cyber threats they could face.
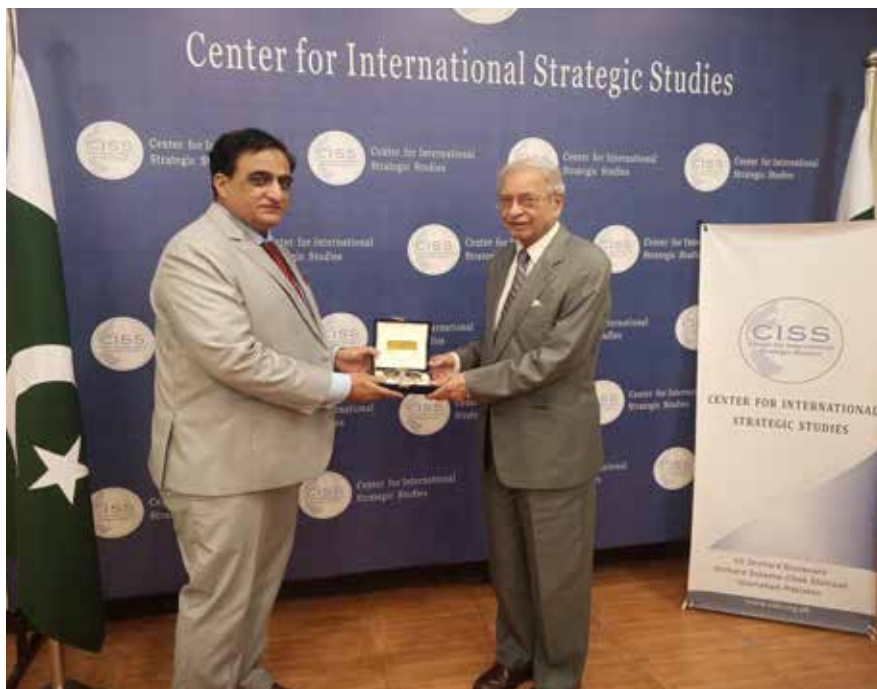
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