AYUSH GARG

NUCLEAR WATERS

DETECTION OF INDIAN NUCLEAR SUBMARINES USING AI

NUCLEAR WATERS

Detection of Indian Nuclear Submarines using AI

Ayush Garg

The Age of AI Warfare is here

First Published, 2022

Published by Vaishnavi Press
Umcom Graphix, Keshav Puram
Delhi - 110035

Printed and Bound in India by Vaishnavi Offset Printers.

Edition I

Summary: “Indian nuclear thought is based on ‘Credible Minimum Deterrence’ in which the sea leg of the nuclear triad is seen as the most reliable and secure. With the militarization of artificial intelligence technology, specially by adversaries like China; and given the limited strike range of missiles carried by INS SSBN, Indian nuclear submarines become *restricted* in their geography when on deterrence patrols. This in a rapidly evolving Artificial Intelligence based Intelligence, Surveillance and Reconnaissance world can increasingly result in early detection of Indian SSBNs upsetting Indian strategic thought and regional nuclear balance of power in the Indian Ocean as well as the larger Indo-Pacific.” – Provided by author.

ISBN: 9783161484100

To

The Indian Nation

CONTENTS

LIST OF FIGURES

ACKNOWLEDGEMENTS

As I embarked on this book I prayed to god to give me strength and dedication to fulfill the task ahead of me. The strength and motivation I prayed for was graciously answered through the following people. First and foremost, I would like to thank Dr. M. Venkataraman, Dr. E. Prabhakaran and Dr. S. Utham Kumar Jamadhagni for their guidance. No words could express the outstanding support, motivation, and exceptional guidance that I have received from them, particularly from Dr. M. Venkataraman. Without them I would have surely fallen short of completing this book. I would also like to thank my parents, Dr. Anuj Garg and Mrs Ritu Garg for encouraging me to put my best work forward and keeping me motivated towards writing. Their unconditional support and values have been a guiding light for me. Finally, this appreciation note will not be complete without thanking my dear sister Miss Aakriti Garg, for her joyful attitude and valuable insights. Without her this momentous achievement would not be possible.

NUCLEAR WATERS

Chapter 1
Introduction

"Stability and Predictability are the most important values in international relations"

President Vladimir Putin[1]
Russia

The Cold War has ended, the world has become much more complicated. With the emergence of the 4th Industrial Revolution (4IR), an unprecedented era in human history has begun, ushering in a shift in the international balance of power – spurred by Artificial Intelligence (AI). Unlike the previous Cold War, in this new chapter of 'Great Power Politics', India is now facing the prospect of being a frontline state, which creates unique vulnerabilities for the Indian Nation.

As the strategic competition deepens between the United States of America and China; so too does the power disparity widen between India and China in basic indicators of economic, military, political and technological prowess. The domination of Chinese actions in and within Indian periphery expand by the day, leading to serious incompatibility of national interests – *within a sizable but well defined geographical space of the Indian Ocean Region* (IOR). A risen China now aspires to neutralize the United States, and in this pursuit is hegemonising the Eurasian landscape through the Belt and Road Initiative, exerting tremendous influence over the Indian subcontinent. While India, which is an emerging pole in the world, is doubling down on its own Indian Ocean backyard, as the gateway to India's ambition of becoming a 'Leading Power' in the world.

This has created a situation of maritime conflict: where the Great Game for the Indian Ocean is well underway. In this context, when next generation technologies such as artificial intelligence and autonomous weapons systems are infused in the region; the technology differential between China and India grows to such an extent that the Indian nuclear strategic deterrence against China comes under increasing scrutiny and observation.

Within Indian Ocean Region's naval battlespace – the idea of the 'Indo-Pacific' has proliferated amongst USA and her allies and partners, (India being a core partner), bringing all major powers and their forces to the warm waters of the Indian Ocean. In reaction to this, China is now fortifying the naval forces of Pakistan, resulting in increasing Chinese and Pakistan maritime

[1] Vladimir, P. (2021, June 17). *NBC News exclusive interview with Russian President Vladimir Putin*. NBC NEWS. https://www.nbcnews.com/nightly-news-netcast/video/nightly-news-full-broadcast-june-11th-114695749694

forays into India's 'net security zone' within the Indian Ocean.[2] Thus as the waters of the Indo-Pacific become increasingly crowded, India's complex strategic environment further deteriorates, particularly within India's immediate neighborhood.

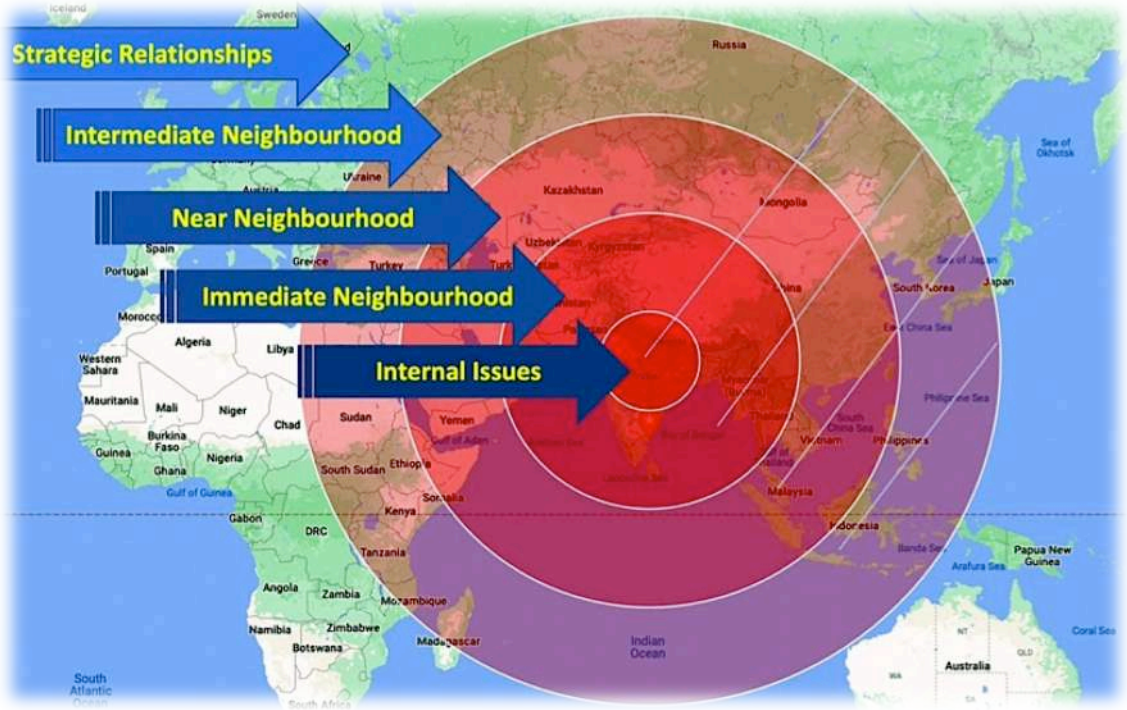


Figure 1 – **India's Complex Strategic Security Environment**. Kautilya's (Arthashastra) Mandala Theory mapped out for India.

(Source: Lt Gen P R Shankar, Fmr. Director General Artillery, Indian Army : Gunners Shot.com

It is this emerging naval dynamic of the Indian Ocean geography, infused with militarized AI configurations that forms the basis of research, fundamentally questioning *whether India will continue to enjoy operating Ballistic Missile Submarines (SSBNs) without strategic vulnerabilities in the Indian Ocean Region (IOR), particularly the Bay of Bengal*.

Key definitions

Artificial intelligence

Artificial intelligence is a catch-all term that refers to a wide set of computational techniques that allow computers and robots to solve complex, seemingly abstract problems that had previously yielded only to human cognition.

Nuclear weapon systems

Nuclear weapon systems should be understood in the broadest sense. They include not only the nuclear warheads and the delivery systems but also all nuclear force-related systems such as nuclear command-and-control systems, early-warning systems, and intelligence, reconnaissance and surveillance systems. Relevant non-nuclear strategic weapons include long-range high-precision missiles, unmanned combat aerial vehicles (UCAVs) and ballistic missile defence systems.

Source: Stockholm International Peace Research Institute

[2] Lt Col Kumar, D. (2019, April). *Indian Ocean Region (IOR): India as a Net Security Provider – The Way Ahead*. The United Service Institution of India. https://usiofindia.org/publication/usi-journal/indian-ocean-region-ior-india-as-a-net-security-provider-the-way-ahead/

THE PROBLEM

"India's sea-based deterrent would eventually be "secured in havens", waters we are pretty sure of, by virtue of the range of the missiles.
We will be operating in a pool in our own maritime backyard."

Vice Admiral Vijay Shankar[3]
Fmr. Commander in Chief, SFC

Independent India has a uniquely difficult land frontier. Faced with the immediate China-Pakistan nuclear axis on its western and northern borders, South Asia is defined by nuclear rivalries and strategic arcs (China, Pakistan, Afghanistan in the north; and India and USA in the south [especially after the Fall of Kabul 2021][4]). This has made the region a highly contested battlespace – and as the experiences of the Balakot airstrikes 2019 and of Chinese ingress in Ladakh 2020 have shown, India will not have singular control over the skies or land.[5] In fact, every air combat system that is airborne in the northern part of South Asia, is immediately detectable and tracked through a plethora of Chinese, Indian and Pakistan deployed radar and surveillance systems, the latest of them being the S-400 Triumf Missile system deployed by China in Tibet and Xinjiang in 2021.[6] Contested land and air frontiers will be the norm for combat operations in this geo-strategic landscape. And it is here that the Indian Ocean becomes critical.

As India journeys into the new multipolar international system it is increasingly bringing its maritime frontier into play with urgent emphasis on strengthening, building and better equipping its blue water navy.[7]

---

[3] Vice Admiral Vijay Shankar was the Commander in Chief of India's Strategic Forces Command from 2006 to 2008. The SFC is responsible for the management & administration of India's Nuclear Weapons under control of the Nuclear Command Authority.
Unnithan, S. (2018, November 5). *From India Today magazine: A peek into India's top secret and costliest defence project, nuclear submarines*. India Today. https://www.indiatoday.in/magazine/the-big-story/story/20171218-india-ballistic-missile-submarine-k-6-submarine-launched-drdo-1102085-2017-12-10

[4] Note - Afghanistan fell to the Taliban insurgency on 15 August 2021. It is widely known and published that it was the Pakistan Military Establishment that enabled the Taliban to outlast the U.S. and its Allies invasion of Afghanistan since 2001, under its policy of achieving 'strategic depth' against India.
Mohan, C. Raja. (2021, August 25). *It is Pakistan's moment of triumph in Afghanistan, but India must bet on patience*. The Indian Express. https://indianexpress.com/article/opinion/columns/afghanistan-crisis-taliban-takeover-pakistans-moment-of-triumph-india-must-bet-on-patience-7467450/

[5] Gupta, S. (2021, Jun 23). *Chinese S-400 systems across LAC, forces India to rethink air defence*. The Hindustan Times. https://www.hindustantimes.com/analysis/chinese-s-400-systems-across-lac-forces-india-to-rethink-air-defence-101624417959950.html

[6] Ibid.

[7] Indian Navy. (2015). *Ensuring Secure Seas:Indian Maritime Security Strategy*. Naval Strategic Publication, Indian Navy. Pg. 10. https://www.indiannavy.nic.in/sites/default/files/Indian_Maritime_Security_Strategy_Document_25Jan16.pdf

Yet simultaneously, the military-technological domains are transforming under the 4th Industrial Revolution[8] – with the militarization of AI and advancements in Unmanned Underwater Vehicles (UUVs),[9] fusion of adversary's (China) civil-military Intelligence, Surveillance and Reconnaissance Systems (ISR)[10] and increased mapping and maritime feature identification of the Indian Ocean sea bed.[11] These developments are creating new vulnerabilities and exposing weaknesses of Indian Naval Operations. In addition, the prospect of future permanent deployment of Chinese aircraft carrier strike groups in the Indian Ocean[12] and the multiple choke points of IOR; make this maritime geography an increasingly constricted frontier where *detection, tracking and engagement of submarines* will be more and more feasible and favorable under the new maritime-technological paradigm.

These adverse developments for India will be compounded by the fact that, India does not possess capability of Submarine Launched Ballistic Missiles (SLBMs) carrying nuclear warheads with Range of 10,000+ kilometers that can target the Chinese mainland from the vast depths of the southern Indian Ocean[13]; nor is it realistic for Indian SSBNs to traverse swaths of the South China Sea (SCS) *undetected,* for a launch, given the presence of China's Great Undersea Sensor Wall and the dominant control of the SCS by the People's Liberation Army Navy (PLA Navy, China).[14]

Further, it is extremely unlikely that Indian SSBNs will approach China from the Western Pacific, due to deep sensitivities of the increasingly escalating East Asian Nuclear Dynamic (North Korea, Japan, South Korea, USA and China)[15] with this maritime geography largely

---

8 Schwab, K. (2016, January 26). *The Fourth Industrial Revolution*. Foreign Affairs. https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

9 United States Government, Department of Defense. (2013). *Unmanned Systems Integrated Roadmap: FY2013-2038*. https://archive.defense.gov/pubs/dod-usrm-2013.pdf

10 Lt Col McCabe, T.R. (2021). *Chinese Intelligence, Surveillance and Reconnaissance Systems*. Journal of Indo Pacific Affairs, *Spring 2021*. *https://media.defense.gov/2021/Mar/07/2002595026/-1/-1/1/25%20MCCABE.PDF*

11 White, J.T. (2020), *China's Indian Ocean Ambitions: Investment, Influence, and military advantage*. Brookings Institution, *June 2020*. *https://www.brookings.edu/wp-content/uploads/2020/06/FP_20200615_chinas_indian_ocean_ambitions_white-1.pdf*

12 Colley, C. (2021, April 2) *A future chinese indian ocean fleet?* War on the Rocks. https://warontherocks.com/2021/04/a-future-chinese-indian-ocean-fleet/

13 Rehman, I. (2015). *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Vol. 9). Washington, DC: Carnegie Endowment for International Peace. Pg. 54 https://carnegieendowment.org/files/murky_waters.pdf

14 Tsering, D (2016, December 09). *China's 'Undersea Great Wall' Project : Implications*. National Maritime Foundation. https://maritimeindia.org/wp-content/uploads/2021/02/CHINA-UNDERSEA-GREAT-WALL-PROJECT-IMPLICATIONS.pdf

15 Rehman, I. (2015). *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Vol. 9). Washington, DC: Carnegie Endowment for International Peace. Pg. 121 https://carnegieendowment.org/files/murky_waters.pdf

demarcated as U.S. operational theatre within the 'Indo-Pacific' construct.[16] And finally, it is unfeasible for Indian SSBNs to target China from the Bering sea– southwards, as the Arctic waters are an unknown maritime geography for Indian submariners, with overwhelming Russian naval presence.[17]

Therefore the likely and (perhaps sole) scenario is that Indian Nuclear Submarines will traverse comfortable waters of the northern Indian ocean, particularly ***the Bay of Bengal*** *and launch a strike from there*. The Fmr. Commander in Chief of India's Strategic Forces Command, Vice Admiral Vijay Shankar has admitted as much in public strategic discourse.[18]

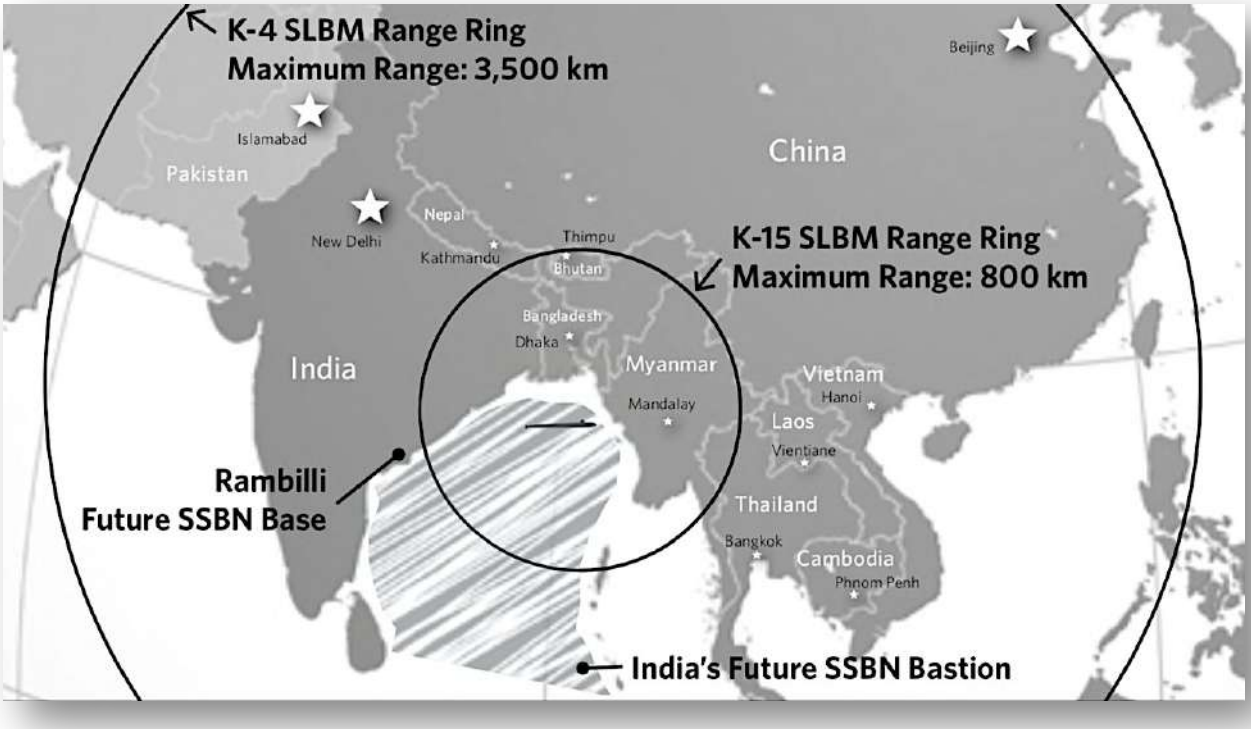


Figure 2 – **The extent of the K-4 Submarine Launched Ballistic Missiles that will arm India's SSBNs in the future.** *(Source: New Delhi, Centre for Air Power Studies, 2014).*

Which brings the issue of AI enabled ISR Capabilities of countries like China and the USA to the forefront, particularly when it relates to detecting and tracking Indian naval operations in the IOR, as great power competition in the Indo-Pacific intensifies. This research delves into the crucial strategic problem of *possible early identification and neutralization of Indian SSBNs by adversaries' use of AI-ISR militarized configurations in the northern Indian Ocean*.

---

16 President of the United States, White House. (2021, May 01). *U.S. Strategic Framework for the Indo-Pacific* (U.S. National Security Council Declassified Document) https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/IPS-Final-Declass.pdf

17 Nanda, D. (2019, Feb) "India's Arctic Potential", *ORF Occasional Paper No. 186*, Observer Research Foundation. https://www.orfonline.org/research/indias-arctic-potential-48263/

18 Rehman, I. (2015). *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Vol. 9). Washington, DC: Carnegie Endowment for International Peace. Pg. 54 https://carnegieendowment.org/files/murky_waters.pdf

RESEARCH OBJECTIVES

"Stability derives from a balance of legitimacy and power"

- Henry Kissinger[19]

The Main Objective of this research is to analyse the effect of AI-ISR militarized systems on the operations of Indian SSBNs in the Indian Ocean and consequently map its strategic ramifications for nuclear thought and strategic stability on the subcontinent.

The Sub Objectives of the study are:

(1) *Examine* the role of militarized AI-ISR in a maritime environment.

(2) *Rationalize* why the IOR is critical for India's sea-based nuclear deterrent.

(3) *Define* asymmetric strategic stability.

(4) *Theorize* how militarized AI-ISR can make Indian SSBNs immensely vulnerable in IOR

RESEARCH QUESTIONS

"Is the Indian Ocean still India's Ocean?"

- The New Indian Express[20]

The Central Question of this research is – **will India continue to enjoy her ability to operate Ballistic Missile Submarines *undetected, for large intervals* in the Indian Ocean Region, particularly in the Bay of Bengal?**

The Specific Research Questions are –

(1) What are the ramifications of militarization of artificial intelligence technology on strategic stability, particularly on the nuclear deterrent?

(2) Are Indian SSBNs restricted in their 'range' when on deterrent patrol against an adversary like China?

(3) Can AI-ISR eliminate the 'surprise element' of the sea-leg of the nuclear Triad by making SSBNs visible on the high seas?

(4) Is the northern Indian Ocean, particularly the Bay of Bengal, truly secure waters when littered with AI-ISR military systems?

(5) How vulnerable are Indian SSBN's to detection by AI-ISR technology in the northern Indian Ocean?

---

[19] *NSCAI Conference - Fireside Chat: AI for Humanity*. (2019, November 15). [Video]. YouTube. https://www.youtube.com/watch?v=YaigPwhZLqI

[20] Moorthy, S. (2020, Nov 05). *Is the Indian Ocean Still India's Ocean?* The New Indian Express. https://www.newindianexpress.com/opinions/2020/nov/05/is-the-indian-ocean-still-indias-ocean-2219532.html

METHODOLOGY

STANDING ON THE SHOULDERS OF GIANTS

The primary data for this research is composed of *government publications*, *military strategic documents and national policy doctrines of India, China, USA and Pakistan*. Additionally substantial secondary data is used in the project. The research captures a complex evolving military scenario – *use of AI-ISR to detect Indian SSBNs in the Indian Ocean* and therefore the methodology is grounded in an anti-foundational, post positivist framework. It endeavors to outline why militarized AI technology is a game-changer, particularly in the realm of intelligence, surveillance and reconnaissance in the IOR; and further analyzes the strategic consequences for Indian SSBN operations, using a qualitative approach.

Elements of the Army design methodology (U.S.) are used for analysis, as this is a methodology for applying critical and creative thinking to understand, visualize and describe problems and to identify approaches to solving them.[21] This approach is especially useful to systematically frame a complex problem,[22] which for the purposes of this research will be the most relevant part of the methodology. The problem of *early detection and neutralization of Indian SSBNs by adversary's AI-ISR militarized systems* is a rather complex one for it –

(1) Involves a large number of interacting elements which when faced with minor changes can produce disproportionately major consequences. (E.g. Number of UUVs deployed in IOR)

(2) Is a dynamic system and the whole is greater than the sum of its parts. (E.g. Importance of the IOR to Indian SSBNs, Indian nuclear strategic doctrine & the larger Indo-Pacific geography)

(3) Integrates the past developments of AI technologies with the present, as strategic decisions are based on past patterns of success and failure rather than definable rules. (E.g. *perception* of adversary's AI capabilities may encourage State Actors to *use force/weapons early*.)

(4) Has multiple identities and fluidity. (E.g. what will be the level of autonomy in militarized AI systems in the future? Will they be completely autonomous or semi-autonomous?)

Thus it is envisioned that the research will inherently evolve with time, military factors, technological set-ups and evolving State response; employing the use of inductive ideas within the thematic-geographical boundary of the Indian Ocean Region and the Indo-Pacific construct.

Lastly, the nature of the study will be explanatory – as naval military equations and the Balance of Power in Asia itself, are under flux – with China putting forward the proposition of an

---

[21] Headquarters, Department of the Army, Army Doctrine Reference Publication 5-0, *The Operations Process* (Washington, DC: Government Printing Office, March 2010), 2-24. https://rdl.train.army.mil/catalog-ws/view/ARIManagingComplexProblems/downloads/Army_Design_Methodology_ATP_5-0.1_July_2015.pdf

[22] Ibid.

'*Asia for Asians*'[23] which is a direct challenge to the U.S. founded and U.S. led 'Rules based International Order' across the Asian Continent.

USE OF DIGITAL TRAILS

The research will focus on doctrinal data of the Military, Defence, Foreign, and Prime Minister/President's Offices of India, China, Pakistan and the U.S.A. This will be supported by official statements, tweets, remarks and posts on digital media platforms, with the purpose of incorporating the latest policies, conversations and postures adopted by major powers of the region. This inclusion of social media digital trails is highly pertinent and necessary as they are the foremost medium through which a researcher can capture the new changes in diplomatic practices i.e. '*China's wolf warrior diplomacy*'[24] as well as thread out the thought process behind the escalating rhetoric and tensions amongst major regional powers i.e. '*Prime Minster of Pakistan's direct personal attacks on World Leaders on twitter.*'[25]

Further, social media is also a viable medium to track naval military deployments in the Indo-Pacific through the feeds & account handles of Official Military Spokespersons/ Officers, Certified Journalists as well as Global Strategic Watchers, providing up-to-date information on the evolving naval dynamics in the Indian Ocean and larger Indo-Pacific geography.

In fact the criticality of digital trails can be suitably illustrated by recent events – The announcement of the IAF Mi-17V5 Helicopter crash, carrying the Indian Chief of Defence Staff (CDS), his wife and team was first officially announced on **Twitter** (social media) on 8 December 2021 at 1:53pm from the Official Indian Air Force [IAF] account.[26] *This was followed by the shocking announcement by the IAF Twitter handle that the Indian CDS, General Bipin Rawat, his wife and 11 others had died in the same Helicopter crash at 6:03pm on the same day (8 Dec 2021).*[27]

---

23 Rolland, N. (2020, Jan 27). *China's Vision for a New World Order*. The National Bureau of Asian Research. Special Report Number 83. Pg. 17. https://www.nbr.org/wp-content/uploads/pdfs/publications/sr83_chinasvision_jan2020.pdf

24 Zhu, Z. (2020, May 16). *Interpreting China's 'Wolf-Warrior Diplomacy'*. The Diplomat. https://thediplomat.com/2020/05/interpreting-chinas-wolf-warrior-diplomacy/

25 Tweet. (2020, Oc 25). *Imran Khan Attacks President Macron*. Pakistan PM Imran Khan on Twitter. https://twitter.com/imrankhanpti/status/1320286659477442565?

26 Tweet. (2021, Dec 08). *OAF Mi-17V5 helicopter crashes*. Twitter. Indian Air Force. https://twitter.com/IAF_MCC/status/1468496444063576065

27 Tweet. (2021, Dec 08). *Chief of Defence Staff, Gen Bipin Rawat dies in crash*. Twitter. 6:03pm. Indian Air Force. https://twitter.com/IAF_MCC/status/1468559355868028936

RELIANCE ON SECONDARY DATA

Substantial secondary data is used because – *First*, there exists considerable knowledge analyzing artificial intelligence, the Indian Ocean geography and the Indian nuclear doctrine as standalone topics. *Second*, the COVID-19 Global Pandemic has presented unique challenges in conducting research, particularly when the research involves sensitive military domains, where lack of physical access to libraries, national archives etc. can pose a major challenge. Hence a practical and feasible approach is to rely on secondary sources of data.

Additionally, the research uses the example of the **Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) –** as proof of concept [28] employing it as part of secondary source data. Developed and deployed by the Defence Advanced Research Projects Agency (DARPA) for the United States Military, the ASW ACTUV SEA HUNTER, is an unmanned naval vessel optimized to robustly track quiet submarines.[29]

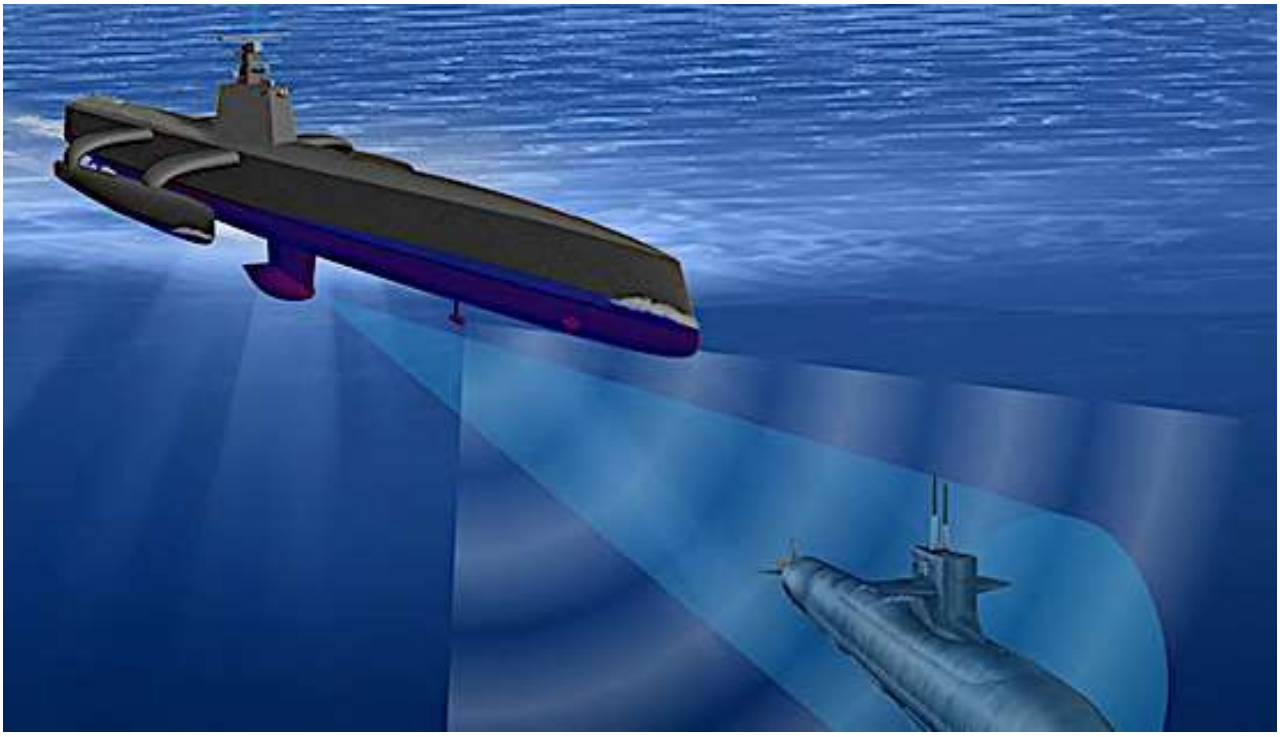


Figure 3 – **DARPA ASW ACTUV.**
The Sea Hunter was handed over to the US Navy on 30 January 2018. It has already demonstrated the capability of traversing the entire Pacific Ocean on a round trip from San Diego to Pearl Harbor – more than **8,300 kms without any human abroad**. And has reportedly successfully tracked submarines!
(Source: DARPA, Office of Naval Research)

[28] US Defence Advanced Research Projects Agency (DARPA), 'ACTUV "Sea Hunter" prototype transitions to Office of Naval Research for further development', 30 Jan. 2018. https://www.darpa.mil/news-events/2018-01-30a

[29] Ibid.

SCOPE AND SIGNIFICANCE OF STUDY

" Whoever controls the Indian Ocean, dominates Asia. This ocean is the key to the Seven-seas. In the 21st century, the destiny of the world will be decided on its waters."

– Alfred Thayer Mahan[30]
1897

Within the field of Indian security studies, it can be reasonably argued that the domain of nuclear deterrence is *the most closely guarded national capability of strategic importance*. Its fundamental significance can be judged by the fact that Nuclear Weapons provide India with:

1. Deterrence against Nuclear, Chemical, Biological blackmail
2. Ensure the strategic balance of power in Asia (China, India, Pakistan)
3. Provide the ultimate hard power weapons capability

Indian SSBNs in particular, operationalize the nuclear Triad and give legitimacy to the Indian Nuclear Doctrine of – **No First Use** and **Credible Minimum Deterrence** [31] Thus if the SSBNs were to become vulnerable on the indispensible elements of *'survivability'* and *'surprise'* – which are the foundational basis of the sea-leg of the nuclear Triad[32] – due to militarized AI-ISR, Indian nuclear thought will be severely challenged.

Until India develops demonstrable capability of SLBMs with ranges of 10,000+ kilometers, which is still years away, the possibility of early detection in the northern Indian Ocean exists.[33] If a major conflict/ war with China were to break out today, especially given the present hostile equations on the Line of Actual Control between the two countries, India faces the distinct possibility of having a compromised sea based nuclear deterrent.

Thus **new nuclear thought** and strategy is needed to defeat adversary's AI-developed military systems and prevent them from becoming a strategic disadvantage. This research opens the door to such a possibility, while critically identifying the important and immediate technological challenge of *militarization of artificial intelligence for Indian nuclear deterrence*.

---

[30] Ghosh, P. (2011, September 1). *Indian Ocean dynamics: An Indian perspective*. East Asia Forum. https://www.eastasiaforum.org/2011/04/05/indian-ocean-dynamics-an-indian-perspective/

[31] Government of India, Press Information Bureau. (2003, Jan 4). *Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine*. Prime Minister's Office. https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html

[32] Department of Defense, United States of America. (2020 Nov). *The Importance of the Nuclear Triad*. Factsheet, OSD Nuclear and Missile Defense Policy. https://media.defense.gov/2020/Nov/24/2002541293/-1/-1/1/FACTSHEET-THE-IMPORTANCE-OF-MODERNIZING-THE-NUCLEAR-TRIAD.PDF

[33] Department of Defense, United States, (2009, August). *Kill Box : Multi-Service Tactics, Techniques, and Procedures for Kill Box Employment*. Air Land Sea Application Centre, Department of Defense. https://info.publicintelligence.net/MTTP-KillBox.pdf

The research is also particularly significant given South Asia's *asymmetric escalation pyramid* and nuclear flashpoint viz-a-viz India and Pakistan. There is tremendous strategic debate yet to take place within the Subcontinent, on whether militarized AI will be characterized as a sub-conventional, conventional or nuclear enabler – and this research opens new debate on the issue, providing much needed understanding of AI-nuclear dynamics in the Indian Ocean.

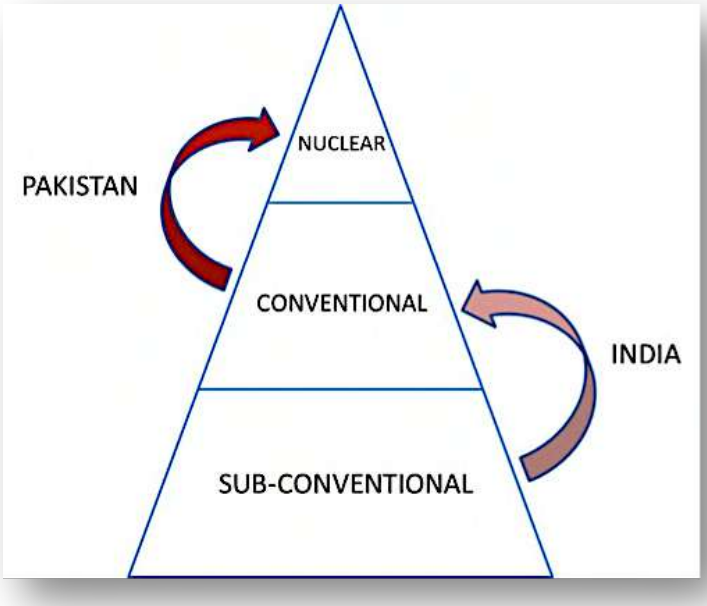


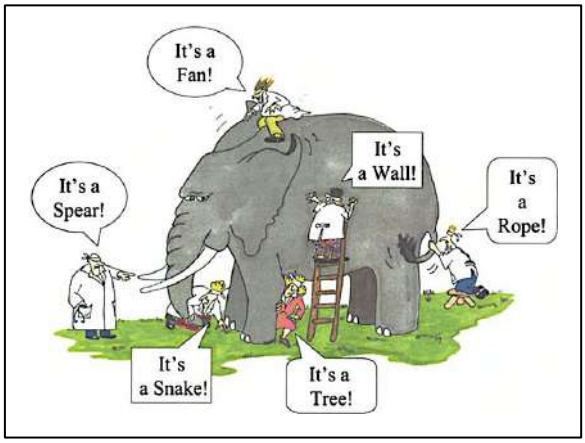
Figure 4 – **South Asia's Asymmetric Escalation Pyramid.** Concept developed by Dr. Rudra Chaudhuri, Director, Carnegie India and Mr. Kamaldeep Sandhu, Fmr Indian Army Paratrooper.

(Source: Strife Journal, Department of War Studies, King's College London) 28 Feb 2019.

Further, as the Indo-Pacific global commons turn into contested seas, the research highlights why India must gravitate towards this new geo-strategic reality, shrugging off its 'sea blindness' and orient itself for the *Century of the Seas* before it is too late.

" India is a Strategically Blind Nation "

\- General Krishnaswamy Sunderji
Blind Men of Hindoostan



Finally, the research **presents a working definition of Asymmetric Strategic Stability –** an important conceptual outline – for the future of Indo-Pacific and Great Power Competition in the 21st Century.

Chapter 2
Literature Review

" Adversaries ignorance of AI-developed Configurations will become a strategic disadvantage."

– Henry Kissinger [34]

For the purposes of this research, a review of completed and ongoing research has been conducted to identify the key vulnerabilities Indian SSBNs face, particularly in light of increasing AI-ISR capabilities of adversaries, which may be used to detect, intercept and engage India's sea-based nuclear deterrent, within the northern Indian Ocean, Bay of Bengal geographical region.

The literature review addresses the following issues:

- ✓ Militarization and Weaponization of Artificial Intelligence by USA and China and its consequences for India
- ✓ Indo-Pacific Political and Maritime Geography
- ✓ Indian Nuclear Doctrine and SSBNs

The key sources that have been referenced in this literature review are:

- ❖ SIPRI. (2020, June). Artificial Intelligence, Strategic Stability and Nuclear Risk
- ❖ SIPRI. (2020, April). Impact of Artificial Intelligence on Strategic Stability and Nuclear Risk, Volume III, *South Asian Perspectives*
- ❖ President of the United States, White House. (2021, May 01). *U.S. Strategic Framework for the Indo-Pacific* (U.S. National Security Council, Declassified Document)
- ❖ The National Bureau of Asian Research. (2020, January). *China's Vision for a New World Order*. NBR Special Report #83
- ❖ United Nations Office for Disarmament Affairs (2020, June 3). *The militarization of artificial intelligence.*
- ❖ Journal of Indo Pacific Affairs. (Spring 2021). *Chinese Intelligence, Surveillance and Reconnaissance Systems*. *Vol.* 4, 263- 268.

[34] *NSCAI Conference - Fireside Chat: AI for Humanity*. (2019, November 15). [Video]. YouTube. https://www.youtube.com/watch?v=YaigPwhZLqI

- Carnegie Endowment for International Peace. (2015, March). Murky Waters: *Naval Nuclear Dynamics in the Indian Ocean*
- United Nations Institute for Disarmament Research. (2015, August). *The Weaponization of Increasingly Autonomous Technologies in the Maritime Environment: Testing the Waters*.
- United States Government, Department of Defense. (2013). *Unmanned Systems Integrated Roadmap: FY2013-2038*.
- NITI Aayog. (2018, June). *National Strategy for Artificial Intelligence*. Discussion Paper.

At the outset, one must acknowledge the extensive literature that exists individually on artificial intelligence, the Indian Ocean region and the Indian nuclear doctrine of 'credible minimum deterrence'[35] as three independent and separate research domains.

Contrary to popular perception, artificial intelligence (AI) as a technology is not new. The earliest science in AI began in the 1950s.[36] Since then research, debate and ideas on AI have existed for more than 70 years. What has recently changed is the explosion of data and computing power available to train and develop AI systems beginning from the 21st century onwards, which has made AI the most dynamic technological field within a span of a few years.

Similarly a myriad of literature, mapping and research exits on the Indian Ocean Region (IOR) and its maritime features. What is new is the addition of the 'Indo-Pacific' construct to the geographical and normative boundaries of the IOR. Proposed in 2007 by then Japanese Prime Minister Shinzo Abe, in his speech to the Indian Parliament[37] – the 'Indo-Pacific' is a geographical maritime expanse spanning the entirety of the Indian and Pacific Oceans, whose conceptual underpinning is found in medieval history in the writings of Mughal Scholar Prince Dara Shikoh[38] and more recently in the work of Karl Haushofer, the German geopolitical scholar in the 1920s.[39] Yet it is the contemporary 'Pivot to Asia' initiated by Former U.S. President Barack Obama in 2011; that makes the 'Indo-Pacific' the strategic maritime geography of our world today.

---

35 Government of India, Press Information Bureau. (2003, Jan 4). *Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine*. Prime Minister's Office. https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html

36 S.I.T.N.F. (2020, April 23). *The History of Artificial Intelligence*. Harvard University. https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

37 MOFA: Speech by H.E. Mr. Shinzo Abe, Prime Minister of Japan, at the Parliament of the Republic of India "Confluence of the Two Seas" (August 22, 2007) https://www.mofa.go.jp/region/asia-paci/pmv0708/speech-2.html

38 Mirror, M. (2007, August 22). *"˜India and Japan will make a broader Asia."* Mumbai Mirror. https://mumbaimirror.indiatimes.com/news/india/india-and-japan-will-make-a-broader-asia/articleshow/15734909.cms

39 Li, H. (2021). The "Indo-Pacific": Intellectual Origins and International Visions in Global Contexts. *Modern Intellectual History,* 1-27. doi:10.1017/S1479244321000214

As for the Indian Nuclear Program and strategic doctrine of 'credible minimum deterrence' – an entire ecosystem of strategic and defense literature is available. India declared itself as a State *armed* with Nuclear Weapons in May 1998.[40] Since then in the 23 years that have passed, detailed research studies and comparative analysis have been published on India's Nuclear Posture.

To understand this better let us delve into some key literature and documents that cover either one or more of the *three* distinct domains – (1) Artificial Intelligence. (2) Indo-Pacific. (3) Indian Nuclear Doctrine.

This research integrates and fuses together these 3 distinct domains, mapping out *how* artificial intelligence – as an *asymmetric strategic technology* – can change the game and guiding principles behind nuclear deterrence, bearing unique and strategic ramifications for Indian nuclear submarines within the Indo-Pacific geography.

2.1 Militarization of Artificial Intelligence

The United Nations Office on Disarmament Affairs (UNODA) paper titled *Militarization of Artificial Intelligence (2020);* argues that AI could have a destabilizing effect for international peace and security, particularly on global strategic stability. It envisions that military applications of artificial intelligence might make *war more likely and/or increase its lethality*. This is because, *First* – AI will affect military organizations and combat philosophy by changing the distribution of human and machine resources needed to engage in war and war-adjacent operations. *Second* – artificial intelligence will affect the speed of operations, which will, paradoxically both increase and decrease the time for decision-making.[41]

Applied to Intelligence, Surveillance and Reconnaissance operations (ISR), the paper explains how AI's interpretation and monitoring of sensor data – *will make the oceans more transparent, raising questions about the invulnerability of nuclear submarines*.[42] If nuclear assets in previously hard-to-detect places become traceable, then countries will face an unstable situation

---

[40] *Pokhran II- Atal Bihari Vajpayee's major nuclear initiative*. (2014, December 24). [Video]. YouTube. https://www.youtube.com/watch?v=ozhdzVPecSE

[41] United Nations. (August, 2019). *The militarization of artificial intelligence* – UNODA. United Nations. https://www.un.org/disarmament/the-militarization-of-artificial-intelligence/

[42] United Nations Institute for Disarmament Research. (2014). *The Weaponization of Increasingly Autonomous Technologies in the Maritime Environment : Testing the Waters*. UNIDIR. https://unidir.org/publication/weaponization-increasingly-autonomous-technologies-maritime-environment-testing-waters

not seen since the early days of the Cold War. Crucially, it won't matter whether AI actually enables these capabilities; *the mere perception that AI puts counterforce targeting in reach will be* ***destabilizing***.[43]

Nations want to be assured that their nuclear weapons will always fire when ordered and never fire unless the launch is intentional.

Further, the UNODA document highlights how AI can undermine deterrence by inducing states to *deliberately use* their nuclear weapons! If states believe that counterforce targeting is possible, or that other states could use AI systems to detect, intercept and engage strategic assets (SSBNs) – or interfere with their command and control, they might feel pressured to use their weapons early. The decision-making logic is as follows: *Nations want to be assured that their weapons will always fire when ordered and will never fire unless the launch is intentional*. The possibility that a submarine could be destroyed, or its systems hacked, complicates this **always-never calculation**.[44] Fearing that they might eventually lose the ability to use their nuclear weapons, states might decide to use them early, rather than risk future obsolescence. Finally the authors say that *autonomous vehicles* (UCAVs, UUVs) will become faster, stealthier, smaller, and more numerous, and will persist longer on the battlefield. This will have strategic implications on deterrence, as **Time** is a key commodity in a nuclear crisis. *Nuclear-armed missiles can reach their target in minutes in an India-Pakistan nuclear conflict*. Thus if detection, interception and engagement through AI-ISR autonomous platforms is a possibility, the escalation ladder climbs dramatically.

Further complicating the South Asian nuclear dynamic is the fact that: unlike the United States and the Soviet Union during the Cold War, whose strategic centers were separated by great distances, India is caught in between two nuclear adversaries (China and Pakistan). And while the Indian nuclear deterrence is aimed at China in the larger strategic sense, it is the *threat of use* emanating from Pakistan that can disproportionately affect nuclear calculations, especially given Pakistan's *asymmetric escalation nuclear posture*[45], its *horizontal dispersal of nuclear assets at sea*,[46] shortened nuclear timelines and adoption of AI across its nuclear deterrence architecture.

---

[43] Dr. Boulanin, V. (2019 May). *The Impact of Artificial Intelligence on Strategic Stability and Nuclear Risk*. Stockholm International Peace Research Institute. Volume I, Euro-Atlantic Perspectives. https://www.sipri.org/publications/2019/other-publications/impact-artificial-intelligence-strategic-stability-and-nuclear-risk-volume-i-euro-atlantic

[44] United Nations. (August, 2019). *The militarization of artificial intelligence* – UNODA. United Nations. https://www.un.org/disarmament/the-militarization-of-artificial-intelligence/

[45] Narang, V. (2014) *Nuclear Strategy in the Modern Era: Regional Powers and International Conflict*. Princeton. Princeton University Press. Page 113.

[46] Rehman, I. (2015). *Murky Waters: Naval Nuclear Dynamics in the Indian Ocean* (Vol. 9). Carnegie Endowment for International Peace. Pg. 76 https://carnegieendowment.org/files/murky_waters.pdf

2.2 Indo-Pacific Political and Maritime Geography

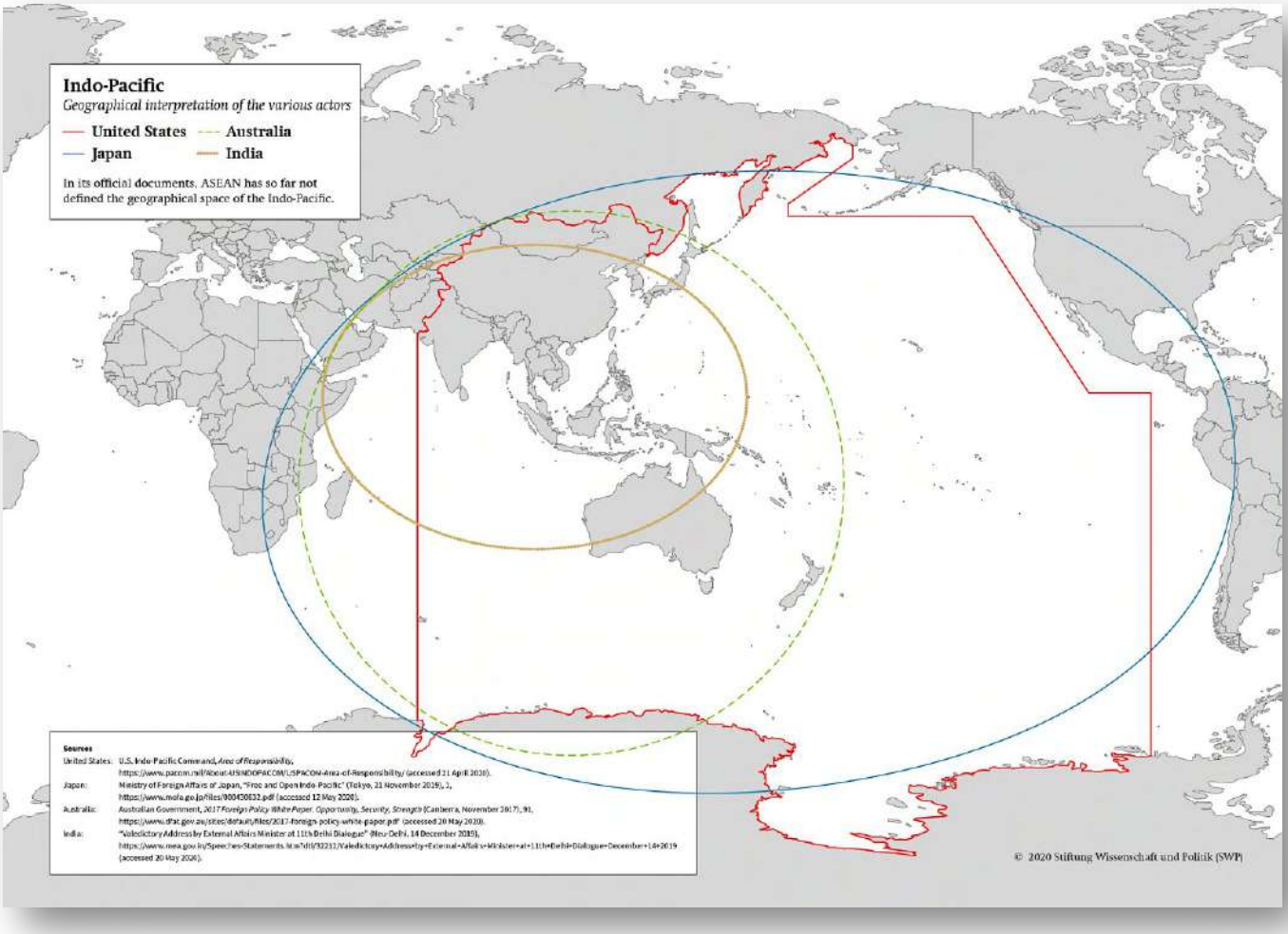


Figure 5 – **Geographical Interpretation of the Indo-Pacific by the 'Quad Countries'.**
(Source: German Institute for International and Security Affairs, SWP Research Paper 9, July 2020).

With the United State's 'Pivot to Asia' announced under President Barack Obama, his Successor President Trump **declassified** in part, a crucial security policy document titled the – **U.S. Strategic Framework for the Indo-Pacific** – on 01.05.2021.[47] The strategy document outlines the political-maritime framework for the Indo-Pacific region, clearly positing India as a Frontline State – acting as a counter-balance to China in the Indo-Pacific.[48] Further the document calls for action to *deny China* air and sea dominance within the First Island Chain, while calling for a complete U.S. domination of military domains outside the First Island Chain.[49]

The U.S. policy clearly defines the contours of a *"containment policy"* on behalf of the United States viz-a-viz China; signaling the start of a **'New Cold War'** dynamic, as the world's

[47] President of the United States, White House. (2021, May 01). *U.S. Strategic Framework for the Indo-Pacific* (U.S. National Security Council Declassified Document) https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/IPS-Final-Declass.pdf

[48] Ibid.

[49] Ibid.

political and military gravity shifts from the large Asian Continent (Asia Pacific) to the waters of the Indo-Pacific. Within this new Great Power Competition the U.S. has clearly politically demarcated maritime areas where it envisions dominance of the land, air and sea.

4 U.S. Presidents and 3 Indian Prime Ministers have referred to the India - U.S. relationship as that of ***essential strategic allies.***

Interestingly, even as India is emerging as a major *Swing State* in international relations; all successive U.S. Presidents and Indian Prime Ministers from the time of George W. Bush and Atal Bihari Vajpayee have referred to the bilateral relationship between the two countries as that of *essential strategic allies*.[50] This 'coming together' of the world's oldest and the world's largest democracies, can be seen playing out in the Indo-Pacific through the formation of the 'Quad' (Quadrilateral Security Dialogue) comprising of India, USA, Japan and Australia for a Free and Open Indo-Pacific[51] and a *rules based International Order*.[52]

Yet within the Quad, each country has different and individualized maritime interpretation of the geographical expanse of the 'Indo-Pacific' construct[53], with India largely focusing on the Indian Ocean Region, leaving the larger 'Pacific' for the U.S. – illustrated in Figure 5. This inherent division of the geographical boundaries combined with the political-maritime outline of the U.S. Strategic Framework for the Indo-Pacific, as discussed above, has profound implications for Indian military operations and plans.

Further, the Indian perception of encirclement by China through a *'String of Pearls'* strategy[54], is primarily focused on the Indian Ocean Region. Given recent PLA Navy advances in militarized AI systems like autonomous swarm boats, the distinct possibility of the 'string of pearls' being converted into a Chinese **'Bow and Arrow Strategy'** exist[55] – which will make the waters of the IOR increasingly crowded and contested maritime spaces.

---

[50] Cut the Clutter Episode No. 934. *Zero-sum game choices for India as China-Russia 'Anti-Quad' emerges & Pakistan tags along*. (2022, February 7). [Video]. The Print. YouTube. https://www.youtube.com/watch?v=E88dxBze6Hs

4 U.S. Presidents – George W. Bush, Barack Obama, Donald Trump and Joe Biden.
3 Indian Prime Ministers – Atal Bihari Vajpayee, Manmohan Singh, Narendra Modi

[51] Ministry of External Affairs. (2021, Sep 24). *Joint Statement from Quad Leaders*. (Washington DC) https://mea.gov.in/bilateral-documents.htm?dtl/34318/Joint+Statement+from+Quad+Leaders

[52] Ibid.

[53] H. Felix, W. Gudrun (2020, July). *From Asia-Pacific to Indo-Pacific*. German Institute for International and Security Affairs. SWP Research Paper 9. doi:10.18449/2020RP09

[54] Rolland, N. (2020, Jan 27). *China's Vision for a New World Order*. The National Bureau of Asian Research. Special Report No.83. Pg. 23. https://www.nbr.org/wp-content/uploads/pdfs/publications/sr83_chinasvision_jan2020.pdf

[55] Dixon, J. (2014). *From "Pearls" to "Arrows": Rethinking the "String of Pearls" Theory of China's Naval Ambitions*. Comparative Strategy. D.O. 33. 10.1080/01495933.2014.941730.

2.3 Indian Nuclear Doctrine and SSBNs

India is a formidable State *armed* with Nuclear Weapons, Intercontinental Ballistic Missiles (ICBMs and SLBMs) and Nuclear Submarines (SSBNs).

India has a publically declared Nuclear Doctrine – published in 2003 under a Press Information Bureau Press Release from the Prime Minister's Office, titled – *Cabinet Committee on Security Reviews Progress in Operationalizing of India's Nuclear Doctrine*.[56] The nuclear doctrine spells out the 'No First Use' Nuclear Policy, with the stated objective of achieving 'Credible Minimum Deterrence.'[57] This vision requires the establishment of a Nuclear 'Triad' of air, sea and land.

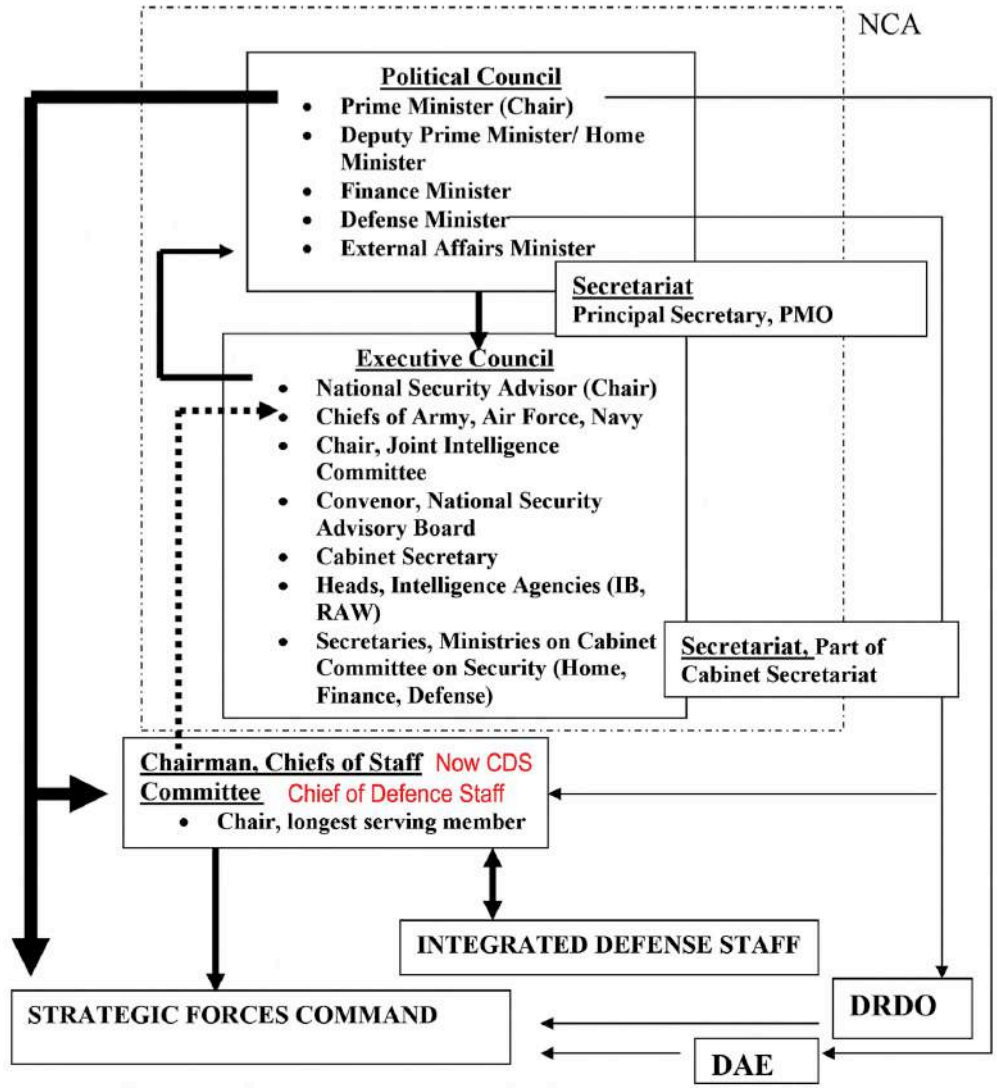


Figure 6 – **Structure of India's Nuclear Command Authority**

(Source: Nuclear Confidence Building Measures in South Asia: Nuclear Operations and Avoiding Inadvertent Nuclear War. Gaurav Rajen 2003.)

[56] Government of India, Press Information Bureau. (2003, Jan 4). *Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine*. Prime Minister's Office. https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html

[57] Ibid.

In particular, the sea-based leg of the Triad is viewed as the most survivable component by the Indian policy and strategic community.[58] The *'element of surprise and survivability'* is most potent in SSBNs, which make them a formidable platform. **The theoretical argument being** – a submarine launched strategic offensive missile constitutes a highly secure capability by virtue of the characteristics of a nuclear-powered submarine, compared to air and land-based systems which could be taken out.[59]

Yet in a rapidly evolving AI World – India's Nuclear Submarine capabilities and technologies face growing threats of early engagement. **According to the Nuclear Threat Initiative,** India currently has a submarine fleet of 16, with 1 SSBN (INS Arihant). The INS Arihant carries 12 Sagarika (K-15) submarine launched ballistic missiles (SLBMs) with a range of around 700 km, as well as versions of the nuclear-capable Nirbhay cruise missiles.[60] In November 2018, it was announced that INS Arihant had undertaken its first deterrent patrol.[61] The Indian government did not release information regarding the type of submarine-launched ballistic missiles (SLBM) the Arihant carried and *whether they were mated with a nuclear warhead*. Notably, the official Indian policy is to keep nuclear warheads de-mated from actual missiles.[62]

This can raise questions on India's 'Credible Minimum Deterrence posture' especially in regards to China. Further, in an age of Hypersonic Missiles, Indian Inter Continental Ballistic Missiles (ICBMs) of the **Agni Series** – have a comparatively long way to go. And with China's application of artificial intelligence for *strike capability* in the maritime domain; India's capacity for nuclear deterrence is called into question.

Interestingly the final developmental tests for India's K-4 SLBM, which has a range of 3,500 kms, making it a medium range ballistic missile (MRBM) were carried out on 24 January 2020.[63] This Missile is now in production mode and will arm the INS Arihant, greatly enhancing India's nuclear doctrine. Still it is glaringly obvious that current Indian SSBNs and ICBMs have a

---

[58] Singh, A. (2016, May 06). *India's Submarine Modernisation Plans*. Institute of Defence Studies and Analyses. https://idsa.in/idsacomments/indias-submarine-modernisation-plans_asingh_050516

[59] Department of Defense, United States of America. (2020 Nov). *The Importance of the Nuclear Triad*. Factsheet, OSD Nuclear and Missile Defense Policy. https://media.defense.gov/2020/Nov/24/2002541293/-1/-1/1/FACTSHEET-THE-IMPORTANCE-OF-MODERNIZING-THE-NUCLEAR-TRIAD.PDF

[60] Nuclear Threat Initiative (2021). *Indian Submarine Capabilities*. *https://www.nti.org/analysis/articles/india-submarine-capabilities/*

[61] Press Information Bureau. (2018, Nov 5). *Prime Minister felicitates crew of INS Arihant on completion of Nuclear Triad*. Prime Minister's Office, Government of India. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1551894

[62] Gady, F. (2019, January 30). *Indian Navy Boomer Completes 'First Deterrent Patrol.'* The Diplomat. https://thediplomat.com/2018/11/indian-navy-boomer-completes-first-deterrent-patrol/

[63] Peri, D. (2020, January 19). *India successfully test-fires 3,500-km range submarine-launched ballistic missile K-4*. The Hindu. https://www.thehindu.com/news/national/india-successfully-test-fires-3500-km-k-4-slbm/article30601739.ece

long road ahead, which in a fast paced technological world can easily become a strategic disadvantage under present conditions, having grave implications for Indian Nuclear Thought.

Therefore the <u>main understanding</u> that can be construed from these key literatures is that:

In the current global strategic scenario, militarized artificial intelligence is increasingly becoming a driver of entanglement between conventional and nuclear systems: for AI enhances and optimizes the lethality, scope and proficiency of conventional platforms (like UAVs and UUVs built for ISR Missions), which in turn can have strategic ramifications for nuclear systems; that is – detection, identification and early neutralization of SSBNs.

In such conditions AI becomes an **<u>asymmetric strategic technology</u>** holding the potential to change the strategic balance of power in a region – which for the purposes of this paper is defined as the Indian Ocean Region.

Chapter 3

Defining Asymmetric Strategic Stability

" AI is probably the most important thing humanity has ever worked on. It is more profound than electricity or fire… "

\- Sundar Pichai[64]
CEO Google

3.1 Strategic Stability

Nuclear weapons are the Great Stabilizer. Their deterrent ability has prevented the major powers[₸] from engaging in all out armed conflict with each other since 1945. Never before has the world been so reluctant to go to war than since the dawn of the Nuclear Age. The death and destruction witnessed in the Ancient Punic Wars (*Rome Vs Carthage*), the Medieval 100 Year's War (*England Vs France*), the Great War (*World War I*) and the World War II was **total** – compared to the shadowy indirect hostilities of the Cold War between the United States and the Soviet Union.

In fact the only thing that kept the Cold War 'cold' was the mutual deterrence afforded by nuclear weapons. Based on the logic/doctrine of *'mutually assured destruction'* (MAD) – **nuclear deterrence** has emerged as the only kind of political-military deterrence, which produces the effect of *avoiding or ending war*[65]*,* resulting in relative global security and peace amongst all the major powers over the last 70 years. It was the French Général d'Armée (Army General) André Beaufre who in his seminal masterpiece titled *Deterrence & Strategy,* outlined the capacity and effect of nuclear weapons to be a stabilizing factor in great power competition and elucidated the mating of nuclear deterrence theory with conventional deterrence policy, stating –

Victory in a conventional war is unilateral. In a nuclear war, destruction is bilateral.

> The nuclear and classical levels tied to each other, essentially with classic atomic weapons, brings to the latter the stability it lacks and returns to the former the elemental risk of instability that it needs in order to continue its role as the great stabilizer**.** [66]

---

[64] Sundar Pichai at the World Economic Forum, Davos Summit 2018. https://www.weforum.org/agenda/2018/01/google-ceo-ai-will-be-bigger-than-electricity-or-fire/

[₸] Major Powers here refers to the Permanent 5 members of the United Security Council (UNSC): United States, Russia, China, France and the United Kingdom – All P-5 countries are Nuclear Weapons States.

[65] Beaufre, A. (1965). *Deterrence and Strategy. United Kingdom: F. A. Praeger.* Pg. 32. ASIN: B005BKFXE2

[66] Ibid.

Thus the whole business of deterrence is built on uncertainty, with nuclear weapons fundamentally changing military calculations – both when they are *used* (bombing of Hiroshima and Nagasaki led to the unconditional surrender of Japan in WWII)[67] and when they are *threatened to be used* (Pakistan viz India, U.S.A viz Soviet Union). It is the inherent annihilation characteristic of nuclear weapons that led Maraget Thatcher, Fmr. British Prime Minister to declare –

> A world without nuclear weapons may be a dream but you cannot base a sure defence on dreams. Without far greater trust and confidence between East and West than exists at present, a world without nuclear weapons would be less stable and more dangerous for all of us.[68]

It is this sentiment of *distrust* between major powers that necessitates the need for strategic stability – and impacts the Action-Reaction cycle for the 'International Balance of Power' through the ages and now particularly through the prism of nuclear weapons.

Key definition

Strategic stability

Strategic stability has many definitions. It is understood here as 'a state of affairs in which countries are confident that their adversaries would not be able to undermine their nuclear deterrent capability' using nuclear, conventional, cyber or other unconventional means.

Source: Bulletin of Atomic Scientists: The myth of strategic stability ₸

Global Strategic stability since 1949 (the year the Soviet Union tested its first atomic bomb)[69] has been underpinned by nuclear logic and the MAD doctrine; instrumentalised in the *Nuclear Triad* through military forces operating in the land, air and sea. Each leg of the Triad provides unique and complementary attributes as part of robust deterrence –

(1) Land – ICBMS are *responsive*

(2) Air – Bombers are *flexible*

(3) Sea – SSBNS are *survivable*

---

67 The Manhatten Project, an Interactive History. *Japan Surrenders*. U.S. Department of Energy. https://www.osti.gov/opennet/manhattan-project-history/Events/1945/surrender.htm

68 Thatcher, M. (1987, March 30). *Speech at Soviet Official Banquet*. Margaret Thatcher Foundation. https://www.margaretthatcher.org/document/106776

₸ Podvig, P. (2012, Oct 31). *The myth of strategic stability*. Bulletin of the Atomic Scientists. https://thebulletin.org/2012/10/the-myth-of-strategic-stability/

69 CTBTO. *29 August 1949 – First Soviet Nuclear Test*. Comprehensive Nuclear Test Ban Treaty Organisation https://www.ctbto.org/specials/testing-times/29-august-1949-first-soviet-nuclear-test

General Mark A. Milley, Chairman of the U.S. Joint Chiefs of Staff (current), highlighted the role played by the triad in maintaining strategic stability and global order by stating on record that –

> The nuclear Triad has kept the peace since nuclear weapons were introduced and has sustained the test of time.[70]

Yet today, as the binary U.S.-Russian strategic stability framework disintegrates (legacy of the old Soviet-U.S. confrontation and particularly after the *War in Ukraine 2022*); it is replaced by regional nuclear rivalries (India-Pakistan) and strategic nuclear triangles (U.S.A, China and Russia), (China, India, Pakistan) – which have increasingly deteriorated the international security situation. To escalate matters, the 4th Industrial Revolution (4IR) – which is characterized by advances in artificial intelligence, automation, quantum technology, digital fabrication etc – is rapidly enabling new capabilities in crucial fields such as Intelligence, Surveillance and Reconnaissance, which is introducing new strategic possibilities. Recent fast paced advances in missile defences, hypersonic missiles, anti-satellite weapons (ASAT) and offensive cyber capabilities have strategic implications that are not yet clear for nuclear stability.

The 4IR is a major force driving all nuclear-armed states towards modernizing their nuclear systems and announcing new capabilities. In such circumstances, misperception and misunderstanding of the new infused technologies into nuclear systems can bring about alarm and crisis due to the **perceptional and psychological impact** they generate in the strategic thinking of other nuclear-armed states. *For E.g.* – The United States and the Soviet Union spent a great deal of time and effort studying each other's strategic systems and behavior during the Cold War and had regular bilateral interactions between military representatives. These practices helped generate a sense of predictability and maintained stability in each State's behavior.

Now, as a new multipolar international order takes shape, with the relative weakening of the United States and rise of China, the dynamics of a New Cold War are setting in – making it increasingly important to map out *how* the 4IR technologies, primarily artificial intelligence, are being integrated into military systems so as to outline and mitigate their destabilizing effect. Without proper communication and understanding amongst major powers about the deployment and use of the such technologies, the strategic stability maintained since after World War II has the potential of breaking down, leading to a return of the old unpredictable and unstable cold war days, particularly in regards to the infusion of AI in a state's nuclear deterrence architecture.

---

[70] Department of Defense, United States of America. (2020 Nov). *The Importance of the Nuclear Triad*. Factsheet, OSD Nuclear and Missile Defense Policy. Pg. 1. https://media.defense.gov/2020/Nov/24/2002541293/-1/-1/1/FACTSHEET-THE-IMPORTANCE-OF-MODERNIZING-THE-NUCLEAR-TRIAD.PDF

3.2 Artificial Intelligence and Strategic Stability

Artificial Intelligence has often been compared to electricity. Strategic thinkers say that just as electricity transformed everything 100 years ago, AI too will spread across the world and change the nature and behavior of human societies.[71] It is estimated that we are in the early decades of what is a multi-decade adjustment period with the comprehensive penetrative effect of AI on strategic stability being negative across the *Economic, Societal, Political and Security domains.*[72]

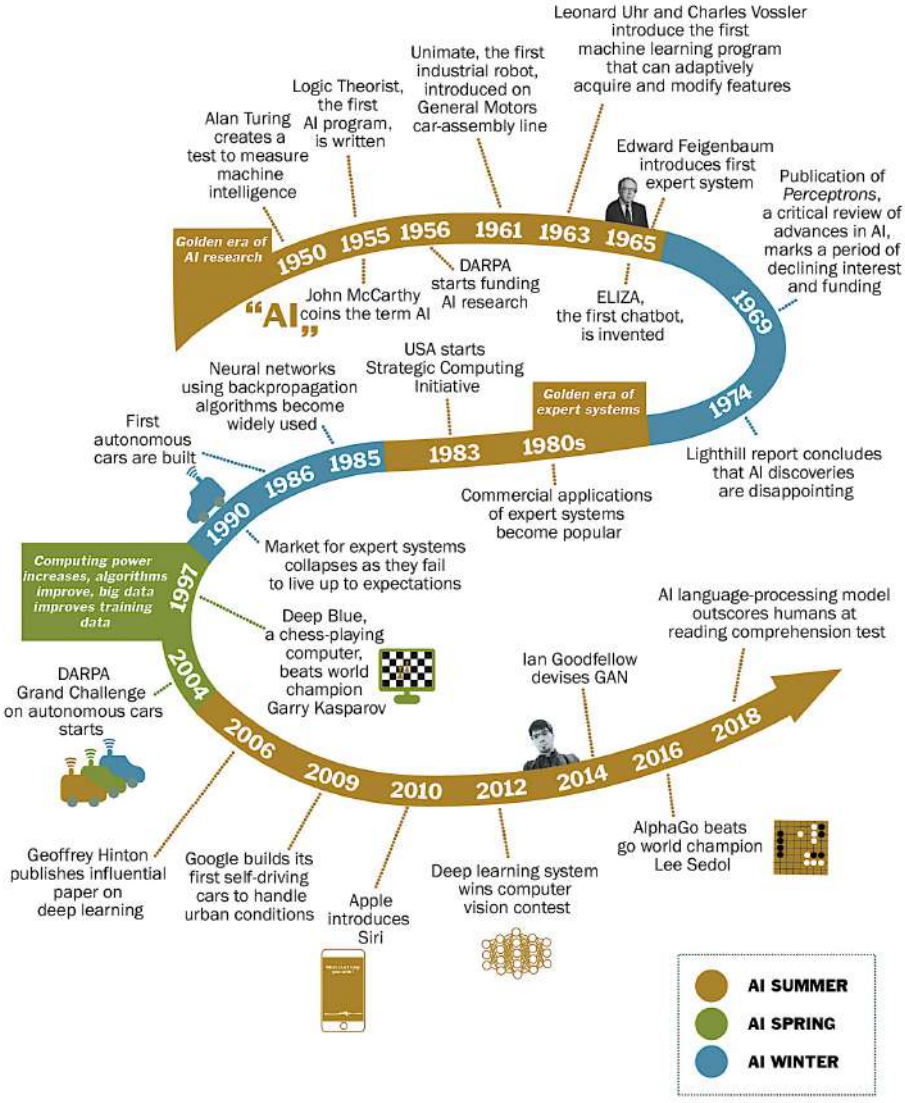


Figure 7 – **A brief history of Artificial Intelligence**
(*Source: Russel, S. & Norvig, P., Artificial Intelligence: A Modern Approach, 3rd edn (Pearson Education 2014)*

[71] Lynch, S. (2017, March 11). *Andrew Ng: Why AI is the New Electricity.* Stanford Business, Graduate School of Business. Stanford University. https://www.gsb.stanford.edu/insights/andrew-ng-why-ai-new-electricity

[72] Boulanin, V., Saalman, L., Topychkanov, P., Su, F & Carlsson, M. P. (2020 June). *Artificial Intelligence, Strategic Stability and Nuclear Risk.* Stockholm International Peace Research Institute. Pg. 10. https://www.sipri.org/sites/default/files/2020-06/artificial_intelligence_strategic_stability_and_nuclear_risk.pdf

As the current AI Summer advances, artificial intelligence is making rapid progress, exhibiting superhuman performance at increasingly complex tasks. Within the military domain, AI is being looked at for different Mission Roles:[73]

(1) **Force Application**
- 1.1 Automated target recognition system (increased precision)
- 1.2 Autonomous navigation systems (missiles and UCAVs)
- 1.3 AI software for force operations (increase speed & agility)
- 1.4 Autonomous swarms (enable attrition attacks)
- 1.5 Autonomous vehicles for offensive mining, countermining
- 1.6 UAVs for ground support (provide battlefield intelligence)

(2) **Battlespace Awareness**
- 2.1 Onboard processing of sensing & intelligence data
- 2.2 AI software for ISR data analysis (faster & agile processing)
- 2.3 Autonomous swarms (enhance situational awareness)

(3) **Force Protection**
- 3.1 Automated cyber security & cyber-defence systems
- 3.2 Unmanned autonomous systems for lifesaving battlefield medical assistance and casualty evacuation

(4) **Logistics**
- 4.1 Machine learning-powered data analytics for adaptive logistics
- 4.2 Unmanned autonomous systems for delivery & maintenance

With the militarization of AI, the two AI Superpowers of the world – the United States and China[74] – are locked in a strategic competition for the reigns of international balance of power and there are increasing concerns about the emergence of an *'AI arms race'* or an *'AI Cold War'*[75] amongst them, if one has not started already.

---

[73] US Executive Office of the President and National Science and Technology Council (NSTC). (2016, Oct). *Preparing for the Future of Artificial Intelligence*. Committee on Technology, White House. Pg. 38 https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf

US Department of Defense. (2018). *Summary of the 2018 Department of Defense Artificial Intelligence Strategy*. *https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF*

[74] Lee, K.F. (2018). *AI Superpowers: China, Silicon Valley, And the New World Order*. Harper Business. Pg. 6

[75] Zwetsloot, R., Toner, H. and Ding, J. (2018, Nov 16). *Beyond the AI arms race: America, China, and the dangers of zero-sum thinking*. Foreign Affairs. https://www.foreignaffairs.com/reviews/review-essay/2018-11-16/beyond-ai-arms-race

Notably, all three major nuclear powers – U.S., Russia and China are already adopting and deploying AI across the 4 Pillars of nuclear deterrence architecture[76]:

(1) Early Warning and Intelligence, Surveillance and Reconnaissance

(2) Command and Control

(3) Precision Strike and Delivery

(4) Non-nuclear operations

with little or no international consensus or policy on how stable these *unfamiliar strategic pairings* (AI with nuclear) will be in maintaining the relative uneasy peace of the international system.

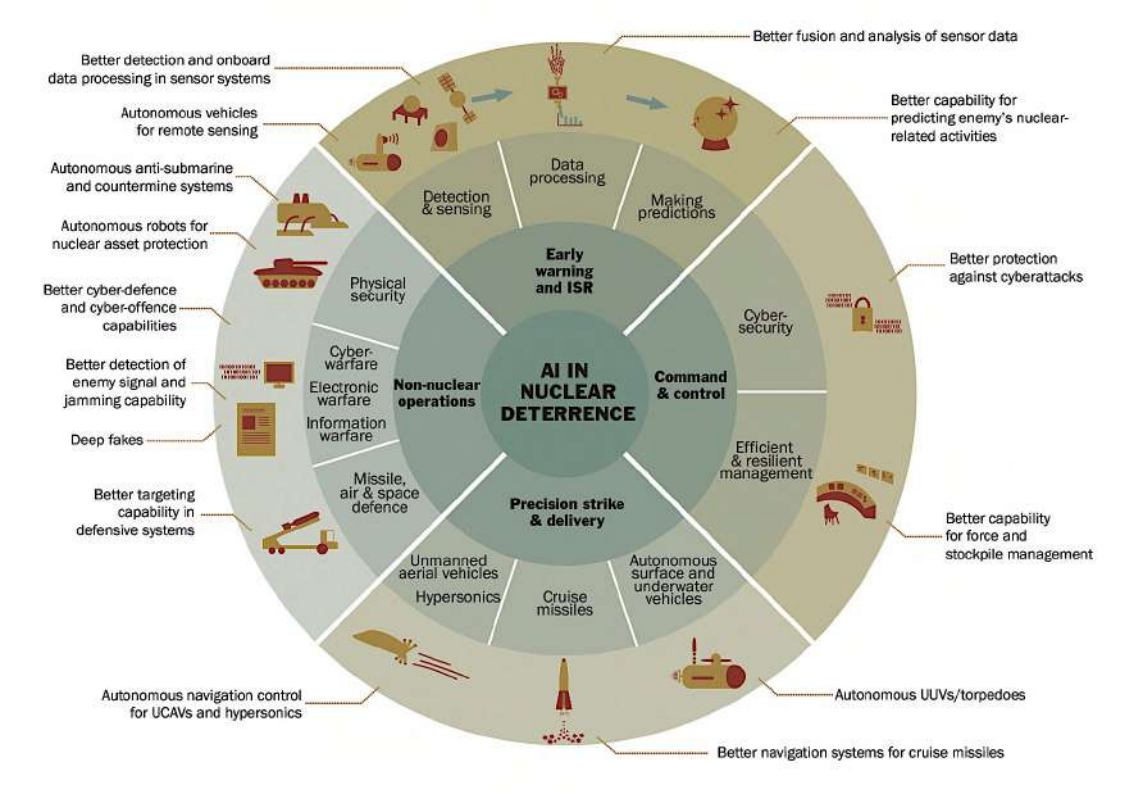


Figure 8 – **Foreseeable applications for AI in nuclear deterrence**

(Source: SIPRI, Artificial Intelligence, Strategic Stability and Nuclear Risk. 2020

Militarized AI in nuclear deterrence architecture may embolden countries to solve geo-strategic issues militarily as it would provide new and powerful capabilities, making even defensive AI-nuclear pairing a *perceived strategic offensive capability* by other States – holding enormous implications for the goals and strategies of nuclear-armed states.

---

[76] Boulanin, V., Saalman, L., Topychkanov, P., Su, F & Carlsson, M. P. (2020 June). *Artificial Intelligence, Strategic Stability and Nuclear Risk*. Stockholm International Peace Research Institute. Pg. 24. https://www.sipri.org/sites/default/files/2020-06/artificial_intelligence_strategic_stability_and_nuclear_risk.pdf

The Nuclear strategy goals of [77] **–**

I. COERCION
   I.I Deterrence: *dissuade adversaries from doing something they want to do*
   I.II Compellence: *force adversaries to do something they do not wish to do*

II. ASSURANCE
   Convince allies that security guarantees are credible

III. REASSURANCE
   Convince adversaries that they will not be attacked so long as they refrain from provocative behaviour

are severely **destabilized** once artificial intelligence is infused into nuclear deterrence posture, due to its inherent ability to complicate the always-never calculation (that nuclear weapons will always fire when expressly ordered to do so and never fire without proper orders). AI disrupts nuclear strategy by undermining the confidence nuclear-armed states place in their second-strike capability.[78]

Further, there is wide divergence in the way China and the West understand and view concepts related to AI and nuclear deterrence.[79] China views war between Modern States as a *conflict between systems of systems*.[80] Led by President Xi Jingping, all military units of the Chinese State have placed considerable emphasis on developing strategies & technologies suited to an AI conductive battle environment.[81] China anticipates that swarm intelligence and swarming tactics could serve as an asymmetric method to target high-value US weapons platforms[82] (aircraft carriers). Swarm technology is attractive to Beijing, as it would allow China to project force with a lower probability of military confrontation.[83] China is also planning to provide its nuclear

---

77 Geist, E., and Lohn, A. J. (2018). *How might artificial intelligence affect the risk of nuclear war?* RAND Corporation. Pg. 7. https://www.rand.org/content/dam/rand/pubs/perspectives/PE200/PE296/RAND_PE296.pdf

78 United Nations. (August, 2019). *The militarization of artificial intelligence* – UNODA. United Nations. https://www.un.org/disarmament/the-militarization-of-artificial-intelligence/

79 Saalman, L. (2018, April 24). *Fear of false negatives: AI and China's nuclear posture.* Bulletin of the Atomic Scientists. https://thebulletin.org/2018/04/fear-of-false-negatives-ai-and-chinas-nuclear-posture/#:~:text=Understanding%20China's%20insecurity%20about%20being,the%20United%20States%20should%20respond

80 Lt Col McCabe, T.R. (2021). *Chinese Intelligence, Surveillance and Reconnaissance Systems*. Journal of Indo Pacific Affairs, *Spring 2021*. *https://media.defense.gov/2021/Mar/07/2002595026/-1/-1/1/25%20MCCABE.PDF*

81 Ibid.

82 Feng, E. and Clover, C. (2017, Aug 24). *Drone swarms vs conventional arms: China's military debate*, Financial Times. https://www.ft.com/content/302fc14a-66ef-11e7-8526-7b38dcaef614

83 Ibid.

submarines with an AI-based decision support system, one that would lessen the burden of its submarine commanders.[84]

At the other end, The Third Offset Strategy developed by the Department of Defense of the United States places considerable importance on developing military uses of artificial intelligence, with the purpose of *maintaining battle-space superiority*.[85] The US strategy of distributed lethality aims to shed years of naval strategy around high-value targets and distribute action capabilities among dispersed assets, particularly in the Indo-Pacific.[86]

Both these AI military strategies of China and the United States, make targeting difficult and can overwhelm the capabilities of the other, creating a critical need to map AI in relation to nuclear deterrence in order to understand how strategic stability may be maintained in an AI-nuclear world.

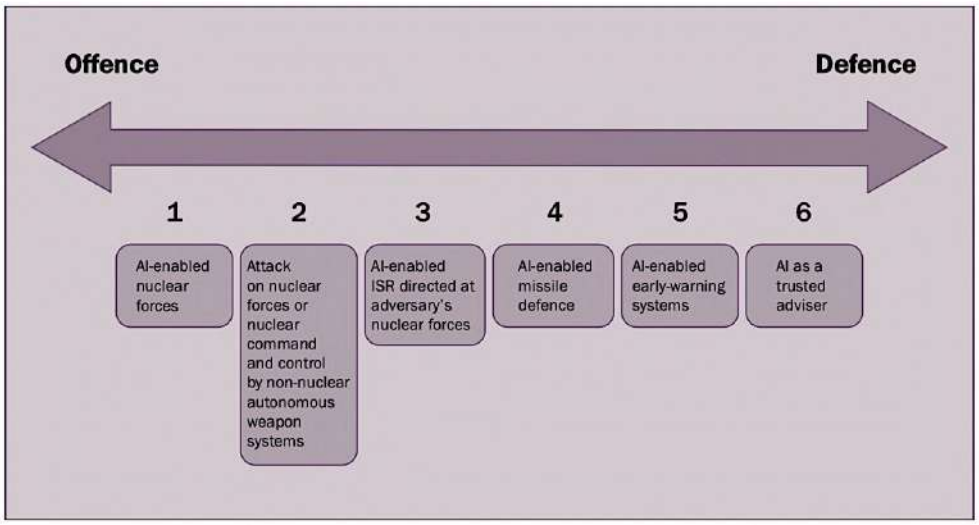


Figure 9 – **Spectrum of Autonomous Weapons Systems in relation to Nuclear Forces**

(Source : SIPRI, Artificial Intelligence, Strategic Stability and Nuclear Risk : East Asian Perspectives. Pg 98.

---

84 Chen, S. (2018, Feb 4). *China's plan to use artificial intelligence to boost the thinking skills of nuclear submarine commanders*. South China Morning Post. https://www.scmp.com/news/china/society/article/2131127/chinas-plan-use-artificial-intelligence-boost-thinking-skills

85 Jesse, E., Samp, L. and Coll, G. (2017, Mar). *Assessing the Third Offset Strategy*. Center for Strategic and International Studies. Pg. 16. https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170302_Ellman_ThirdOffsetStrategySummary_Web.pdf

86 Thompson, L. (2017, Jan 10). *'Distributed Lethality' Is The Surface Navy's Strategy For The Trump Era*. Forbes. https://www.forbes.com/sites/lorenthompson/2017/01/10/distributed-lethality-becomes-the-surface-navys-strategy-for-the-trump-era/?sh=3376590b5eff

The penetrative effect of AI on nuclear deterrence can be gauged from the fact that all the nuclear powers of the world (U.S.A, Russia, China, U.K., France, India, Pakistan, North Korea and Israel)[87] have adopted or are adopting AI in their nuclear deterrence architectures.[88]

Nuclear Application Area	U.S.A	RUSSIA	CHINA	U.K	FRANCE	INDIA	PAKISTAN	NORTH KOREA
Early Warning & ISR	✔	✔	✔	✔	✔	✔	✔	✔
Command & Control	✔	✔	✔	✗	✔	✔	✔	✔
Precision Strike & Delivery	✔	✔	✔	✔	✔	✗	✔	✗
Non-Nuclear Operations	✔	✔	✔	✔	✔	✗	✗	✔

Figure 10 – **Adoption of AI in Nuclear Deterrence architectures of States**

(Source: Self designed graphic based on information from various official press releases and published research) Key document is the publication Artificial Intelligence, Strategic Stability and Nuclear Risk [SIPRI]

** Israel is not included in the graphic above due to the country's policy of nuclear opacity, which makes it extremely difficult to reliably map any information on the country's adoption of AI in its nuclear architecture. Yet given the sophistication of AI technology and its research and development in Israel, combined with the robustness, accuracy and speed of the highly advanced missile defence systems it has deployed – the adoption of AI in the nuclear architecture of Israel is bound to happen, if it hasn't already.*

The above figure indicates that artificial intelligence has already proliferated across the global nuclear deterrence architecture, even though no international rules, understandings, norms or treaties on the use of AI in the nuclear realm currently exist. This is an extremely worrying and unstable situation as an international AI nuclear arms race presents catastrophic consequences for global strategic stability. AI introduces a *negative perceptional impact* in nuclear deterrence architecture – wherein one nation's fusion of nuclear systems with AI in order to better secure their own capabilities can easily be interpreted by another adversary nation as the making of a first-strike threat or doomsday nuclear machine, forcing that country to react accordingly, leading to adoption of escalatory nuclear mechanisms, such as Launch on Warning nuclear posture.

---

87 Federation of American Scientists. (n.d.). *Status of World Nuclear Forces*. Retrieved March 30, 2022, from https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/

88 Boulanin, V., Saalman, L., Topychkanov, P., Su, F & Carlsson, M. P. (2020 June). *Artificial Intelligence, Strategic Stability and Nuclear Risk*. Stockholm International Peace Research Institute. Pg. 31. https://www.sipri.org/sites/default/files/2020-06/artificial_intelligence_strategic_stability_and_nuclear_risk.pdf

A significant complication of evolving sophistication in missile technology must also be taken into account, for as advances in speed, maneuverability and autonomy of missiles increases – strategic stability comes under increasing pressure. It is already extremely difficult to recall or destruct a missile once it is launched, but now given the blinding speed of supersonic and hypersonic with which strategic missiles can deliver nuclear payloads, an unprecedented shake-up of nuclear deterrence thought is taking place. The predictability of ballistic missile trajectory is being replaced with high maneuverability of cruise missiles[89], as evidenced in the U.S. efforts to reintroduce a nuclear-armed sea-launched cruise missile (SLCM-N).[90] The declared use of the Kh-47M2 Kinzhal hypersonic air launched missile by Russia in the ongoing conflict in Ukraine demonstrates just how impossible defense against such offensive missile systems is, particularly given that these missiles can carry both conventional and nuclear payloads.[91]

Further, the **2020 incident of loitering munitions in Libya, where according to a United Nations report – an AI powered military drone (Kargu-2) attacked soldiers autonomously, without being told**,[92] indicates the arrival of true *'fire, forget and find* capability' of lethal autonomous weapons systems (LAWs). This capability can easily be implemented in nuclear deterrence architecture, particularly in countries like China and Russia if global norms are not set. The drone incident in Libya was possibly the first time a *"Killer Robot"* autonomously attacked a human being, ushering a new age of autonomous machine based intelligent targeting in conflict.

As such disturbing trends escalate, there is a high probability that these unfamiliar strategic systems could prove less stable than those that kept an uneasy peace between the United States and the Soviet Union.

---

89 North Atlantic Treaty Organisation. (2022, January 26). *Ballistic missile defence*. NATO. Retrieved March 30, 2022, from https://www.nato.int/cps/en/natohq/topics_49635.htm

90 Office of the Under Secretary of State for Arms Control and International Security. (2020, July). *Strengthening Deterrence and Reducing Nuclear Risks, Part II: The Sea-Launched Cruise Missile - Nuclear (SLCM-N)* (Volume I, Number 11). US State Department, Government of the United States of America. https://www.state.gov/wp-content/uploads/2020/07/T-Paper-series-SLCM-N-Final-508.pdf

91 Kirby, B. P. (2022, March 19). Russia claims first use of hypersonic Kinzhal missile in Ukraine. *BBC News*. Retrieved 31 March 2022, from https://www.bbc.com/news/world-europe-60806151

Dahlgren, M., & Shaikh, S. (2022, March 19). *Kh-47M2 Kinzhal*. Missile Threat Project, CSIS. Retrieved March 31, 2022, from https://missilethreat.csis.org/missile/kinzhal/

92 Cramer, M. (2021, June 4). *Libyan Fighters Attacked by a Potentially Unaided Drone, UN Says*. The New York Times. https://www.nytimes.com/2021/06/03/world/africa/libya-drone.html

United Nations Security Council. (2021, March). *Final report of the Panel of Experts on Libya established pursuant to Security Council resolution 1973 (2011)* (S/2021/229). https://documents-dds-ny.un.org/doc/UNDOC/GEN/N21/037/72/PDF/N2103772.pdf?OpenElement

3.3 Asymmetric Strategic Stability

The risks associated with AI in nuclear weapons are quite real and increasingly complex. Spurred by the 4IR, a modern revolution in nuclear armament is underway, bearing huge ramifications that are neither known nor properly understood as yet.

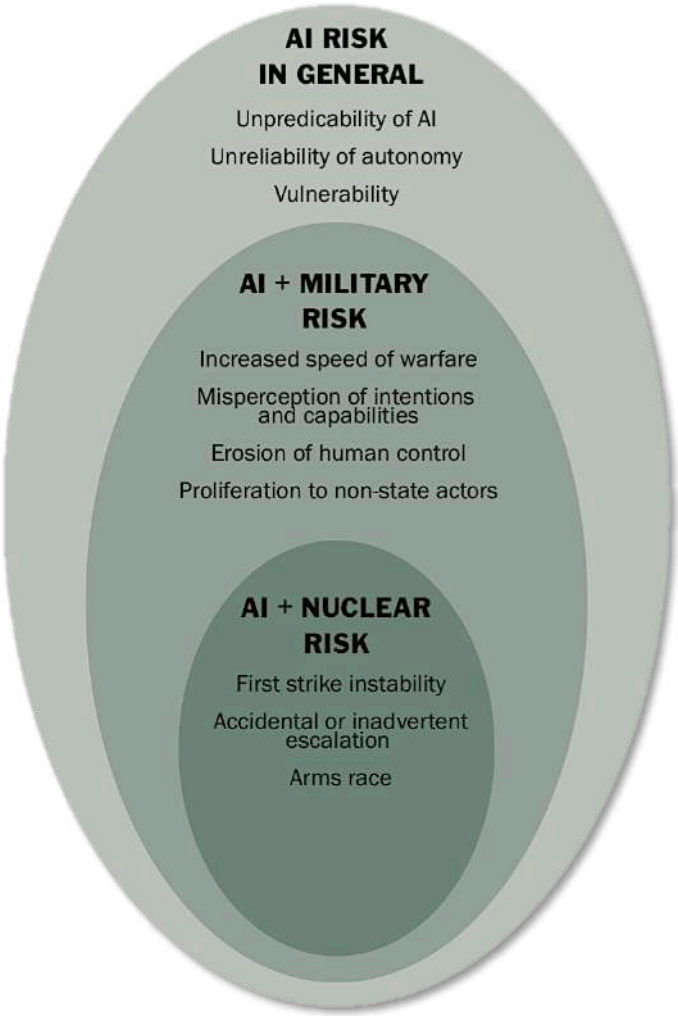


Figure 11 – **Risks and Challenges posed by AI in Nuclear Weapons**
(Source: SIPRI - AI, Strategic Stability and Nuclear Risk. Pg. 124)

The need of the hour thus is to develop new understanding and consensus on AI in nuclear deterrence architectures that is consistent with the technological trends underway in all nuclear-armed states. Simply stating that 'AI should not be used in nuclear defence architecture' due to the inherent instability it brings is not enough. Factually, as shown in Figure 10 - we are past that stage in the proliferation cycle. The questions that now arise is just how much integration should take place between AI technologies and Nuclear Systems? Is it enough to have integration with

'**Human in the loop'** for nuclear command and control? Meaning that a human being must always exercise *meaningful human control* over nuclear weapons. Or as AI systems and algorithms get ever more complex and faster, should the approach of appointing an expert **AI Nuclear Czar (Advisor) to Political Leadership** (Prime Minister/ President) be the way forward?

The problem with 'human in the loop' concept in the modern era is that when faced with overwhelming machine analysis/ systems alert of an incoming attack under extremely short timelines, will a human decision maker have the adequate time and mental capacity to make a sound judgment call? Can a nuclear attack decision of annihilistic proportions be sensibly made in minutes or even seconds by the leadership of any nuclear-armed country when faced with the perception/warning of an incoming nuclear attack? Will the human decision maker have adequate time to analyze the systems warning and verify it to be accurate? The 1983 Stanislav Petrov incident of the Soviet Air Defence Forces presents a case in point[93] – *when the false alarm alerted Petrov of an imminent nuclear attack, his understanding of the limits of machine-induced analysis caused him to assess a malfunction – **halting** what could have been a nuclear disaster*. Petrov had 30 minutes to make a decision. Today's automated systems make decisions in milliseconds with human decision makers expected to give the launch/ no-launch nuclear authorization in seconds/minutes.[94] (in India-Pakistan nuclear dynamics).

In the case of having an AI Nuclear Czar to advise the Political Leadership of a Nuclear Armed Country, will the AI advisor hold **sway** in times of unprecedented existential nuclear crisis to stop the Leadership from launching nuclear weapons when a nuclear alert comes through? Will he be able to make a comprehensive decision about autonomy, speed, maneuverability of the nuclear warhead/ weapons systems and discount the possibility of a nuclear 'false positive' in the alert systems/ machine intelligence networks in minutes if not seconds and convey his assessment in time to the Political Leadership?

These are complex and difficult questions that seemingly have no definitive positive answer. Further complicating this technological modernization of AI-nuclear fusion, is the increasing

---

93 Hoffman, D. (1999, February 10). *"I Had A Funny Feeling in My Gut."* Washington Post. Cold War Report. Retrieved 31 March 2022, from https://www.washingtonpost.com/wp-srv/inatl/longterm/coldwar/shatter021099b.htm

94 Leins, K., & Kaspersen, A. (2021, November 9). *7 Myths of Using the Term "Human on the Loop."* Carnegie Council for Ethics in International Affairs. Artificial Intelligence & Equality Initiative. Retrieved March 31, 2022, from https://www.carnegieaie.org/blog/7-myths-of-using-the-term-human-on-the-loop/

decline in global Arms Control. The United States, Russia and China are now developing their nuclear weapons and doctrines based solely on their own strategic calculus – in an atmosphere of increasing mutual alienation, the absence of dialogue and ever-greater mistrust.[95] Therefore it becomes imperative to define how future strategic stability may be defined.

Nuclear deterrence in the Cold War was based on the concept of *mutually assured destruction.* Then in the 1990's the United States and the Soviet Union defined strategic stability as the *absence of incentives for any country to launch a first nuclear strike.* [96]

The advent of capabilities such as Anti-Satellite Weapons (ASAT), Cyber Weapons, AI Arms Race, Warhead Ambiguity due to same platform use (missiles capable of carrying both nuclear and conventional warheads), Hypersonic and Supersonic advancements and Low-Yield Nuclear Weapons; now require strategic stability to have *absence of incentives to fight a military conflict between any nuclear states*. This dynamic is already on display between Russia and NATO in the ongoing **major armed conflict in Ukraine 2022.** Russia pulled out the nuclear card at the beginning of the conflict, in its **'escalate to de-escalate'** strategy[97] and ensured that NATO did not enter the conflict *directly* against the Russian armed forces particularly through establishment of a no-fly zone over Ukraine.

Yet the absence of incentives to fight a military conflict among nuclear states[98] cannot in and of itself lead to strategic stability in the 21st century. One must take into account the asymmetric nature of new technologies like AI, which are extremely difficult to categorize and put into single definite categories i.e. conventional or nuclear. Thus a more holistic understanding on strategic stability can be developed if we look at how to *limit* the destabilization caused by 4IR technologies, particularly artificial intelligence.

---

[95] Trenin, D. (2019, March). *Strategic Stability in the Changing World*. Carnegie Endowment for International Peace, Moscow Centre. Pg. 3 https://carnegieendowment.org/files/3-15_Trenin_StrategicStability.pdf

[96] Ibid. Pg. 7

[97] Woolf, A. F. (2022, March). *Russia's Nuclear Weapons: Doctrine, Forces, and Modernization* (No. R45861). US Congressional Research Service. Pg. 44 https://sgp.fas.org/crs/nuke/R45861.pdf

[98] Trenin, D. (2019, March). *Strategic Stability in the Changing World*. Carnegie Endowment for International Peace, Moscow Centre. Pg. 10 https://carnegieendowment.org/files/3-15_Trenin_StrategicStability.pdf

The asymmetric nature of the technology be it artificial intelligence, hypersonic, autonomous lethal weapons etc comes from its ability to interfere with and disturb the fundamental strategic always never calculation ₸ – even if these technologies are somehow restricted to the conventional domain. Therefore, by making/declaring *the nuclear arsenals of states and their military nuclear infrastructure invulnerable (off-limits)* – against offensive artificial intelligence capabilities, paralyzing cyber-attacks, ASAT weapons launch, hypersonic or supersonic missile platforms – the **psychological fear of counterforce targeting** can be greatly reduced, resulting in asymmetric strategic stability between nuclear armed states.

The implementing mechanism to provide nuclear-armed states with the assurance of 'Non-Attack' can be modeled on the basis of an existing *unique treaty* -

> The Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities between India and Pakistan (1988)[99]

The treaty states that both nuclear armed countries *'shall refrain from undertaking, encouraging or participating in, directly or indirectly, any action aimed at causing the destruction of, or damage to, any nuclear installation or facility in the other country.'* It further creates the obligation that each party 'shall inform the other on 1st January of each calendar year of the latitude and longitude of its nuclear installations and facilities and whenever there is any change.'

Thus, effectively it puts into place a unique legal mechanism in international relations wherein the contracting parties *cannot* target, damage, disable or destroy each other's nuclear installations and facilities – making the arrangement the most effective Confidence Building Measure (CBM) on record in the South Asian nuclear context. Importantly this treaty has survived both the test of time as well as the test of conflict and war between the two parties, be it the Kargil War (1999), Parliament of India Attack (2001), Mumbai Attack (2008), Balakot Airstrike (2019) and Cross-Border terrorism into India (late 1990s onwards) and has worked well in a hostile India-Pakistan relationship.

Through bilateral, regional, global agreements, modeled on the lines of the above treaty, major nuclear powers can re-assure each other of the sanctity of the '*always-never equation'* stabilizing an increasingly complex instable nuclear world. Further, this approach can be adopted

---

₸States want to be assured that their nuclear weapons will always fire when ordered & never fire unless the launch is intentional

99 Bilateral Treaty between India and Pakistan. (1988, December). *Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities Between India and Pakistan* (No. PAB1232). Ministry of External Affairs, Government of India. https://mea.gov.in/Portal/LegalTreatiesDoc/PAB1232.pdf

immediately even as long-term doctrines and concrete limitations on the use of AI in the nuclear sphere are adopted globally as transparency in AI technologies increases.

Therefore, a working definition of Asymmetric Strategic Stability can be one of:

Asymmetric strategic stability in the 21st century is a two-fold state of affairs where there is an absence of incentives to fight a military conflict between any nuclear states; and where the targeting, disabling and destruction of nuclear arsenals and military nuclear infrastructure of States is declared off-limits through unique treaty mechanisms.

This working definition aims to sufficiently ensure strategic stability under current circumstances, even as it accepts the reality of AI fusion in nuclear deterrence architecture, for which a long-term multi-decade lasting solution must be reached among the nuclear powers.

This definition provides the necessary breathing space to nuclear states to engage in that very conversation, as global consensus on AI limits/ demarcation on the use of AI in the nuclear sphere are the only ways to achieve comprehensive stability in current nuclear thought.

Further, understanding asymmetric strategic stability is the key to identifying the de-stabilizing developments taking shape in the Indo-Pacific geography and their ramifications on the operations of Indian SSBNs in the Indian Ocean, which is the focus of the next chapter.

Chapter 4

Analysis

4.1 Indian Nuclear Battlespace

" Unless India stands up to the world, no one will respect us. In this world, fear has no place. Only strength respects strength "

- A P J Abdul Kalam [100]

The world has entered a second nuclear age. One not defined by a bipolar global superpower competition but rather by regional nuclear powers who are increasingly determining the proliferation and nuclear conflict-landscape. Amongst these regional nuclear powers, **India** finds itself in a unique security position for it is: *the only State in the world having large contiguous borders with two nuclear powers (Pakistan & China) both of whom are openly adversarial towards India and who amongst themselves enjoy a remarkably enduring relationship with a strong military component*. The China-Pakistan axis[101] plays a fundamental role in squeezing India across the spectrum of conflict and deeply influences India's nuclear battlespace and larger Asian geopolitics.

The *axis* fuses a deadly combination of unprecedented scale (China) with asymmetry (Pakistan) and is both a psychological determinant for the balance of power in the Asia-Pacific and a tangible adversarial military alliance with a rooted history of aggression against India; Indo-Pak War (1947-48), Indo-China War (1962), Indo-Pak War (1965), Indo-Pak Bangladesh Liberation War (1971), Kargil Conflict (1999) and India-China Galwan Border Clashes (2020).

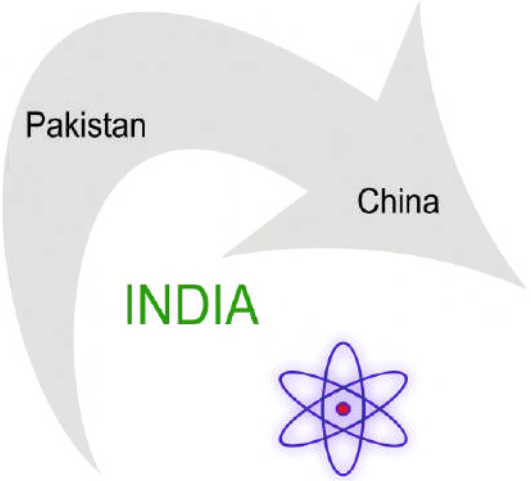


Figure 12 – **China Pakistan Axis**

[100] Economic Times. (2009, August 28). *India needs to be a nuclear weapon state: Kalam*. The Economic Times. Retrieved 6 April 2022, from https://economictimes.indiatimes.com/news/politics-and-nation/india-needs-to-be-a-nuclear-weapon-state-kalam/articleshow/4946436.cms?from=mdr

[101] Small, A. (2015). *The China Pakistan axis: Asia's new geopolitics*. Random House India. Pg 1-3.

Since Independence in 1947, India has been subjected to different kinds of aggression and internal armed violent insurgencies that have largely shaped its battlespace. The security dynamics for the country have been further complicated by the *South Asian asymmetric escalation pyramid* between India and Pakistan, as highlighted in the introduction chapter of the book, which threatens to radically escalate any bilateral military conflict to the nuclear stage. Thus over the years the Indian Armed Forces have been systematically and psychologically made to operate across the full range of situations in the 'spectrum of conflict' – ranging from stable peace to nuclear war.

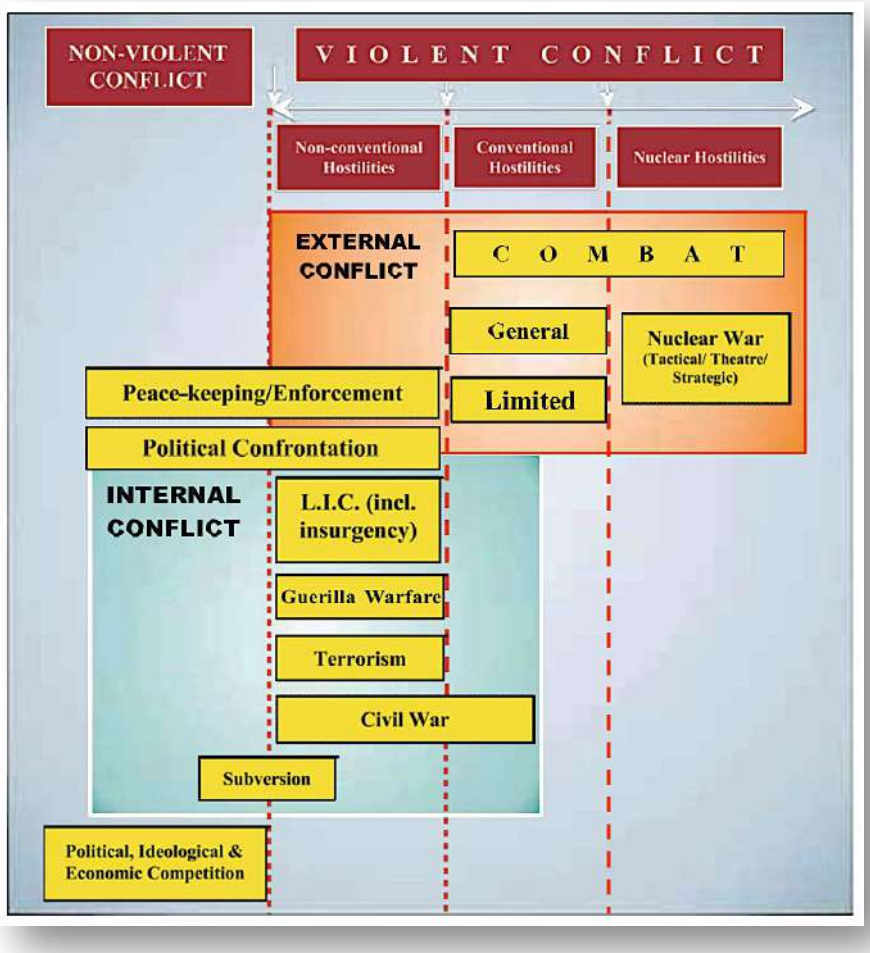


Figure 13 – **Spectrum of Conflict for Indian Armed Forces**

(Source: Indian Maritime Doctrine 2009, Indian Navy. Pg. 13)

Nuclear hostilities lie at the highest level of the spectrum and largely are both determinants and drivers in shaping India's nuclear battlespace. To understand how India perceives nuclear threat at the tactical/ theatre & strategic level it is important to map out India's Nuclear Posture (policy).

4.1.1 INDIAN NUCLEAR POSTURE

India has for systematic and predictable reasons, chosen a clearly identifiable nuclear policy and posture which determines its ability to deter conflict. **Nuclear posture** here can be defined as –

> The incorporation of some number and type of nuclear warheads and delivery vehicles into a state's overall military structure, the rules and procedures governing how those weapons are deployed, when and under what conditions they might be used, against what targets, and who has the authority to make those decisions. [102]

India's nuclear posture through the form of its declaratory doctrine was released in draft form in 1999 – The Draft Report of National Security Advisory Board on Indian Nuclear Doctrine[103] – and then as a series of eight points in 2003 – Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine.[104] Its 3 fundamental pillars are:

(1) No First Use

(2) Assured Massive Retaliation

(3) Under no condition would the weapon be conventionalized [105]

The posture's overriding objective is to "deter the use and threat of use of nuclear weapons" by maintaining an "adequate retaliatory capability should deterrence fail."[106] Its key features can be understood as being *limited in size, separated in disposition and centralized in civilian control*.[107] This policy (posture) was determined through India's external security environment – the absence of powerful allies and the severity of its immediate threats (Pakistan and China). At the domestic level– it was first and foremost *civil-military relations* followed by financial resource constraints and internal political dynamics that determined India's choice of a 'No First Use' policy and an 'Assured Retaliation' nuclear posture. India operationalized its nuclear posture through formation of the **Nuclear Command Authority** (NCA) Headed by the Indian Prime Minister.

---

[102] Narang, V. (2014). Nuclear Strategy in the Modern Era. In *Nuclear Strategy in the Modern Era*. Princeton University Press. Pg. 4

[103] Draft Report of National Security Advisory Board on Indian Nuclear Doctrine. https://mea.gov.in/in-focus-article.htm?18916/Draft+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine\

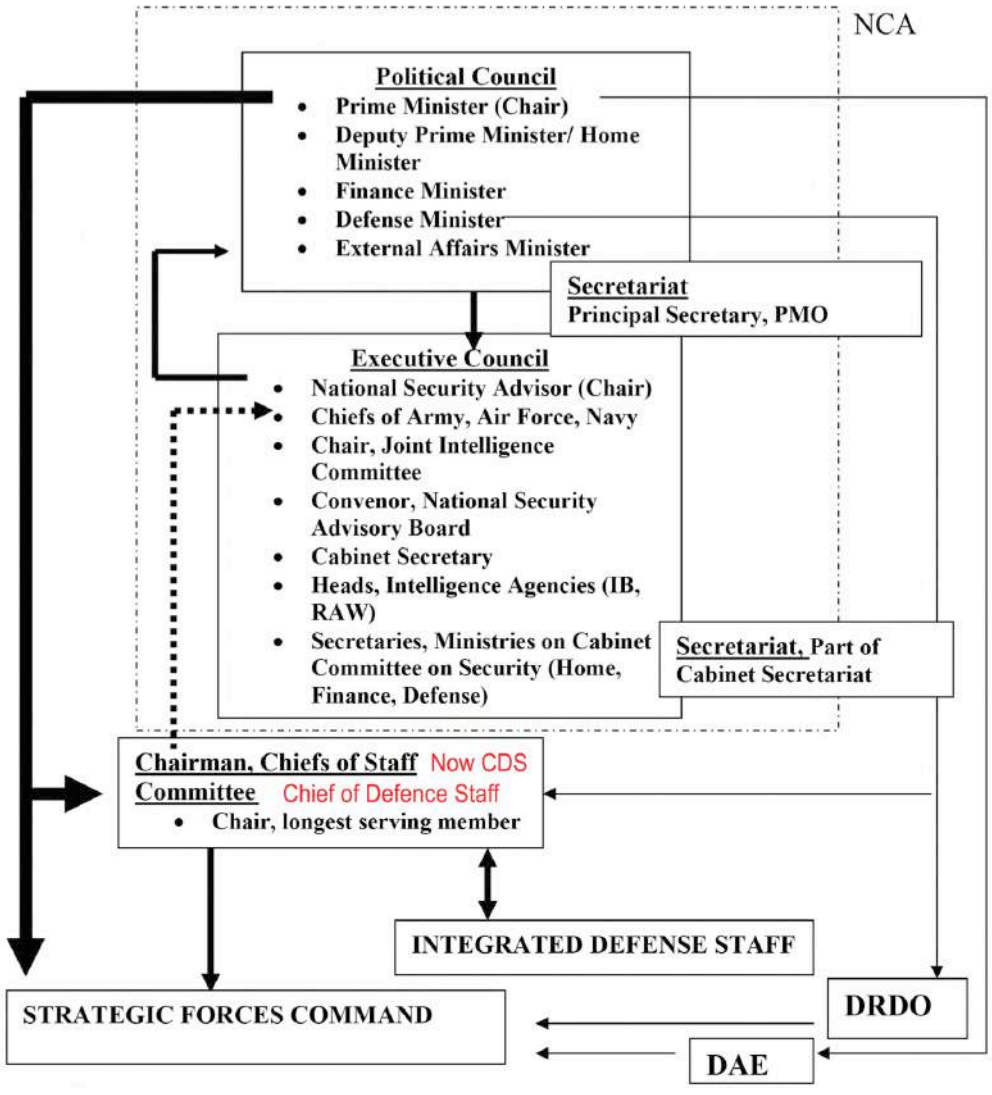
[104] Government of India, Press Information Bureau. (2003, Jan 4). *Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine*. Prime Minister's Office. https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html

[105] Ibid.

[106] Draft Report of National Security Advisory Board on Indian Nuclear Doctrine. https://mea.gov.in/in-focus-article.htm?18916/Draft+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine\

[107] Tellis, A. J. (2001). *India's emerging nuclear posture: Between recessed deterrent and ready arsenal* (No. 1127). Rand Corporation. Pg. 374-466

The NCA comprises of a Political Council and an Executive Council. The Political Council is chaired by the Prime Minister and it is the sole body which can authorize the use of nuclear weapons.[108] In 2003 the special **Strategic Forces Command** (SFC) under the command of the NCA was raised to steward India's nuclear arsenal. Thus Indian Nuclear Command Authority can be visually be represented as follows –



Structure of India's Nuclear Command Authority

(Source: Nuclear Confidence Building Measures in South Asia: Nuclear Operations and Avoiding Inadvertent Nuclear War. Gaurav Rajen 2003.)

The key permanent feature of India's nuclear posture is that civilians not only maintain *control* over India's nuclear forces, but they maintain *custody* of it. Nuclear assets can only be constituted,

[108] Government of India, Press Information Bureau. (2003, Jan 4). *Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine*. Prime Minister's Office. https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html

operationalized and transferred to military end users on the orders of the Prime Minister of India.[109] In fact the cornerstone of India's present command-and-control structure is ***"a clear and inviolable demarcation between custodian and controller."***[110] With the custodians being civilians represented by DRDO and DAE and the controllers being the SFC. India has highly assertive civil-military relations that emphasize firm civilian control over the nuclear arsenal. Organizationally, the SFC is under the PMO's chain of command and not integrated with the conventional military chain of command in India – that is, an order to release nuclear weapons from any of the Indian Service Chiefs or even the Chief of Defence Staff would have no authority without the go-ahead from the Nuclear Command Authority. Further, multiple redundancies and fundamental three-agency rule (presence of all 3 services Army, Navy, Air force officers) exists at every stage of nuclear operations to exercise *negative control* over the arsenal.[111] Across political parties India has shown remarkable continuity in this nuclear posture.

Admiral Arun Prakash, former Chief of India Navy and the Chairman of the Chiefs of Staff Committee has publically written on the overbearing civilian dominance of the military in India, emphatically stating that –

> The isolation of the armed forces from India's strategic programmes has been so complete … it is a policy of segregation.[112]

This policy of overwhelming separation, particularly in the nuclear domain, becomes important for in the age of emerging and strategic 4IR weaponry, with supersonic and hypersonic missile technology becoming a reality, the **time constraints** in nuclear decision making are going to reduced to single minutes, if not seconds, in the context of South Asia. Thus having complete separate *civilian* and *military* procedures for the nuclear assets – which is a time-consuming process – can prove fatal in the advent of a crisis situation.

Further, the 'No-First Use' (NFU) principle has moved India to adopt an *assured retaliation posture* which according to Brajesh Mishra, the former Indian National Security Advisor, who

---

[109] Draft Report of National Security Advisory Board on Indian Nuclear Doctrine. https://mea.gov.in/in-focus-article.htm?18916/Draft+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine\

[110] Narang, V. (2014). Nuclear Strategy in the Modern Era. In *Nuclear Strategy in the Modern Era*. Princeton University Press. Pg. 106

[111] Shankar, V. (2011). *A Covenant Sans Sword*. Centre for Global Security Research. https://www.youtube.com/watch?v=OZpIrZvP0Co

[112] Arun, P. (2012, July 12). *9 Minutes to Midnight*. Force Magazine. Pg. 6 - 8.

drove India's nuclear posture developments from 1998 to 2004 means *"we aim to have enough to absorb an attack [nuclear] and strike back."*[113] This has resulted in an unequal deterrence capability for India, as detailed by nuclear specialist Vipin Narang from the Massachusetts Institute of Technology, USA; particularly in the India-Pakistan nuclear dynamic.[114] Pakistan which has adopted a '*first strike'* nuclear posture and envisions nuclear weapons as *war-fighting instruments* has successfully deterred Indian conventional attack on numerous occasions (2001, 2008, 2019), knowing full well that even though it wages conventional or asymmetric war against India, the NFU principle restricts India from nuclear escalation. Consequently India has not been able to deter Pakistan sufficiently, in spite of possessing nuclear weapons, as the 1999 Kargil War or the 2008 Mumbai Attacks have demonstrated.

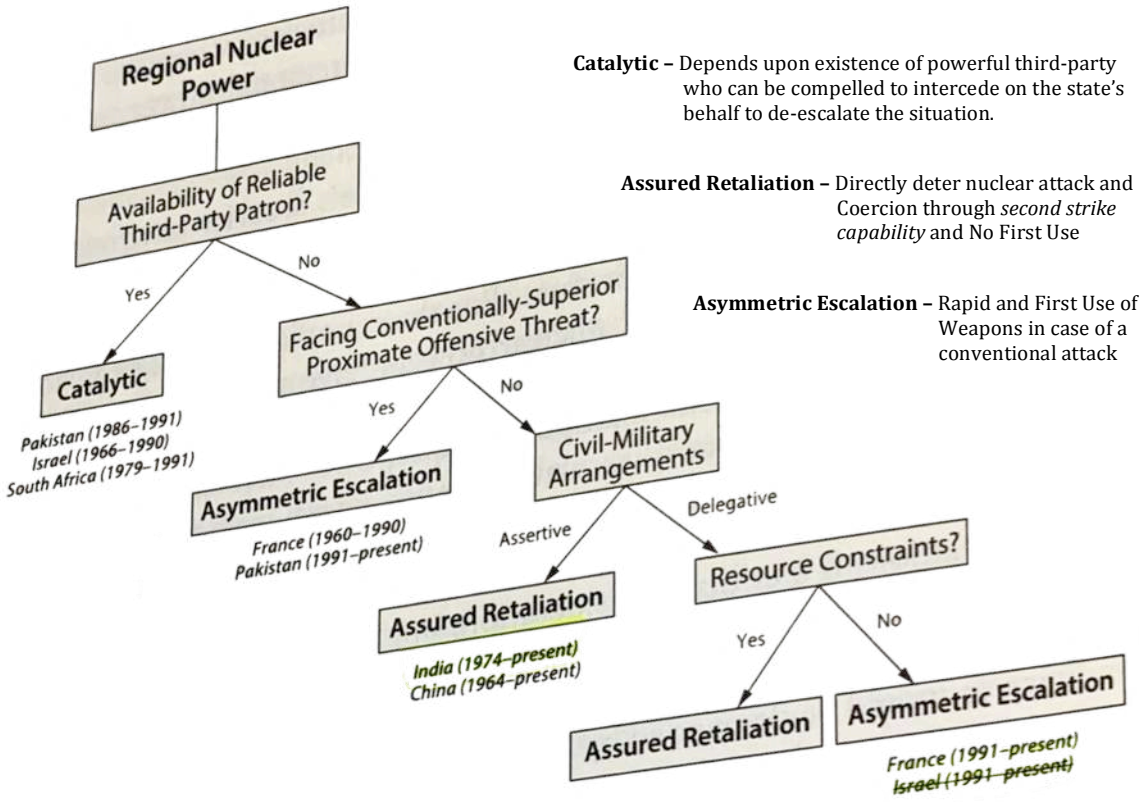


Figure 14 – **Nuclear Optimization Theory**
(Source: Nuclear Strategy in the Modern Era. Pg. 302)

But reversely, since India has a great apprehension that Pakistan might use nuclear weapons against India, not China, one can be make a well informed guess that the 800 km Agni I

[113] Narang, V. (2014). Nuclear Strategy in the Modern Era. In *Nuclear Strategy in the Modern Era*. Princeton University Press. Pg. 100

[114] Ibid.

missile (designed specifically for nuclear retaliation against Pakistan) must be kept in an advanced/ full state of readiness during peacetime. It is estimated India has some nuclear forces capable of being operationalized and released within seconds or minutes once alerted.[115]

Dr. Avinash Chander, as Head of DRDO in 2013 had publically stated that it is India's ultimate aim to deploy its entire strategic nuclear missile force in an *"anytime-anywhere" state, saying* –

> We are working on canisterized systems that can launch from anywhere at anytime… We are making much more agile, fast reacting, stable missiles so response can be within minutes.[116]

The critical test for this kind of Indian command and control structure, particularly in regards to full state alert weaponry is how India will manage/manages the INS SSBN Arihant as it deploys the SFC Submarine on *deterrence patrol*.[117]

Therefore it would be prudent to mention that the Indian Nuclear Posture is under some flux, especially after introduction of the 'sea-leg' of the nuclear triad in the form of SSBN Arihant – which makes two additional factors, *Geography and Strategic Culture,* critical to determining what shape a future declared Indian command and control structure will look like in the rapidly modernizing nuclear battlespace.

---

115 Narang, V. (2014). Nuclear Strategy in the Modern Era. In *Nuclear Strategy in the Modern Era*. Princeton University Press. Pg. 104

116 Aroor, S. (2013, July 3). *New Chief of India's Military Research Complex Reveals Brave New Mandate*. India Today. https://www.indiatoday.in/india/story/indias-nuclear-counterstrike-response-time-to-be-in-minutes-drdo-chief-169019-2013-07-03

117 Press Information Bureau. (2018, Nov 5). *Prime Minister felicitates crew of INS Arihant on completion of Nuclear Triad*. Prime Minister's Office, Government of India. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1551894

4.1.2 TYRANNY OF GEOGRAPHY

Geography matters, and India's geographical landscape particularly in its western and northern areas is *fundamental* in determining its immediate security environment.

The fact that India shares contiguous land borders with both Pakistan and China has been explained above, yet there is a major difference between the two borders, which is critical for deterrence posture. Nation-states with plain contiguous borders have more to fear than those buffered by impassable terrain.[118] Land power is the dominant form of military power in the modern world and geography – oceans, mountains, forests; sharply limit an army's power projection capability.[119] This is especially important in the China-India-Pakistan nuclear triangle, where the Armies are the dominant armed forces in all three nuclear powers.

Pakistan

The easily traversable plains and desert sections of the large Indo-Pak border make Pakistan extremely vulnerable to India's conventionally superior military power. While Pakistan has attempted to compensate for its numerical inferiority by operating on interior lines of communication, adopting a "*defense in depth"* strategy, it cannot escape the fact that a large Indian neighbor presents a *conventionally superior proximate offensive threat*.[120]

China

Throughout history India and China *never* shared contiguous land borders. Tibet was always the buffer state between the two civilizational giants. But in the modern era, after China's occupation and annexation of Tibet in the 1950's,[121] India and China now share thousands of kilometers long direct border that redefines Indian security landscape. However with the Himalayas between them, India is geographically buffered against China's larger conventional land capability by the inhospitable mountainous terrain over which any land war between the two countries would have to be fought. This geographical condition gives India protection against an *existential* threat from China, determining India's relative freedom in its choice of nuclear posture in respect to this adversary.

---

118 Mearsheimer, J. J. (1987). *Tragedy of Great Power Politics*. Cornell University Press. Pg. 83.

119 Ibid. Pg. 89 – 97

120 Narang, V. (2014). Nuclear Strategy in the Modern Era. In *Nuclear Strategy in the Modern Era*. Princeton University Press. Pg. 35

121 Goldstein, Melvyn C. (1991). *A history of modern Tibet, 1913-1951, the demise of the lamaist state*. University of California Press. p. 639.

4.1.3 STRATEGIC CULTURE

General Krishnaswamy Sundarji, the Great Doyan of Indian military warfare had famously asserted, ***"India is a strategically blind nation."***[122] Such strategic blindness was on global display recently as India dealt with the COVID 19 Pandemic –

> India exported over 66.4 million vaccines to over 90 countries before the monstrous 2nd Wave of coronavirus ravaged the nation,[123] choosing to export vaccines to other nations rather than inoculate its own population of 1.3 billion people. *This essentially left almost all Indian citizens unvaccinated when the Delta Variant of the coronavirus hit India like a tsunami*. Authoritative independent Indian media reports have estimated that somewhere between 500,000 to 4 million Indian people died during the 2nd Wave of the COVID 19 Pandemic across the country.[124] The conscious decision to export vaccines to other countries, at a time when all major countries were hoarding vaccines and vaccinating their citizens as much as possible, and consequently leaving our own population *unvaccinated and vulnerable* is indicative of lack of national strategic thinking in India.

The question that arises from this recent horror is whether a lack of strategic culture within Indian government polity extends to the Indian nuclear battlespace? Nation states care more about what an adversary can credibly *do* with its nuclear weapons than what it *says* about them. Therefore, how does the strategic culture in India credibly back the country's nuclear posture to ensure deterrence as envisioned in the country's nuclear doctrine.

In order to answer this question one must look at how India *defines* nuclear weapons within its strategic conversations and culture. That India has a soft/ non-existent strategic culture is well known.[125] In essence the soft strategic culture in India, since the time of its first prime

---

122 General, K. S. (1993). Blind Men of Hindoostan: Indo-Pak Nuclear War. *New Delhi, India: UBS Publishers' Distributors Ltd*, Pg. 03.

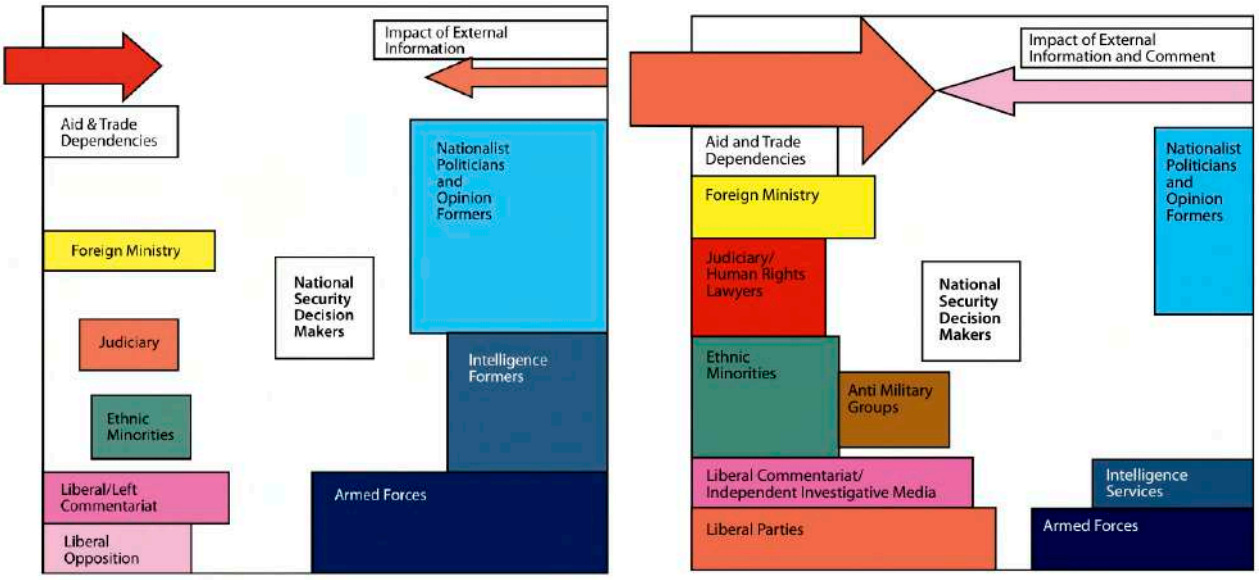
123 Sharma, K. (2021, July 19). India's COVID second wave disrupts vaccine export plans. *Nikkei Asia*. Retrieved April 9, 2022, from https://asia.nikkei.com/Spotlight/Asia-Insight/India-s-COVID-second-wave-disrupts-vaccine-export-plans

124 Mander, H. (2022, February 27). How many Indians actually died during the second Covid-19 wave? *Scroll.In*. Retrieved April 9, 2022, from https://scroll.in/article/1018163/harsh-mander-how-many-indians-actually-died-during-the-second covid-19-wave

Yadav, Y. (2021, June 16). What shocking data on Covid second wave deaths really reveals. *ThePrint*. Retrieved April 9, 2022 from https://theprint.in/opinion/what-shocking-data-on-covid-second-wave-deaths-really-reveals-yogendra-yadav/678890/

125 General, K. S. (1993). Blind Men of Hindoostan: Indo-Pak Nuclear War. *New Delhi, India: UBS Publishers' Distributors Ltd*, Pg. 5 - 17.

minister, Jawaharlal Nehru – *intensely abhors nuclear weapons as military weapons*.[126] The nuclear foundation of the country is based on – *nuclear weapons not being used*.[127] Which is diametrically opposite to the most proximate adversarial nuclear threat that India faces – in the form of Pakistan and its instrumentalization of nuclear weapons as "*war fighting weapons*."[128]



A hard-boiled, difficult-to-deter strategic culture

A softer, more deterrable strategic culture

Figure 15 – **Hard and Soft Strategic Cultures**

(Source: Deterrence in the 21st Century, Proceedings London. Pg. 220)

Therefore Indian strategic culture in respect to nuclear weapons can be ascribed to have 3 basic characteristics:

(1) Nuclear weapons have limited utility for national security

(2) They are primarily political weapons

(3) India has restrained responses to external stimuli [129]

These characteristics are reflected in the shape given to the Strategic Forces Command (SFC) and in the *complete de-coupling* of civil and military forces in India's nuclear architecture. The fact

---

126 Hymans, J. E. (2006). *The psychology of nuclear proliferation: Identity, emotions and foreign policy*. Cambridge University Press. Chapter 7.

127 Basrur, R. M. (2009). *Minimum deterrence and India's nuclear security*. NUS Press. Pg. 54.

128 Lodhi, Sardar F.S. (1999 April). *Pakistan's Nuclear Doctrine*. Defence Journal (Pakistan), vol.3, No. 4. http://defencejournal.com/apr99/pak-nuclear-doctrine.htm

129 Basrur, R. M. (2009). *Minimum deterrence and India's nuclear security*. NUS Press. Pg. 58.

that *custody* of Indian nuclear weapons remains firmly in civilian hands – underscores just how deeply India views the weapons primarily as a *political tool* rather than instrumentalizing them as tools of war.

Therefore:

Indian Nuclear Posture, Geography and Strategic Culture *combine* to create India's Nuclear Battlespace, which is today founded on the logic of **credible minimum deterrence.**

---

4. 2 Artificial Intelligence enabled ISR

" The Supreme Art of War is to subdue the enemy without fighting "

- Sun Tzu in 'Art of War'[130]

The best weapons in the world are useless unless aimed accurately, which requires sophisticated intelligence, surveillance and reconnaissance (ISR) systems to detect and track targets. The 21st century is littered with such ISR military systems be they Unmanned Aerial Vehicles (UAVs), Radar systems, Satellites, Signals Intelligence sites (SIGINT) and others – which are able to provide real time or near real time intelligence on designated targets and adversary's military systems. Now with the emergence of artificial intelligence as an asymmetric strategic technology, the fusion of AI with ISR is taking place across most military ISR configurations which is leading to AI *enabled* ISR.

This is possible through the use of **Machine Learning,** (ML) which can be understood as AI systems that are "trained" on and "learn" from data[131], and **Autonomy,** which is the ability of a machine to "execute" a task, or tasks, without human input, using interactions of computer programming with the environment.[132] These emerging technologies hold major promise for early warning and ISR capability as they enable –

(1) More capable early-warning and ISR systems (*ML application)*
(2) Searching and making sense of large sets of intelligence data *(ML application)*
(3) Making predictions *(ML application)*
(4) Achieve greater reach, persistence and mass in ISR missions *(Autonomous platforms)*
(5) Safe deployment in anti-access/area-denial (A2/AD) areas *(Autonomous platforms)*

These abilities can give Human Military Command better situational awareness, farther reach and potentially more time to make decisions, which can in turn lead to better targeting and engagement of the adversary.

---

130 Tsu, Sun. *The Art of War*. Classics.

131 ICRC. (2020). *Artificial Intelligence and Machine Learning in Armed Conflict: A human centered approach*. Digital technologies and war. International Review of the Red Cross, 102 (913), 463-479. Doi:10.1017/S1816383120000454

132 Williams, A and P. D. Scharre, *Autonomous Systems: Issues for Defence Policymakers* (NATO Headquarters Supreme Allied Commander Transformation: Norfolk, VA, 2015), pp. 27–62.

It is notable that Internet service providers, such as Google, Facebook or Baidu, routinely use machine learning to label and organize content such as text, images and videos, and to predict customer preferences.[133] National militaries are now trying to develop a similar capability to process intelligence data.

An early illustration of this capability is the US military's 'Project Maven', also known as the *Algorithmic Warfare Cross-Function Team*, which aims to use machine learning to automatically analyze video surveillance footage gathered during counterinsurgency operations in Iraq, Afghanistan and elsewhere.[134] The US Department of Defense has also used Project Maven and specifically its deep neural networks – to identify targets in its fight against the Islamic State terrorist group.[135] Operation Iraqi Freedom in 2003 was one of the earliest military operations to see the first use of autonomous underwater vehicles for mine warfare operations in Umm Qasr Harbor.[136] AI *enabled* ISR is an increasingly attractive proposition for militaries across the world and these ISR technical capabilities developed for war fighting and insurgent conflicts can easily be repurposed for nuclear-related intelligence, surveillance and reconnaissance. Thus it becomes important to map probable platforms that could deploy AI enabled ISR systems.

4.2.1 MILITARY PLATFORMS and ISR

Satellites. Military reconnaissance satellites can use AI to 'analyse and sort' captured images, and transmit the sorted images to ground stations on Earth. With AI, satellites can be programmed to recognize clouds and transmit only the cloud-free images to Earth and to identify and detect anomalies in images – such as waveform patterns on the open oceans. The European Space Agency's *PhiSat-1 Nanosatellite* has an artificial intelligence chip that allows the satellite to quickly filter through images & discard the ones that aren't useful for the assigned mission role.[137] Chinese military researches have also developed an advanced AI system that turns commercial satellites into spy trackers, able to follow small, distinct, targeted objects with precision.[138]

---

[133] Marr, B. (2017, August 8). *The amazing way Google uses deep learning AI*. Forbes. https://www.forbes.com/sites/bernardmarr/2017/08/08/the-amazing-ways-how-google-uses-deep-learning-ai/?sh=2b23a5ab3204

[134] Weisgerber, M., 'General: Project Maven is the just the beginning of the military's use of AI', Defense One, 28 June 2018. https://www.defenseone.com/technology/2018/06/general-project-maven-just-beginning-militarys-use-ai/149363/

[135] Allen, G. C., 'Project Maven brings AI to the fight against ISIS', *Bulletin of the Atomic Scientists*, 21 Dec. 2017 https://thebulletin.org/2017/12/project-maven-brings-ai-to-the-fight-against-isis/

[136] Office of Naval Research, USA. *Tales of Discovery: REMUS and Mine Countermeasures - Office of Naval Research*. Office of Naval Research. Retrieved April 10, 2022, from https://www.onr.navy.mil/en/About-ONR/History/tales-of-discovery/remus

[137] Intel. (n.d.). *Intel Powers First Satellite with AI on Board*. Intel Newsroom. Retrieved April 10, 2022, from https://www.intel.com/content/www/us/en/newsroom/news/first-satellite-ai.html#gs.we0js9

[138] Chen, S. (2022, April 7). Chinese AI turns commercial satellite into a spy tracker able to follow small objects with precision

Signals Intelligence. Artificial Intelligence and Machine Learning are poised to revolutionize embedded computing sensor processing for applications of signals intelligence. AI and ML's big promise for military use involves image and radio frequency analysis – not so much to determine what is significant in gathered intelligence, but to throw away the mountains of data that have no importance.[139] Machine learning can be used to find correlations in large and potentially heterogeneous sets of intelligence data, greatly improving performance, reducing costs and extending system life.

Radars. The deployment of over-the-horizon (OTH) radars by countries like USA and China[140] can significantly upend the ISR domain particularly if these OTH radar systems are infused with machine learning to identify, detect and discriminate targets. OTH radars are those, which operate on radio frequencies that either reflect off the ionosphere (sky wave) or follow the surface of the earth (surface wave) and are not limited to line-of-sight like higher frequency radars. The Chinese navy already claims to have deployed a new 'compact' radar that will allow it to keep watch over an area the size of India.[141] Significantly, even without deep AI being embedded into sensors, radar technology has advanced so much that once India operationalizes the Russian S-400 Air Missile Defence System, on its western border, the entire Pakistan Air Force Fleet will be detectable even before they take off from their airfields.[142]

Unmanned Systems. There is extensive effort underway in AI enabled ISR through unmanned systems, be it in the air, on the surface or underneath the seas. UAVs, USVs, UUVs (unmanned aerial/surface/underwater vehicles) are being paired with AI software to change the very nature of ISR Operations. Drones could now be used to process data on-board and identify by itself not only signals or objects but also situations of interest such as unusual movement of troops. A notable example is the *Automated Image Understanding Project* of the US Office of Naval Research, which intends to develop techniques to infer intentions and threats from surveillance imagery.[143]

---

paper. *South China Morning Post*. https://www.scmp.com/news/china/science/article/3173285/chinese-ai-turns-commercial-satellite-spy-tracker-able-follow

[139] Keller, J. (2020, July 23). *Artificial intelligence: the intelligence analyst's friend*. Military + Aerospace Electronics. Retrieved April 10, 2022, from https://www.militaryaerospace.com/computers/article/14180205/signal-processing-artificial-intelligence-ai-machine-learning

[140] Federation of American Scientists. (n.d.-a). *AN/FPS-118 Over-The-Horizon-Backscatter (OTH-B) Radar - United States Nuclear Forces*. Retrieved April 10, 2022, from https://nuke.fas.org/guide/usa/airdef/an-fps-118.htm

Tol, J. V., Gunzinger, M., Krepinevich, A. F., & Thomas, J. (2010, May). *AirSea Battle: A Point-of-Departure Operational Concept*. Center for Strategic and Budgetary Assessments. https://csbaonline.org/research/publications/airsea-battle-concept

[142] ANI. (2021, December 21). India deploys first S-400 air defence system in Punjab sector, to take care of aerial threats from China, *The Economic Times*. Retrieved April 10, 2022, from https://economictimes.indiatimes.com/news/defence/india-deploys-first-s-400-air-defence-system-in-punjab-sector-to-take-care-of-aerial-threats-from-both-china-pakistan/articleshow/88397852.cms

[143] Office of Naval Research, USA. (n.d.-a). *Programs - Computational Methods for Decision Making – Automated Image Understanding - Office of Naval Research*. Office of Naval Research. Retrieved April 10, 2022, from

Autonomous Platforms. The primary value of autonomous platforms is that they could improve the remote-sensing capabilities of states — especially for ISR missions. Compared to remotely controlled (UAVs) and manned systems (ships), autonomous platforms can be safely deployed in operational theatres of deep water (oceans) or areas protected by A2/AD systems. They can conduct extended missions over days or, in the case of underwater platforms, even months. And they can potentially be deployed in great numbers for they can be relatively inexpensive.[144]

These attributes are extremely attractive in the conduct of nuclear-related ISR operations, particularly *submarine reconnaissance*. Many types of autonomous platforms could be used for this type of mission including autonomous vessels (also known as autonomous surface vehicles, ASVs), autonomous underwater vehicles (AUVs) and autonomous aerial vehicles (AAVs). The USA has already developed a prototype ASV, *Sea Hunter*.[145] for anti-submarine warfare. Russia, China, Japan and a few other states are also developing such autonomous underwater systems. Additionally, the *US Littoral Battlespace Sensing-Gilder programme* can be manufactured at a relatively low cost and, thus, deployed on a massive scale.[146]

Anti Submarine Warfare Sensors. All nuclear-armed states, specially U.S., China, Japan, India, Russia in the Indo-Pacific are working on a variety of 'smart' sensors that can be used to track and detect hostile submarines and ships. China in particular poses a direct adversarial threat to Indian submarines as it has developed a plethora of military systems including *'Passive Sound-Detection Arrays'* on South China Sea, Pacific sea bottoms[147]; *Nominally Civilian Acoustic Listening Systems* on the deep-sea bottom near Guam and Yap Islands in the Philippine Sea[148]; and *hundreds of anchored buoys* throughout the western Pacific. Additionally, Beijing has built a massive dual-use military-civilian sensor system for adjacent seas called the Underwater Great Wall.[149] It has

---

https://www.onr.navy.mil/en/Science-Technology/Departments/Code-31/All-Programs/311-Mathematics-Computers-Research/computational-methods-automated-image-understanding

144 Verbruggen, M and Boulanin, V. (November 2017). *Mapping the Development of Autonomy in Weapon Systems*, Stockholm International Peace Research Institute, https://www.sipri.org/publications/2017/other-publications/mapping-development-autonomy-weapon-systems

145 United States Government, Defence Advanced Research Projects Agency (DARPA), 'ACTUV "Sea Hunter" prototype transitions to Office of Naval Research for further development', 30 Jan. 2018. https://www.darpa.mil/news-events/2018-01-30a

146 Teledyne Brown Engineering. (2018, April). *LBS-G: Littoral Battlespace Sensing–Gliders*. TBE. https://www.tbe.com/what-we-do/markets/maritime-systems/current-programs/littoral-battlespace-sensing-glider

147 Goldstein, L. and Knight, S. (2014, April). *Wired for Sound in the 'Near Seas'*. Naval Institute Proceedings. https://www.usni.org/magazines/proceedings/2014/april/wired-sound-near-seas

148 Chen, S. (2018, January 22). *Acoustic sensors in waters near US military base in Western Pacific are 'standard practice' for monitoring submarine traffic, US analyst says*. South China Morning Post. https://www.scmp.com/news/china/society/article/2130058/surveillance-under-sea-how-china-listening-near-guam

149 Das, Dr. (Cdr). A. (2019, April 15). *China's 'Undersea Great Wall' Project: Implications Dissecting the Threat and the Possibilities*. Bharat Shakti. Retrieved April 10, 2022, from https://bharatshakti.in/chinas-undersea-great-wall-project-implications-dissecting-the-threat-and-the-possibilities/

also deployed nine *Surface-Towed Array Sonar Systems* (SURTASS) ships.[150] Further, China is working on other potential submarine detection methods, including lasers from satellites and wake detection.[151] All these developments are critical for India in Anti-Submarine Warfare (ASW) for what happens in the South China Sea will happen in the Indian Ocean. Precedent gives way to behavior setting, and India should be prepared for such *warfare sensors in the Indian Ocean*.

Ships. Ships have traditionally played a crucial role in ISR Operations. Within the Indo-Pacific maritime geography specifically, we have seen how China has used its maritime shipping vessels - *Maritime Militia* (84 full-time large vessels in 2019), *Coast Guard* (225 vessels larger than 500 tons in early 2019), *Fishing Fleet* (187,200 "marine fishing vessels" in 2018), and sea traffic as potential surveillance assets to detect and track movements of hostile surface warships.[152] There is no reason why such tactics will not be employed against India in the Indian Ocean Region. Further with advances in emerging technology, the US, UK and China are now deploying AI Threat Monitoring Systems like *STARTLE (UK)*[153] on Warships which will make ISR Operations lethal.

Figure 16 – **STARTLE :** ***Autonomous AI Threat Monitoring System***
(Source: Roke, Complex Information Fusion and Advanced Threat Warning System)

150 Joe, R. (2018, October 16). *Chinese Anti-Submarine Warfare: Aviation Platforms, Strategy, and Doctrine.* The Diplomat. https://thediplomat.com/2018/10/chinese-anti-submarine-warfare-aviation-platforms-strategy-and-doctrine/

151 Kou, W. (2016). *Evaluation of wake detection probability of underwater vehicle by IR.* International Symposium on Optoelectronic Technology and Application. https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10157/101572H/Evaluation-of-wake-detection-probability-of-underwater-vehicle-by-IR/10.1117/12.2246860.short

152 Lt Col McCabe, T.R. (2021). *Chinese Intelligence, Surveillance and Reconnaissance Systems*. Journal of Indo Pacific Affairs, *Spring 2021*. Pg. 3. *https://media.defense.gov/2021/Mar/07/2002595026/-1/-1/1/25%20MCCABE.PDF*

153 ROKE. *Complex Information Fusion And Advanced Threat Warning System*. STARTLE - Roke. Retrieved April 11, 2022, from https://roke.co.uk/products/startle

STARTLE is a biologically inspired threat monitoring system that *detects* anomalous or threatening conditions by emulating the mammalian conditioned-fear response mechanism. It helps military teams rapidly detect and assess threats in complex and evolving situations.[154] Successful sea trials have demonstrated the systems ability to support the British Royal Navy Command Teams in warfare operations.[155] Network protection teams have also used the platform to detect and assess cyber threats in large Enterprise-class networks worldwide.[156]

This is cutting edge militarization of AI, which is already *deployed and in use* by the UK Armed Forces. It showcases how fast the world of ISR Operations is transforming.

Therefore the Adversary's ability to *use* militarized AI in real-time will redefine ISR.

Importantly, the capabilities of AI enabled ISR will most certainly be tested on the waters of the Indo-Pacific as 'Great Power Competition' between the United States and China will make both these AI Super powers deploy their most sophisticated military configurations in the region and fuse them with AI, hypersonic and autonomous strategic technologies in a faster and more broader way.

This will in turn spur a new militarized environment, especially on the waters of the Indian and Pacific oceans, making the Indo-Pacific Geography a most critical element of the *New Cold War*.

[154] ROKE. *Complex Information Fusion And Advanced Threat Warning System*. STARTLE - Roke. Retrieved April 11, 2022, from https://roke.co.uk/products/startle

[155] Ibid.

[156] Ibid.

4. 3 Bay of Bengal Maritime Geography

" The vital feature which differentiates the Indian Ocean from the Atlantic or the Pacific is the subcontinent of India, which juts out far into the sea for a thousand miles. It is the geographical position of India that changes the character of the Indian Ocean"

- K.M. Pannikar [157]
Indian Statesman

Figure 17 – **Important Chokepoints and ISLs of the IOR**
(Source: Ensuring Secure Seas. Indian Maritime Security Strategy, Pg. 18-19)

The Indian Ocean, with an area of 68.56 million sq km, is the third largest body of water in the world and covers about 20% of the earth's surface. India with its natural geographic characteristics enjoys a beneficial maritime security outlook in the Indian Ocean Region (IOR), as the Indian Ocean is distinguished by a land rim on three sides, with maritime access to the region possible only through certain **choke points** leading to and from the Arabian Sea, the Bay of Bengal and

157 Panikkar, K.M. (1946). *India and the Indian Ocean: An Essay on the Influence of Sea Power on Indian History.* George Allen and Unwin, India.

from the southern Indian Ocean. Further, India with its vast coastline extending to 7,500 kms+, with more than 1,200 islands and a large Exclusive Economic Zone (EEZ) of about 2 million sq. kms – has a central position in the IOR. Its peninsular feature provides a natural reach across wide sea spaces in all directions, extended by the islands in the Andaman & Nicobar and Lakshadweep Island groups. Its centrality, astride the main International Shipping Lanes (ISLs) accords distinct advantages and places the outer fringes of the IOR and most choke points almost equidistant from India, thereby facilitating reach, sustenance and mobility of its maritime forces across the region.[158]

Therefore India's maritime power – its ability to use the seas to safeguard and progress its national interests – is the dominant force in the Indian Ocean. This power is manifested and instrumentalized through the Indian Navy, which plays 4 major roles –

(1) Military – *threat or use of force at and from the sea*
(2) Diplomatic – *favorably shape the maritime environment to further national interests*
(3) Constabulary – *enforce law of the land*
(4) Benign – *ensure a safe society through HADR Operations, humanitarian aid, Ocean R&D*

The modern Indian Navy owes its intrinsic character to maritime operations that can be traced back to over 4000 years – to the time of the ancient **Indus Valley Civilization** – which was a maritime civilization of Mohenjodaro, Lothal and Harappa thriving on activity between India, Africa, Arabia, Mesopotamia and the Mediterranean. In fact the acclaimed role of ancient Indian expertise and knowledge in maritime trade, commerce and ocean navigation (particularly harnessing the monsoon winds) gave the Indian Ocean its very name. The Indian Ocean is the only ocean in the world named after a country – *India.*

The word 'navigation' itself originates from the Sanskrit word '*Navagati*' which means sea travel. Indians were amongst the original pioneers of sea travel and exploration.

Additionally, it was the ancient Indian Chola Dynasty who were amongst the first rulers globally to use sea power as an extension of state power. They were the ancient masters of the Indian Ocean and their military brilliance enabled them to capture and dominate the maritime geography of South and Southeast Asia for hundreds of years.

Today as India comes closer to its maritime roots under the 'Indo-Pacific' construct it is

---

158 Indian Navy. (2015). *Ensuring Secure Seas:Indian Maritime Security Strategy.* Naval Strategic Publication, Indian Navy. Pg. 17
https://www.indiannavy.nic.in/sites/default/files/Indian_Maritime_Security_Strategy_Document_25Jan16.pdf

rediscovering how critical a lifeline the Indian Ocean is for modern Independent India - 90% of India's trade (by volume) depends upon the Indian Ocean.[159]

However, given the significant flux in the international security environment, the bleak foreseeable global economic situation (particularly due to COVID 19 and the Russian Invasion of Ukraine) and the China-Pakistan strategic axis on India's land border – significantly more resources and investments are required by India in the maritime domain to ensure national security. In strategic terms, India's dominance of the IOR is not tomorrow's vision but yesterday's reality. What India must now contend with and manage is its fast evaporating relative naval dominance of the Indian Ocean particularly as the Chinese and Pakistan navy's increasingly foray into India's own maritime backyard using sophisticated emerging asymmetric strategic technologies like AI and autonomous AUVs.

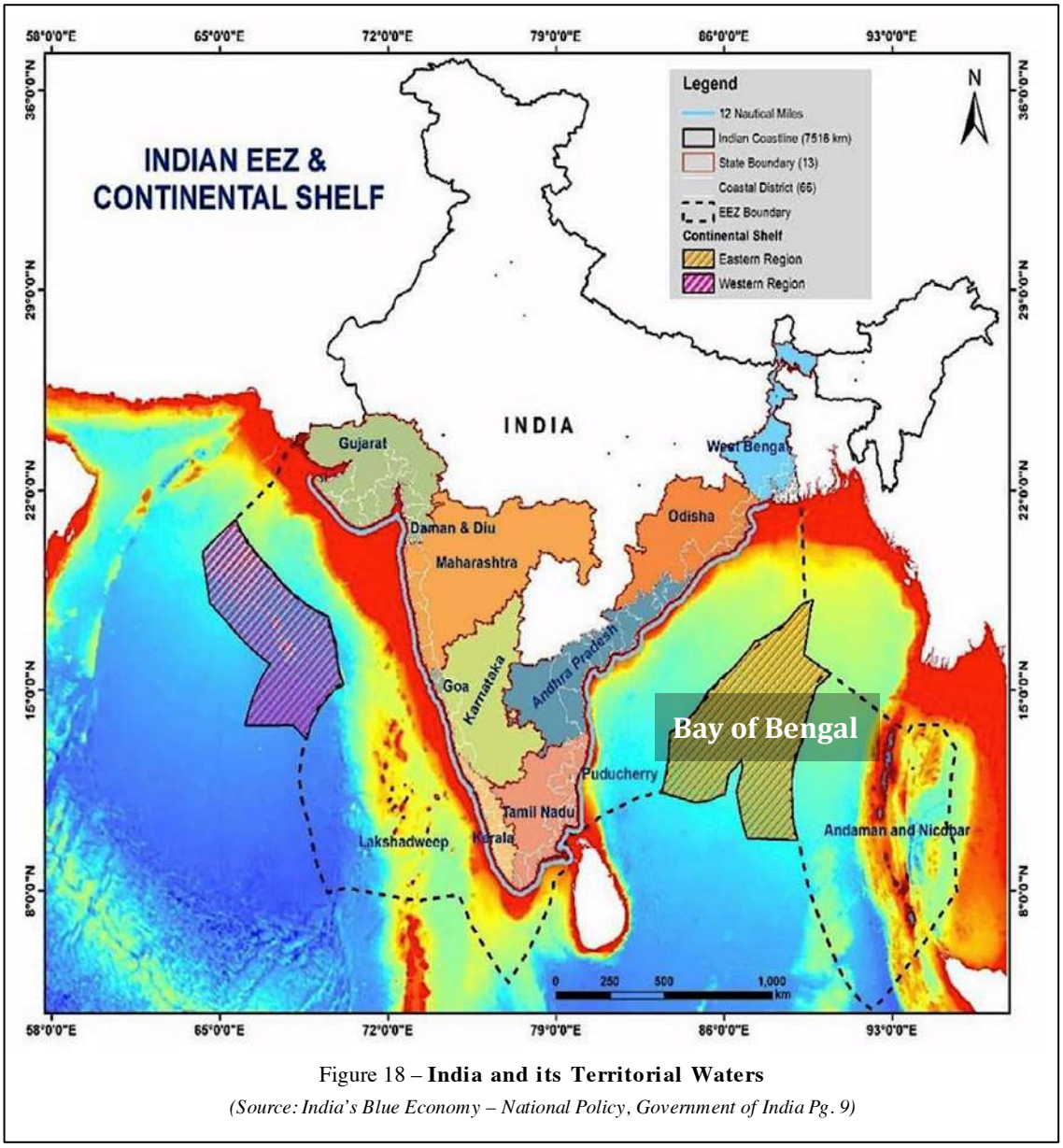


Figure 18 – **India and its Territorial Waters**

(Source: India's Blue Economy – National Policy, Government of India Pg. 9)

[159] Muralidharan, Vice Admiral M. P. (2019, February 28). *Economic and Strategic Importance of Sea in Modern Indian Context*. Indian Defence Review. Retrieved April 12, 2022, from http://www.indiandefencereview.com/spotlights/economic-and-strategic-importance-of-sea-in-modern-indian-context/

The Bay of Bengal in particular is the **largest bay in the world**,[160] and is a sea that is part of the northeastern Indian Ocean. It covers an area of approximately 2.2 million sq. kms. And is bordered by India, Bangladesh, Myanmar and Sri Lanka.[161] Over the last decade, it has once again become a zone of geopolitical rivalry among major powers reminiscent of the massive battles waged in the Bay of Bengal during World War II in what has now come to be known as the *Forgotten War*.[162]

4.3.1 MARITIME MILITARY CHARACTERISTICS of the BAY

Geographic Influence. The Bay provides adversaries access to vital and vulnerable areas, which would otherwise not be accessible by land. Therefore these areas form part of the operations for naval forces from all sides (India, China, USA primarily) to 'use' the maritime areas for themselves and 'deny the use' to the adversary. Unlike land or air, the threat at sea is not limited to international boundaries and the warm waters of the Bay are an inviting prospect for foreign powers like China for economic, natural resource and security reasons.

Further, local geographical conditions enable submarine and anti-submarine operations in the Bay making it an ideal location to deploy autonomous military systems.

Multi-Dimensional. Oceans and high seas are essentially a three-dimensional battlespace in which naval forces must operate on, below and above the sea surface. Consequently, naval power is highly technology intensive. Many times the weapons used have to travel through the interface of two mediums – as in the case of Submarine Launched Missiles (SLMs), Air Launched Torpedoes and Depth Charges. This multi-dimensional nature affects every facet of maritime warfare – surveillance, classification, localization, targeting and weapon delivery, in an omnidirectional atmosphere.[163] Therefore naval combat in the Bay of Bengal will certainly be such that the hunter and hunted *can* operate in totally different mediums i.e. Ships (surface) vs. Submarines (subsurface).

---

[160] National Geographic Society. (2013, April 15). *Bay of Bengal*. Retrieved April 12, 2022, from https://www.nationalgeographic.org/photo/sea-red-990-60612/

[161] Permanent Court of Arbitration. (2014, July 7). *In the Matter of the Bay of Bengal Maritime Boundary Arbitration between The People's Republic of Bangladesh and The Republic of India.* The Arbitral Tribunal AWARD. The Haugue. Pg. 13. https://www.pcacases.com/web/sendAttach/383

[162] Bayly, C and Harper, T (2006). *Forgotten Armies: The Fall of British Asia.* Cambridge: Harvard University Press.

[163] Indian Navy. (2009). *Indian Maritime Doctrine.* Naval Strategic Publication, Integrated Headquarters, Ministry of Defence (Navy). Pg. 52 https://www.indiannavy.nic.in/sites/default/files/Indian-Maritime-Doctrine-2009-Updated-12Feb16.pdf

Mobility and Fluidity at Sea. Unlike on land – the sea is a medium for movement. It cannot be occupied and fortified. Navies cannot dig in at sea, or seize and hold ocean areas that have great value. Even though naval operations involve control and influence over sea areas, they do not involve occupation of sea areas on a permanent basis. There are no positional defences at sea, nor are there battle lines to indicate the progress of an operation. The capability of a navy (the Indian Navy in this context) to effect *sea control* or *sea denial* in the Bay of Bengal during war and peace would be a major determinant of the strategic military outcome.

Presence of Neutrals. There are always neutrals (civilians) present at sea. They can be merchant vessels, fishermen, tourist vessels and the like as the 'great common' is regularly used by all nations. This can tend to confuse the maritime picture and cause misidentification, which can lead to severe consequences. Different from land and air, maritime operations cannot seal of huge areas of the seas to neutrals, specially in an extremely *crowded* sea like the Bay of Bengal.

Freedom of Navigation. The United Nations Convention on the Law of the Sea (UNCLOS) is the international law of the sea, which is binding completely. It provides for the right of *Freedom of Navigation and Freedom of Innocent Passage*.[164 ₸] These rights are applicable to the Bay of Bengal also as India is a signatory to the UNCLOS. Further, India along with the rest of the world **rejects** China's *9-Dash Line claim* in the South China Sea and in order to enforce UNCLOS and protect the Sea Lines of Communication (SLOC) *supports* U.S. led 'Freedom of Navigation Operations' (FONOPs) in the South China Sea.[165] However, India does not, for obvious security reasons, desire or prefer FONOPs in the Bay of Bengal or Arabian Sea region by China's PLA Navy or the Pakistan Navy. Therefore there is both a security as well as a political contradiction in Freedom of Navigation particularly when it comes to *Right to Innocent Passage and FONOPs* in the Bay, which can present a future problem for India.

Thus an emerging India is deeply aware that while it may be alone on the Asian Continent against the China Pakistan Axi, it needs friends and allies (U.S.A, Japan, France, Australia, others) on the high seas, if it is to retain the dominance and security posture it currently enjoys in the IOR. This *alignment* based on the issue of maritime security in the IOR is particularly important due to the strategic importance of the Bay of Bengal in Indian nuclear thought.

---

164 UNCLOS. United Nations Convention on the Law of the Sea. *Treaty.* *https://www.un.org/depts/los/convention_agreements/texts/unclos/part7.htm*

₸ Freedom of Innocent Passage may be defined as - Innocent passage requires that foreign civil and military vessels move directly through the territorial sea of another country, without obtaining prior permission and while transiting refrain from any activity not necessary for their continuous and expeditious passage. However many states do not agree with this definition.

165 Saha, P. (2021, July). *India Calibrates its South China Sea Approach.* Observor Research Foundation. Issue No. 477. Pg 13. https://www.orfonline.org/wp-content/uploads/2021/07/ORF_IssueBrief_477_India-SouthChinaSea_FinalForUpload.pdf

4.3.2 WHY THE BAY MATTERS

It is no secret that to counter China geo-strategically, the Bay of Bengal meets all the requirements for *deterrence patrols* by Indian SSBNs. These requirements may be broadly be listed as:

(1) Comfortable and known waters

(2) Dominant sea control over the water body

(3) Strategic reach of nuclear missiles to Pakistan and China

The deep, temperate waters and hydrology of the Bay of Bengal make it ideal for submarine operations, including strategic deployment. It is thus no surprise that all the Bay countries, excluding Sri Lanka, operate submarines. Further, the Bay is ideal for Indian submariners as the vital Andaman and Nicobar Island chain provides *"safe havens"* for Indian SSBN Operations with the proximity of relay and communication stations ensuring that India's highly assertive civilian hierarchy is assured of Command and Control structures onboard. Further, the Indian continental shelf on the east coast dips sharply into the 'abyssal Bengal fan', meaning a submarine can dive and be concealed just 2 nautical miles from harbor. (On the west Indian coast, it would have to sail out for 80 nautical miles before it could dive), making the Bay an ideal pool for Indian subs.

The Bay also offers India psychological reassurance viz-a-viz Pakistan, as it is on India's Eastern Seaboard and hence unlike the Arabian Sea, removed from Pakistan Navy activities, encounters and trails.

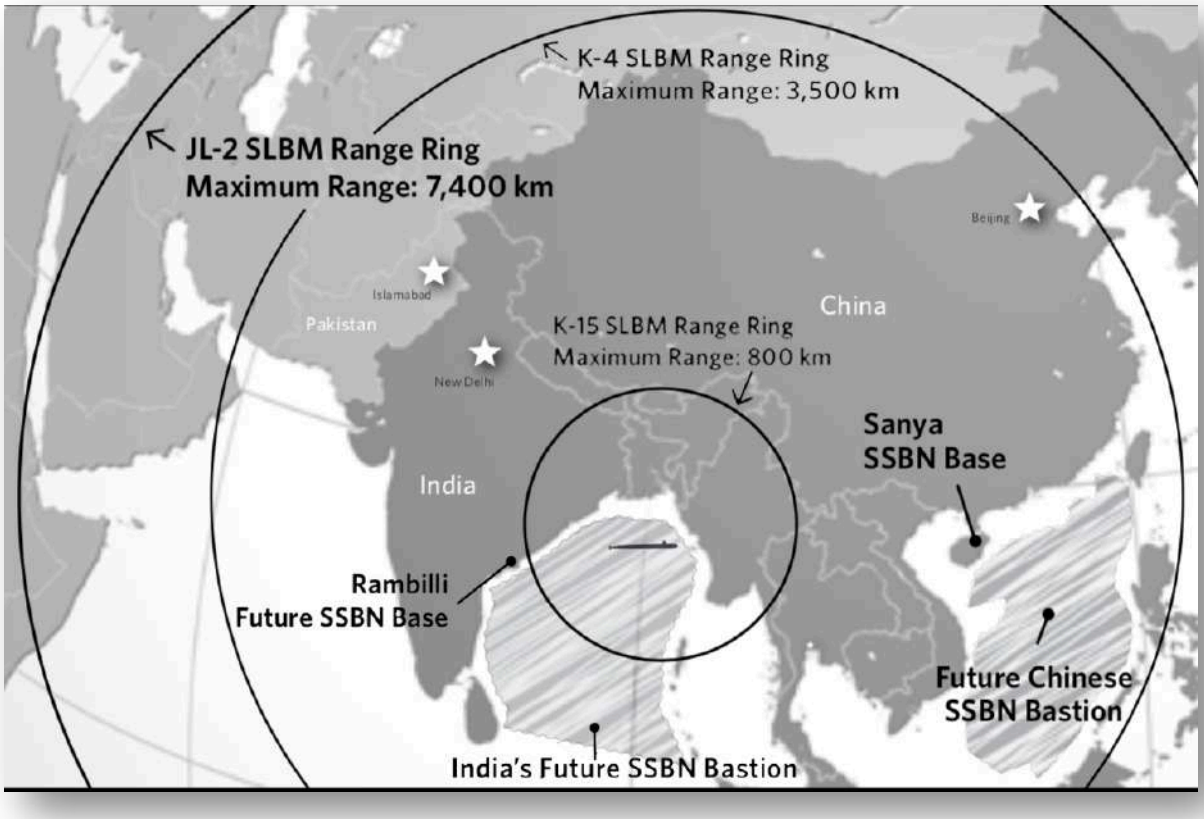


Figure 19 – **Significance of Bay of Bengal for Indian Nuclear Thought**

(Source: Centre for Air Power Studies, 2014)

CHINESE ACTIVITY IN THE BAY OF BENGAL

China is an extra-regional actor in the Bay. The recent decade has witnessed increased PLA Navy submarine sighting and deployments in the Indian Ocean. The brazen deployment of Chinese Submarines in the Bay of Bengal, North Arabian Sea and around the Andaman & Nicobar islands under the thin veil of 'anti-piracy operations' or the Maritime Silk Road which is the sea extension of China's One Belt, One Road (OBOR also known as Belt and Road) strategic initiative present a clear danger to Indian Navy's control of the Bay. Through the OBOR China is reshaping/ has reshaped the Eurasian Landmass and is now increasingly reshaping the waters.

Owing to its own security fears for its sea lines of communication, Beijing is putting greater emphasis on naval presence in the Indian Ocean, including the Bay of Bengal. This has resulted in what has been dubbed as China's **String of Pearls** strategy[166] – a plan to encircle and contain India through a series of strategic pearls (bases) in the Indian Ocean. Further as highlighted in the introduction, statements out of Beijing suggest that it plans to deploy *2 aircraft carrier battle groups* to the Indian Ocean on a permanent basis, to 'protect the maritime silk road'. This development if true, will fundamentally alter Indian maritime security.

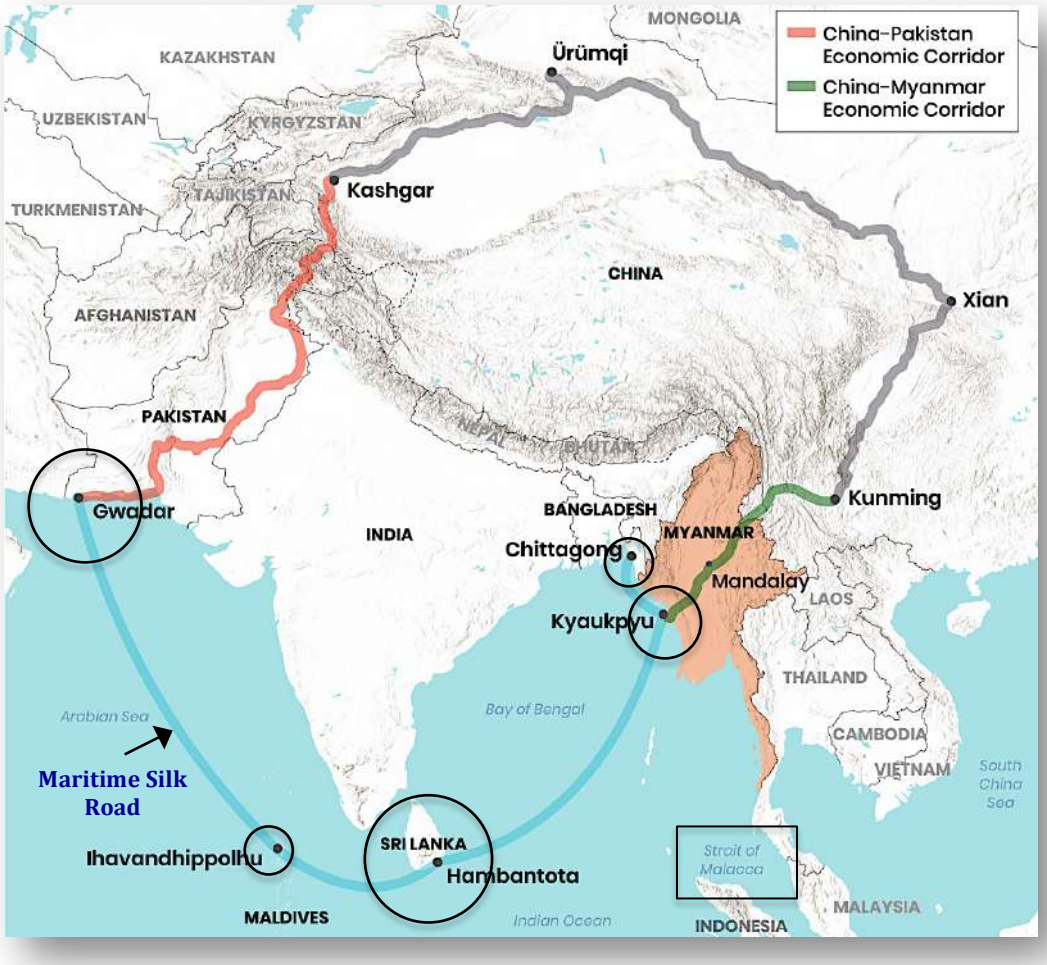


Figure 20 – **One Belt, One Road Initiative in South Asia**
(Source: Centre for International Maritime Security, 2020)

166 Ashraf, J. (2017). String of Pearls and China's Emerging Strategic Culture. *Strategic Studies*, *37*(4), 166–181. https://www.jstor.org/stable/48537578

Through the String of Pearls, China also aims to manage its *Malacca Strait Dilemma* – wherein all Chinese trade exports and crude imports, the lifeline of the Chinese economy, pass through the extremely narrow Malacca Straits, which are the main shipping channel between the Indian and Pacific oceans. Here the Chinese are extremely vulnerable to sea interdiction or naval blockade by the Indian Navy or the 'Quad' countries (U.S.A, India, Japan and Australia) particularly since these straits adjoin the Bay of Bengal. Additionally, the *China Pakistan Economic Corridor* (CPEC) as shown in Figure 20 is a flagship initiative on China's part to solve its 'Malacca Dilemma' by directly connecting the Persian Gulf (at Gwadar port) to the Chinese mainland (at Kashgar) through Pakistan. CPEC has caused further alarm in India in regards to China, as it violates Indian sovereignty by passing through Pakistan Occupied Kashmir, a *disputed territory.*

4.3.3 THE BAY'S STRATEGIC IMPORTANCE to the INDO-PACIFIC

As the new construct of the Indo-Pacific gains traction, its geographical scope now stretches from the Eastern Shores of Africa to the Western Pacific.[167] The Bay of Bengal is at the heart of this vast body of water with the re-emerging geographic centrality of the Bay, making it critical for all major powers. In the quest for *International Balance of Power,* Indo-Pacific is the new theatre of contestation for Great Power Competition and the Bay of Bengal its beating heart.

With India's new outward orientation combined with its rapid economic growth, the Bay of Bengal, which was neglected in the past, has now been elevated to the highest priority in New Delhi. India is now more willing to collaborate with other powers like the US, Japan and Australia in promoting regional connectivity, prosperity, stability and security in the Indian Ocean and particularly the Bay of Bengal. This is manifested through multilateral initiatives like the *Quadrilateral Security Dialogue (Quad),*[168] *Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC),*[169] *Indian Ocean Rim Association (IORA),*[170] *Information Fusion Centre for Indian Ocean Region (IFC-IOR)*[171] and others.

---

167 Mohan, C. R. (2020, October) *The Bay of Bengal in the Emerging Indo-Pacific.* Observer Research Foundation. *ORF Issue Brief No. 416*. https://www.orfonline.org/wp-content/uploads/2020/10/ORF_IssueBrief_416_BayOfBengal-IndoPacific.pdf

168 Ministry of External Affairs. (2021, Sep 24). *Joint Statement from Quad Leaders.* (Washington DC) https://mea.gov.in/bilateral-documents.htm?dtl/34318/Joint+Statement+from+Quad+Leaders

169 BIMSTEC. *Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation.* Charter. https://bimstec.org

170 IORA. *Indian Ocean Rim Association.* About Us. https://www.iora.int/en/about/about-iora

171 IFC-IOR. *Information Fusion Centre for Indian Ocean Region.* About Us. https://www.indiannavy.nic.in/ifc-ior/about-us.html

The Indo-Pacific Ocean space has fast become a modern expression of India's political, economic, connectivity, travel, and societal interests. Particularly amongst the Quad countries, great synergy is being witnessed in the region and this is playing out militarily in the Bay of Bengal through joint exercises such as **Malabar Naval Exercises** and HADR operations.

☐ Excluding China ☐ Including China

Actor	Term/Label	Key elements	Main initiatives	Ideas on regional order
ASEAN	Indo-Pacific	- ASEAN at the heart of regional cooperation ("ASEAN centrality") - Maintaining a rules-based order - Strengthening multilateral cooperation	none	multilateral
Australia	Indo-Pacific	- Maintaining a rules-based order - Enhanced security cooperation in the framework of the Quadrilateral Security Dialogue (Quad) - Opening up new markets for trade and investment - Improving connectivity through infrastructure development - Providing alternatives to the "Belt and Road" Initiative (BRI) - Safeguarding the freedom of navigation	- Infrastructure projects (especially in Papua New Guinea and in the South Pacific) - Expansion of security cooperation with USA, Japan, India - "2+2" dialogues with India, Japan, USA - Revival of the Quad - Strategic dialogues ASEAN countries - Arms exports to partners in Asia - Bilateral and multilateral free-trade agreements	Trade policy: multilateral Security policy: bilateral, minilateral
India	Indo-Pacific	- Maintaining a rules-based order - ASEAN at the heart of regional cooperation ("ASEAN centrality") - Improvement of connectivity through infrastructure expansion - Providing alternatives to BRI - Safeguarding the freedom of navigation	- Infrastructure projects (especially in South Asia) - Asia – Africa Growth Corridor - Expansion of security cooperation with USA, Japan and Australia - "2+2" dialogues with Australia, Japan and USA	Trade policy: bilateral Security policy: multilateral
Japan	Free and Open Indo-Pacific Vision (until 2018: *Strategy*)	- Maintaining a rules-based order - Enhanced security cooperation in the framework of the Quad - Opening up new markets for trade and investment - Improvement of connectivity through infrastructure expansion - Providing alternatives to BRI - Safeguarding the freedom of navigation	- Infrastructure projects (especially in East Africa and South and Southeast Asia) - Asia – Africa Growth Corridor - Expansion of security cooperation with USA, India and Australia - "2+2" dialogues with USA, India and Australia - Revival of the Quad - Bilateral and multilateral free-trade agreements	Trade policy: multilateral Security policy: bilateral, minilateral
United States	Free and Open Indo-Pacific Strategy	- Containment of China - Maintaining a rules-based order - Enhanced security cooperation in the framework of the Quad - Free, fair and reciprocal trade - Improving connectivity through infrastructure development, alternatives to BRI - Safeguarding the freedom of navigation	- Infrastructure projects (especially in the Western Pacific) - Expansion of security cooperation with Japan and Australia and India - "2+2" dialogues with Japan, Australia and India - Revival of the Quad - Modernization of the U.S. Armed Forces - Arms exports to partners in Asia - Bilateral trade agreements	bilateral

Figure 21 – **Different Concepts of Indo-Pacific**

(Source: German Institute for International and Security Affairs, 2020)

Still in spite of the recent advances, India remains some distance away from fully aligning its economic and security policies and bringing greater coherence and purpose to the pursuit of its strategic goals in the Bay of Bengal. The importance of the Bay, especially for Indian nuclear thought cannot be ignored. The sea leg of India's nuclear triad is being operationalized and poised to grow into the most credible component of its nuclear deterrence strategy.

To realize this overarching strategic aim, maintaining sea control and dominance of the Bay will be critical, particularly as India gets increasingly challenged by adversary's deployment of submarines and anti-submarine warfare configurations in the Indian Ocean.

4. 4 Indian Nuclear Submarines and SLBMs

" A ship is safest at harbor. But that is not what ships are built for."

- John A. Shed[172]

Indian nuclear thought, as detailed in the preceding sections, places nuclear deterrence at a separate level, distinct from conventional deterrence and conflict, due to the nature of the atomic weapon and its potential for mass destruction. Under India's nuclear doctrine, the fundamental purpose of *India's nuclear weapons is to deter the use and threat of use of nuclear weapons against India*.[173] Hence, the nuclear weapons will only be used in retaliation against a nuclear attack.[174] This 'credible minimum deterrence' policy, implies assured massive nuclear retaliation designed to inflict unacceptable damage, in response to a first nuclear strike against India. The validity of this nuclear logic and **"retaliation only" policy** rests upon the three central principles of *credibility, effectiveness and survivability*, all of which are imbibed in the sea-based segment of the nuclear triad, primarily the nuclear powered submarine carrying ballistic missiles (SSBN).

An SSBN, due to its stealth characteristics enables discrete and prolonged deployment, and its combat capabilities including weapon payloads, provide a credible, effective and survivable capability; contributing to the assurance of punitive retaliation. SSBNs by their very nature are very hard to detect, track and destroy. **Their main asset, *stealth, is what gives them the intrinsic element of survivability* and that is also the reason why nuclear submarines do not operate in groups.**[175]

The concept of launching strategic ballistic missiles from submarines was first studied by the German Navy, as a possible means of attacking American coastal facilities in World War II.[176]

---

[172] Philosiblog. (2012, March 29). *A ship is safe in harbour, but that's not what ships are for*. Retrieved April 16, 2022, from https://philosiblog.com/2011/09/28/a-ship-is-safe-in-harbour-but-thats-not-what-ships-are-for/

[173] Article 2(4) of Draft Report on *India's Nuclear Doctrine*, released on 17 August 1999 by the National Security Advisory Board (NSAB). https://mea.gov.in/in-focus-article.htm?18916/Draft+Report+of+National+Security+Advisory+Board+on+Indian+Nuclear+Doctrine\

[174] *Ibid*. CCS Review, Article 2 (ii), 04 January 2003. However, in case of a major chemical or biological weapons attack, the option for retaliation with nuclear weapons would be retained.

[175] Ashokan, Capt. P. (2008). Nuclear Submarine for the Indian Navy –Roles and Concepts. *College of Naval Warfare (CNW) Journal*, Annual Issue. Pg. 109.

[176] Refuto, G. J. (2011). *Evolution of the US Sea-based Nuclear Missile Deterrent: War fighting Capabilities*. Xlibris Corporation. Pg. 76

In the post-war period, these German studies were used in US naval research and became the source of technological development of submarine-based ballistic missile systems. By that time the stealth, lethality and psychological domination of the **U-Boats** was well documented and people like Oskar Morgenstern, in his seminal book *The Question of National Defense*, recommended moving the main strategic retaliatory force out of the continental United States into the sea by the late 1950s.[177]

Further, over time and with technological innovations, nuclear weapon states that have only one leg of the nuclear deterrent have chosen the sea-leg of deterrence. The United Kingdom, at present, maintains only its sea-based nuclear deterrence, which consists of Vanguard SSBNs, that are now slowly being replaced by 4 new Dreadnought SSBNs.[178] This is due to the fact that there is always concern and doubt in nuclear armed states about (1) the survivability of land-based and air-based nuclear forces, (2) because it would require enormous resources of the adversary to eliminate the sea-based deterrence. The adversary *must* in a very small time frame eliminate all of a country's SSBNs, which is an enormous time critical task, and if they miss, face retaliatory nuclear strikes from the remaining SSBN forces. This is why nuclear armed states have strived hard, despite huge challenges, to have an effective sea-based deterrence, overwhelmingly undersea. And this is the reason why India too, following in the footsteps of other advanced nuclear powers, has opted for deploying a sea-based deterrent force in the form of INS Arihant.

4.4.1 *ARIHANT* CLASS SUBMARINES

The Indian government announced its intention to put in place a nuclear triad, after the Kargil Conflict in 1999.[179] The Advanced Technology Vessel (ATV) Project, which was underway since the late 1970s got a big boost at the time and the *Arihant class submarines,* which are nuclear powered ballistic missile submarines were built under the project. They are the first nuclear submarines designed and built by India.

The first of its class, the lead vessel of the ATV Project, **INS *Arihant*** achieved reactor criticality of its 80MW miniaturized nuclear reactor in August 2013 and was commissioned in 2016.[180] The SSBN has been classified as a **'strategic strike nuclear submarine'** by India and

---

177 Refuto, G. J. (2011). *Evolution of the US Sea-based Nuclear Missile Deterrent: War fighting Capabilities*. Xlibris Corporation. Pg. 129 – 131

178 UK Government. (2022, April 8). *The UK's nuclear deterrent: what you need to know*. Factsheet. GOV.UK. Retrieved April 17, 2022, from https://www.gov.uk/government/publications/uk-nuclear-deterrence-factsheet/uk-nuclear-deterrence-what-you-need-to-know

179 Malhotra, J. (2013, August 19). *How India's pride INS Arihant was built*. Business Standard. Retrieved April 17, 2022, from https://www.business-standard.com/article/specials/how-india-s-pride-ins-arihant-was-built-113081100745_1.html

180 Ibid.

several agencies like the Department of Atomic Energy (DAE), Defence Research and Development Organisation (DRDO), Indian Naval Engineers, Larsen & Toubro (L&T), Tata Power and others collectively undertook this national project.

In November 2018, Indian Prime Minister Narendra Modi announced that the INS *Arihant* had completed its '*first deterrence patrol*', **officially marking the completion of India's nuclear triad.**[181] He also stated that the deployment constituted *"a fitting response to those who indulge in nuclear blackmail."*[182] The deterrence patrol lasted approximately 20 days, however it is unclear whether the submarine was actually equipped with nuclear weapons.

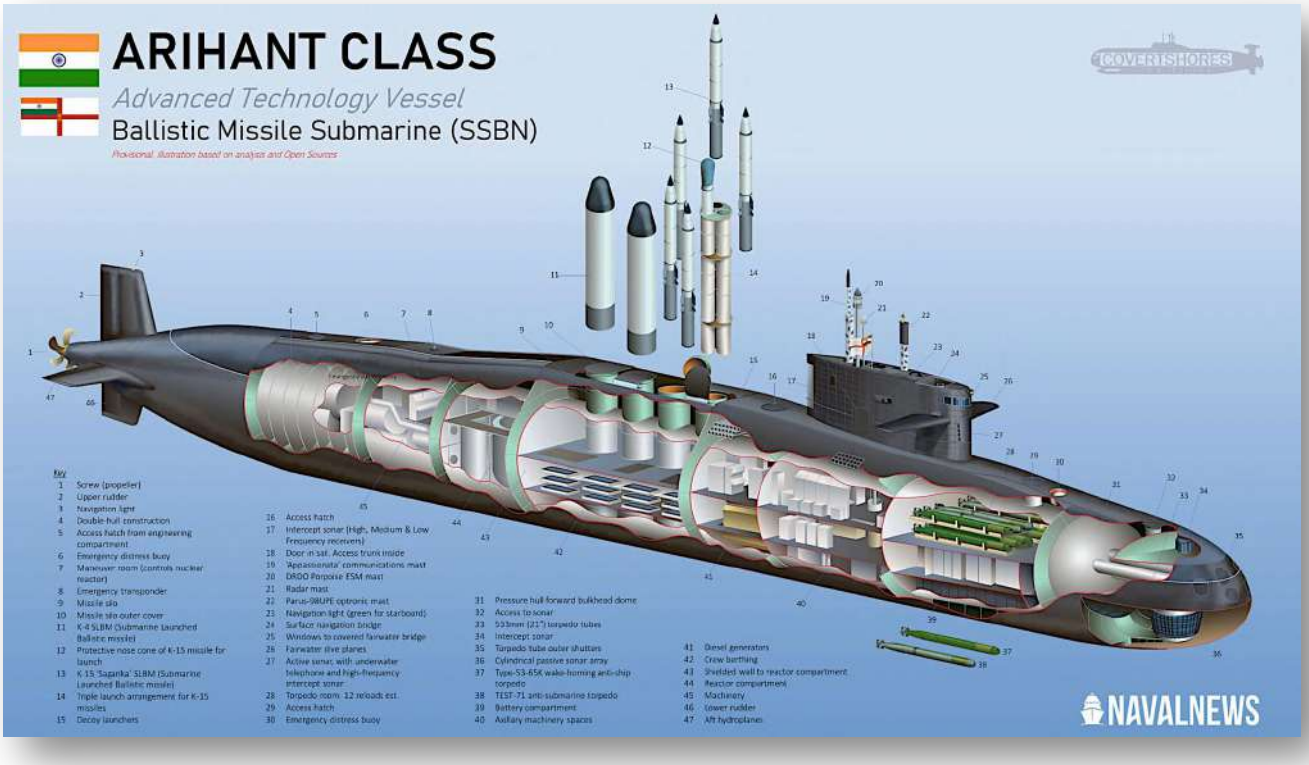


Figure 22 – **Arihant Class Submarines – Indian SSBN**
(Source: Naval News, H I Sutton 2021)

> The success of INS *Arihant* gives a fitting response to those who indulge in nuclear blackmail. In an era such as this, credible nuclear deterrent is the need of the hour. – *Indian PM Narendra Modi*

[181] Government of India, Press Information Bureau. (2018, Nov 5). *Prime Minister felicitates crew of INS Arihant on completion of Nuclear Triad*. Prime Minister's Office, Government of India. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1551894

[182] Singh, R. (2018, November 6). "India completes nuclear triad with INS Arihant's first patrol." *Hindustan Times*, https://www.hindustantimes.com/india-news/fitting-response-to-nuke-blackmail-says-pm-on-ins-arihant-s-first-deterrence-patrol/story-SDGODa4nxf6NfevT5davtJ.html

INS Arihant is a 6,000-tonne submarine with a length of 110 metres and a breadth of 11 metres. It can travel up to 24 knots when submerged and can remain submerged for about 50 days without surfacing. The vessel will be able to carry 12 Sagarika K-15 submarine launched ballistic missiles (SLBM) that have a range of over 700 km as its primary weapon.[183] Some of its salient aspects and doctrinal mechanisms are –

Miniaturized Nuclear Reactor. The submarine is powered by a 80 MW pressurized water reactor with highly enriched *uranium fuel*.[184] This reactor was designed and built by the Bhabha Atomic Research Centre (BARC) – India's primary nuclear research institution – with Russian assistance especially in miniaturizing the reactor to fit into the 10m diameter hull of the SSBN.[185]

Command and Control. Operating a SSBN is a long and complicated task. In the context of the INS *Arihant,* the Indian Command, Control, Communication (C3) mechanisms will have to be, most certainly have been reworked to to have an efficient system in place that will work under a restricted environment. Importantly the Submarine is under the primary control of the Strategic Forces Command and not the Indian Navy, to ensure firm political control is maintained over the nuclear asset as envisioned in India's nuclear doctrine.

Communication With Submarine. Communication is a major challenge when it comes to submarines and *Arihant* is no exception. The seawater heavily attenuates radio signals and this complicates communication. Certain low frequency waves penetrate up to a few meters, for example, Very Low frequency (VLf) which penetrates up to 40-50 meters and Extremely Low frequency (ELf); which due to its lower frequency penetrates even deeper. The Indian Navy is uses both VLF and ELF to communicate with its submarine fleet through the sprawling *INS Kattabomman* transmission station, set up in Tamil Nadu.[186] The primary role of the base is to provide continuous global communication link to ships and submarines in India's areas of interest. Additionally India launched the *GSAT-7 (Rukmini)* military satellite in 2013 – dedicated to the Indian Navy – for high frequency satellite communication. The *Rukmini Satellite* is a considerable force multiplier and will make communication with the *Arihant* more stable and secure.

---

[183] Davenport, K. (2020, March 14). *India Tests Submarine-Launched Missile | Arms Control Association*. Arms Control Association. https://www.armscontrol.org/act/2020-03/news/india-tests-submarine-launched-missile
NTI. (2021, September 14). *India Submarine Capabilities*. The Nuclear Threat Initiative. https://www.nti.org/analysis/articles/india-submarine-capabilities/

[184] The Hindu. (2009, November 5). *High fissile fuel in nuclear submarine lasts long*. The Hindu. https://web.archive.org/web/20121105132403/http://www.hindu.com/seta/2009/11/05/stories/2009110551721200.htm

[185] Malhotra, J. (2013, August 19). *How India's pride INS Arihant was built*. Business Standard. Retrieved April 17, 2022, from https://www.business-standard.com/article/specials/how-india-s-pride-ins-arihant-was-built-113081100745_1.html

[186] Pandit, R. (2014, July 31). Navy gets new facility to communicate with nuclear submarines prowling underwater. *The Times of India*. Retrieved April 17, 2022, from https://timesofindia.indiatimes.com/india/Navy-gets-new-facility-to-communicate-with-nuclear-submarines-prowling-underwater/articleshow/39371121.cms

Operation Strategy. The Indian Navy is structured around *Sea Control* – which is a condition where one is able to use a defined sea area (in this case the Bay of Bengal), for a defined period of time, for one's own purposes, and at the same time deny its use to the adversary.[187] It is the central concept around which the Indian Navy (IN) is employed. It comprises necessary control of the surface and underwater environments, the airspace above the area of control, and also the electromagnetic environment. Sea control is not an end in itself. It is a means to a higher end and very often a pre-requisite for other maritime operations and objectives.

Therefore considering India's nuclear philosophy, capability of the *Arihant* platform, the sea-control structure of the Indian Navy, and public remarks by authoritative personalities in the Indian defence establishment, it is sufficiently clear that **India favours and will adopt a BASTION STRATEGY** *for its SSBNs***.** Meaning the INS *Arihant* will operate close to Indian waters, under the protective envelope of sea-based and land-based Indian defences.

Indian SSBNs are still in the 'boomer' phase and nowhere near as advanced as the SSBNs fielded by the P-5 Nations (USA, Russia, China, UK and France). Hence given the asymmetry as well as the increasingly militarized waters of the Indo-Pacific, INS *Arihant* will be deployed close to Indian coastal waters. The erstwhile Soviet Union and currently China also employ the same strategy, because of the technological inferiority of their submarines and SLBMs compared to those of the USA and the West.

India's sea-based deterrent would eventually be "*secured in havens",* waters we are pretty sure of, by virtue of the range of the missiles. We will be operating in a pool in our own maritime backyard.

The Indian Navy will additionally certainly exercise sea-denial as an offensive measure, to reduce intrusion into the Bay of Bengal, in order to deny an adversary freedom of action when the SSBNs are on *deterrence patrol*. This strategy while making strategic sense, will pose limitations on Indian SSBNs and make them intensely vulnerable to asymmetric militarized strategic technologies with time. Rear Admiral Raja Menon (retd.) has pointed this vulnerability, stating –

> The location of your nuclear weapons eventually becomes known and even a half percent knowledge of your existing weapons sites each year could add up to something substantial over the years, thus degrading the deterrent.[188]

---

[187] Indian Navy. (2009). *Indian Maritime Doctrine*. Naval Strategic Publication, Integrated Headquarters, Ministry of Defence (Navy). Pg. 77. https://www.indiannavy.nic.in/sites/default/files/Indian-Maritime-Doctrine-2009-Updated-12Feb16.pdf

[188] Unnithan, S. (2018, November 5). *From India Today magazine: A peek into India's top secret and costliest defence project, nuclear submarines*. India Today. https://www.indiatoday.in/magazine/the-big-story/story/20171218-india-ballistic-missile-submarine-k-6-submarine-launched-drdo-1102085-2017-12-10

Maritime Domain Awareness. The criticality of MDA in maritime and particularly SSBN operations cannot be overstated. MDA an all-encompassing term that involves being cognizant of the position and intentions of all actors, whether own, hostile or neutral, in the constantly evolving maritime environment in the areas of interest.[189] The intelligence given to INS *Arihant* on presence of foreign naval units including warships, submarines and aircraft, in the region will enable it to monitor their activities for discerning their deployment and intentions. This MDA environment will be achieved through –

(1) Surface and Aerospace surveillance – *UAVs, AWACs, radars*

(2) Subsurface surveillance – *Mobile and Static systems*

(3) Identification – *Friend and Foe Identification systems*

(4) ICT – *Secure, reliable and rapid information exchange*

(5) Cyber Space – *Safeguarding systems and networks*

(6) Cooperative Engagement Capability - *Technologies for Multi-Platform, Multi-Sensor Data Fusion (MPMSDF)*

(7) Satellite Capabilities - *Maritime Command, Control, Communications (C3) across IOR.*

(8) Data Analysis - *Networked operations and MDA. (The establishment of the Information Management and Analysis Centre has been a major positive development in this regard.)*

(9) Geographical Information and Positioning Fixing Systems – *Use of Rukmini Satellite to provide accurate precision weapons engagement for maritime operations*

A strong MDA ecosystem is vital to security operations of the *Arihant*. **The creation of the Information Fusion Centre for the Indian Ocean Region, Gurugram** is a big step in creating a holistic MDA picture for the Indian Navy and SFC Command.

_____

With the INS *Arihant* inducted and operational since 2016, the 2nd nuclear ballistic missile submarine of this Class – the **INS *Arighat*,** (code name *S3*) was quietly launched on 19 November, 2017 and is in the advanced trial phase and is expected to be commissioned soon.[190] Further media and strategic reports indicate the 3rd Indian SSBN – codenamed ***S4*** – was also quietly launched on 23 November 2021.[191] A 4th SSBN is also being developed – codenamed ***S4**** – which is scheduled

---

189 Indian Navy. (2015). *Ensuring Secure Seas:Indian Maritime Security Strategy*. Naval Strategic Publication, Indian Navy. Pg. 134. https://www.indiannavy.nic.in/sites/default/files/Indian_Maritime_Security_Strategy_Document_25Jan16.pdf

190 Rajagopalan, R. P. (2022, January 7). *India Launches 3rd Arihant Submarine*. Observer Research Foundation. https://www.orfonline.org/research/india-launches-3rd-arihant-submarine/

191 Ibid.

to enter service before 2024.[192] India is also developing its next generation of SSBNs — **the S-5 class.** Photos indicate that the new submarines will be significantly larger than the current Arihant class and could have eight or more launch tubes.[193] **A naval base for the SSBNs named INS Varsha is currently under construction near Rambilli on the Indian east coast**, and will be located near the Bhabha Atomic Research Center.[194]

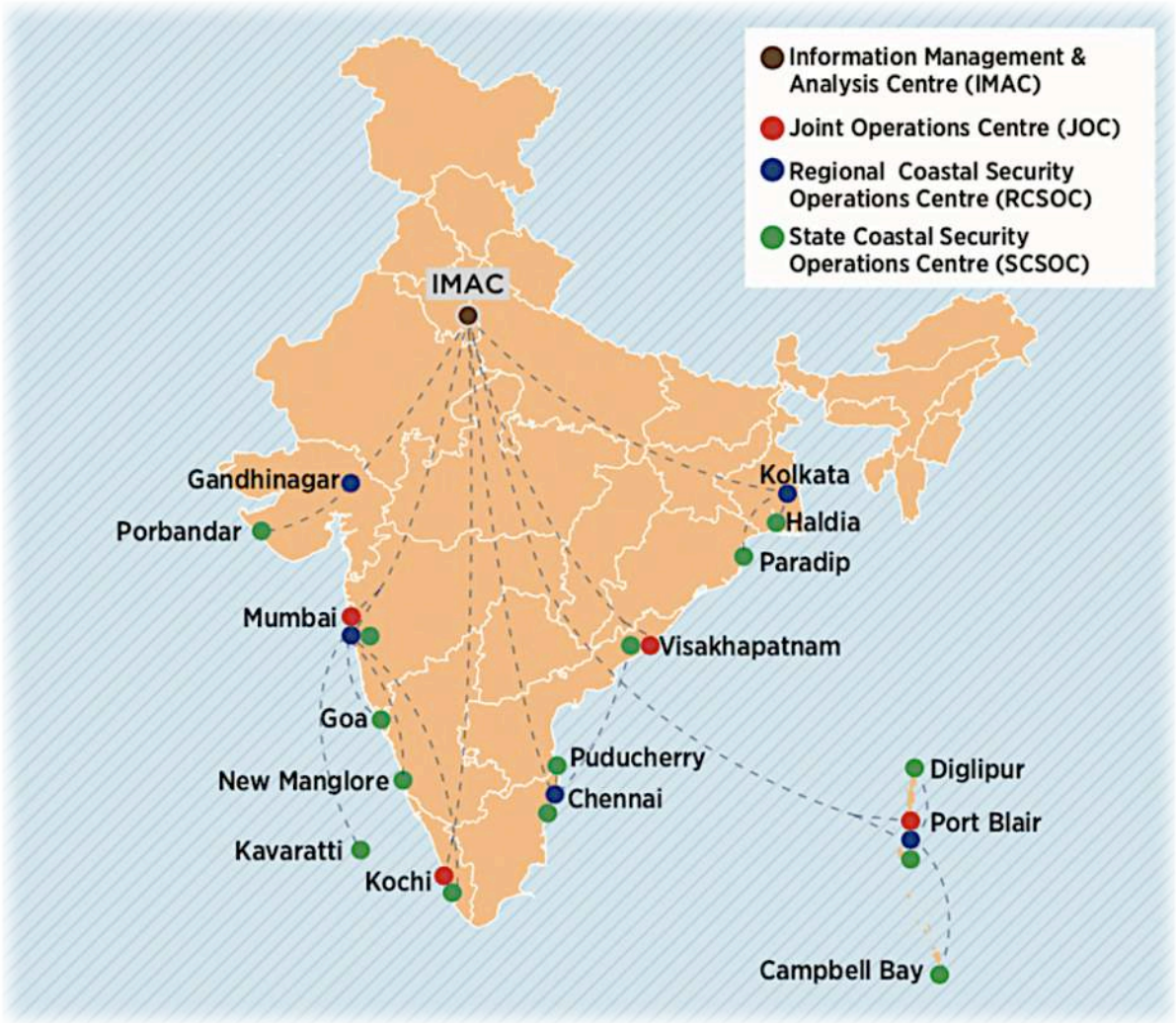


Figure 23 – **National Command Control Communication and Intelligence Network (NC3IN)**
(Source: Indian Maritime Security Strategy, 2015. Pg. 115)

Making the submarine arm of India's nuclear triad *credible* requires at least 4 SSBNs with sufficient number of nuclear missiles with range.

192 Pubby. M. 2020. "India's Rs 1.2 lakh crore nuclear submarine project closer to realisation." *The Economic Times,* February 21. https://economictimes.indiatimes.com/news/defence/indias-rs-1-2-l-cr-n-submarine-project-closer-to-realisation/articleshow/74234776.cms

193 Kristensen, H and Korda, M. (2020, July 1). *Nuclear Notebook: Indian Nuclear Forces, 2020*. Bulletin of the Atomic Scientists. https://thebulletin.org/premium/2020-07/nuclear-notebook-indian-nuclear-forces-2020/

194 Ibid.

4.4.2 INDIAN SEA BASED BALLISTIC MISSILES

To arm the SSBNs, India has developed 2 kinds of nuclear capable Submarine-Launched Ballistic Missile (SLBM). *First* is the K-15 (also known as *Sagarika*) SLBM with a range of 700 kilometers, and the *Second* is the K-4 SLBM with a range of about 3,500 kilometers.[195] These missiles are given the 'K' series designation to honour late President Dr. A P J Abdul Kalam - the *Missile Man of India*.

K-15 with its relatively short range does not have the range to allow SSBNs to target Islamabad, only Karachi, and the submarines would **not** be able to target China at all, unless they sailed deep into the South China Sea. This missile must therefore be seen as a technology demonstrator and will likely be phased out once the program matures.

K-4 on the other hand, will be able to target **all** of Pakistan and most of China from the edges of northern Bay of Bengal. It has undergone six test launches and is reportedly "virtually ready." The Indian Defence Research and Development Organisation has stated that the missile is highly accurate, reaching *"near zero circular error probability."*[196] Further, INS *Arihant*'s four launch tubes will be capable of carrying 4 K-4s or 12 K-15s (three per tube). INS *Arighat* will also have the same payload capacity, but subsequent SSBNs – the S4 and 4* - will likely be able to carry more missiles.[197] With the K-4, Beijing is now technically in range of Indian ballistic missiles, but the SSBN would have to operate on the extreme northeastern zone of the Bay of Bengal, close to the coast of Bangladesh and Myanmar to target the Chinese Capital, putting it at risk of high exposure.

There is also rumours that each K-4 SLBM is capable of carrying Mutiple Independently Targetable Reentry Vehicle (MIRV) technology, which if true, will make the missile tremendously more deadly.

The development of efficient delivery platforms for nuclear weapons has added tremendous value to Indian SSBNs. **Without the delivery systems (missiles), the utility of nuclear weapons as a deterrence tool is negligible or zero.**

---

[195] Davenport, K. (2020, March 14). *India Tests Submarine-Launched Missile | Arms Control Association*. Arms Control Association. Retrieved April 17, 2022, from https://www.armscontrol.org/act/2020-03/news/india-tests-submarine-launched missile

[196] Peri, D. 2020. "India successfully test-fires 3,500-km range submarine-launched ballistic missile K-4." *The Hindu*, January 19. https://www.thehindu.com/news/national/india-successfully-test-fires-3500-km-k-4-slbm/article30601739.ece

[197] Pubby. M. 2020. "India's Rs 1.2 lakh crore nuclear submarine project closer to realisation." *The Economic Times*, February 21. https://economictimes.indiatimes.com/news/defence/indias-rs-1-2-l-cr-n-submarine-project-closer-to-realisation/articleshow/74234776.cms

Increasingly, India can be seen to be focusing on developing and deploying longer-range, nuclear capable ballistic missiles directed at *countering China,* not Pakistan. The DRDO is already planning to develop a 5000 kilometer range **K-5** SLBM and a 6000 kilometer range **K-6** SLBM that would allow Indian nuclear submarines to target all of Asia, parts of Africa, Europe, and the Indo-Pacific region, including the South China Sea.[198]

The ongoing expansion of India's nuclear posture to maintain strategic balance with a conventionally and nuclear superior China, will result in significantly new capabilities being deployed over this decade, which could potentially also influence how India views its nuclear deterrence posture against Pakistan. We may be witnessing a '*decoupling'* of Indian nuclear strategy between China and Pakistan, as the force requirements India needs in order to credibly threaten assured retaliation against China may allow it to pursue more aggressive strategies – such as *escalation dominance* or a '*splendid first strike'*—against Pakistan.[199]

198 Gupta, S. 2020. "India plans 5,000-km range submarine-launched ballistic missile." *Hindustan Times*, January 2020. https://www.hindustantimes.com/india-news/india-plans-5-000-km-range-ballistic-missile/story-bystz09QSaHJwYvAtlbNeI.html

199 Narang, V. 2017. Remarks by Professor Vipin Narang, Department of Political Science, Massachusetts Institute of Technology, at the Carnegie International Nuclear Policy Conference, Washington, D.C. https://fbfy83yid9j1dqsev3zq0w8n-wpengine.netdna-ssl.com/wp-content/uploads/2013/08/Vipin-Narang-Remarks-Carnegie-Nukefest-2017.pdf

4. 5 Weaponisation of AI in Maritime Environment

"Autonomous weapons (AI technology) have been described as the third revolution in warfare, after gunpowder and nuclear arms."

- Stephen Hawking, Elon Musk, Steve Wozniak and others [200]
Autonomous Weapons Open Letter 2015

The marine environment, both on the high seas and underwater, has been the proving ground of increasingly autonomous technologies. During the past 20 years, undersea activity has increased considerably, driven by oil, gas, and oceanographic research, which has resulted in sophisticated technological advances and the emergence of relatively inexpensive undersea vehicles (UVs).

In a military maritime context, the rapidly advancing AI capabilities, particularly in *autonomy*, pose a significant and increasing threat to operational and war fighting doctrines and concepts on the ocean's surface and below it. Various countries have placed considerable importance on developing militarized AI to maintain battle-space superiority and execute complex and exacting missions. The maritime environment fits perfectly in this frame as the applicability of AI to naval operations surpasses its usage in any other military domain due to the *hostility, unpredictability* and *sheer size* of the ocean environment. Oceans are often unmapped and difficult to navigate, and the use of AI-based systems to track, calculate, detect, chart and execute the best actions for naval vessels augments existing military capabilities. Further, in operational geographies that need constant intelligence, surveillance and reconnaissance of the ocean environment, AI based systems can negate the hostilities of marine physics, i.e., hydrostatic pressure, ocean turbulence, thermal gradient, and ocean salinity; helping navies to target, map, and even engage enemy vessels.[201]

These factors make *unmanned autonomous systems* an indispensible asset in current and future naval force postures, with the maritime environment emerging as the first battle-space where fully autonomous weapons are deployed given the ocean's relatively *'uncluttered'* nature.

Many of the world's conflict flashpoints are on coastal or contested waters, rendering the maritime environment an increasingly strategic battle space for an ever growing number of Nation States.

---

[200] Kramar, J. (2021, November 23). *Autonomous Weapons Open Letter: AI & Robotics Researchers*. Future of Life Institute. Retrieved April 22, 2022, from https://futureoflife.org/2016/02/09/open-letter-autonomous-weapons-ai-robotics/

[201] United Nations Institute for Disarmament Research. (2014). *The Weaponization of Increasingly Autonomous Technologies in the Maritime Environment : Testing the Waters*. UNIDIR. Pg. 17. https://unidir.org/publication/weaponization-increasingly-autonomous-technologies-maritime-environment-testing-waters

The vast oceanic areas that must be monitored and potentially controlled, combined with economic considerations of fuel and high costs of manned missions at sea for extended periods and given the limits of human endurance at sea – all make autonomous technologies increasingly attractive for naval assignments that humans find physically and mentally unpleasant or unsuitable, such as extended submarine missions. Additionally, the difficulty of maintaining active communication with systems operating underwater makes autonomous operations viable, particularly when combined with the military desire to benefit from the covert nature of operating in a communication-denied environment or a A2/AD geography.

Thus for commercial, scientific and **military** purposes – sophisticated autonomous marine technologies are being developed across the world with the U.S., China and Russia taking the lead. This development is ensuring that some of the most cutting-edge advances in military robotics are being realized in maritime and underwater environments, particularly in surface combat and anti-submarine warfare.[202] The United States Department of Defense has already mapped out a new naval concept of operations (CONOPS) based on the use of *autonomous naval systems* to maintain and enforce battle-space superiority under its 'Unmanned Systems Integrated Roadmap FY2013 –

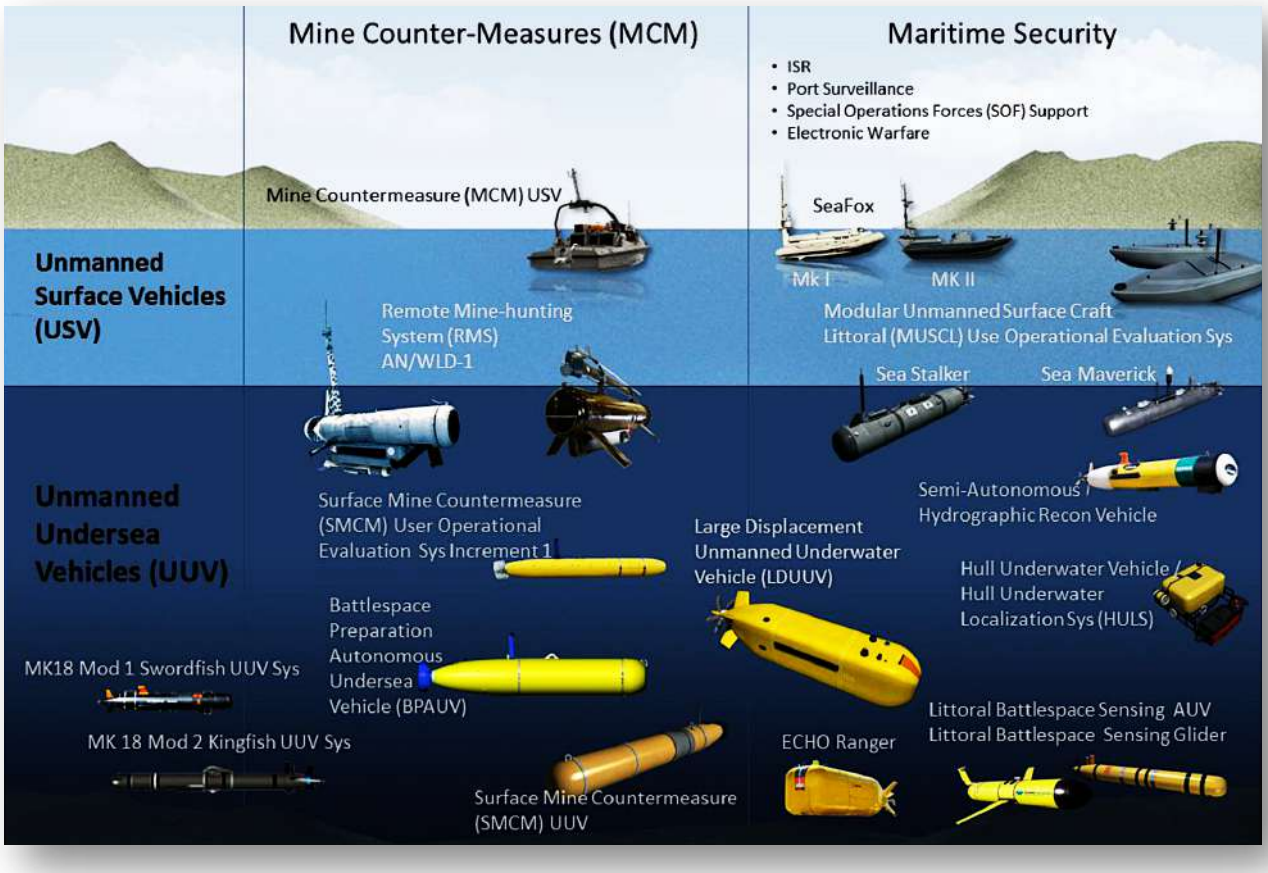


Figure 24 – **Unmanned Maritime Systems by Mission Area**

(Source: Unmanned Systems Integrated Roadmap FY2013-2038, US Department of Defence, Pg. 8)

202 Lucas, G. Automated Warfare, *Stanford Law & Policy Review*. Vol. 25, no 317, Pg. 317–340.

2038.'[203] It envisions a wide range of increasingly autonomous military systems, that go by a variety of names, such as ROVs (remotely operated underwater vehicles), USSVs (Unmanned Sea Surface Vessels), UUVs (unmanned underwater vehicles), AUVs (autonomous underwater vehicles) and UUSs (unmanned undersea systems); all deployed in the maritime environment, for a variety of missions including mine-countermeasures, port surveillance, fleet protection supply and intelligence, surveillance and reconnaissance (ISR).[204]

The US naval authorities further task 'next generation UUSs'[205] to be deployed for –

(1) Sea Choke point control

(2) Surface Action Group Interdiction

(3) Operational Deception

(4) Anti-Submarine Warfare

Such missions, carried out by *unmanned autonomous systems* that are relatively low cost and thus deployable in large quantities, will not put human life at risk, enable redundancy and resilience through numbers and importantly **will change undersea naval-military approach from a submarine perspective of stealth to CONOPS of *distributed lethality*** – as in the maritime environment, quantity truly does have a quality all of its own, with large numbers of low-cost systems providing significant operational capability that limited 'high-value' systems cannot.[206]

In the undersea domain, quantity truly does have a quality of its own.

The new Concept of Naval Operations will allow for acceptance of greater detection and loss of individual units, as UUSVs and UUSs will be lower cost assets compared to manned platforms like naval ships, aircraft carriers and submarines. Large numbers of such inexpensive systems will create challenges that will cost adversaries more to counter than they cost the State to produce – resulting in cost imposition impact on maritime military strategy. Further, commercial USSVs and UUSs can be exploited for military operations using innovate approaches of *cascaded delivery* and *swarming*.

---

[203] Department of Defense, United States of America. (2013). *Unmanned Systems Integrated Roadmap: FY2013 2038*. https://archive.defense.gov/pubs/dod-usrm-2013.pdf

[204] Ibid.

[205] Defence Science Board. (2016, October). *Task Force Report on Next Generation Unmanned Undersea Systems*. Office of the Under Secretary of Defence for Acquisition, Technology and Logistics, Washington DC. https://dsb.cto.mil/reports/2010s/Next-Generation_Unmanned_Undersea_Systems.pdf

[206] Ibid. Pg. 9.

4.5.1 CASCADED DELIVERY and SWARMING

Cascaded delivery entails carrying smaller UUVs and UUSs into an operational area by another larger system, such as a submarine, a surface ship (manned or unmanned), an airplane, or a larger UUV. This approach enables extremely low-cost and limited endurance unmanned systems to be deployed and used efficiently against the adversary in an operational environment. For example, U.S., China and Russia have each discussed the idea of deploying *submarine launched USSVs,* attached to their mother subs by tethers, providing video communications of the surface without the submarine having to come to periscope depth.[207] Further such USSVs could then launch small Unmanned Aerial Vehicles (UAVs) to enable the submarine to engage in reconnaissance from the air.[208] Raytheon SOTHOC (Submarine over the Horizon Organic Capabilities) is an example of such a system as it launches a one-shot UAV from an unmanned launch platform ejected from the submarine's waste disposal lock.[209]

Swarming essentially involves a group of unmanned vehicles that act autonomously within themselves, but as a whole are remotely operated. They are tailored to execute an overall objective, but each unit has individual autonomy in relation to one another. Recent developments in swarming capabilities open possibilities for *automated ship protection and area denial,* where autonomous surface vessels (ASVs) operate in defensive postures yet could have offensive capabilities.[210] The Chinese PLA Navy puts great emphasis on such swarming technology for asymmetric capabilities against the US Navy especially in the Indo-Pacific.[211] These 'swarmed advances' have the ability to transform naval operations, which have been traditionally centered on strategic assets like aircraft carriers. Swarming will allow navies to disperse their smaller tactical assets and perform the same security missions as a large conventional vessel. These unmanned vessels are constantly learning from their environment and improving their capability to execute missions with increased intelligence.[212]

---

207 Welsh, S. (2015, June 5). *Lethal Autonomy in Autonomous Unmanned Vehicles*, Center for International Maritime Security. Pg 23. http://cimsec.org/lethal-autonomy-autonomous-unmanned-vehicles/16732

208 Lucas, G. Automated Warfare, *Stanford Law & Policy Review*. Vol. 25, no 317, Pg. 286.

209 Page, L. (2008, October 27). *Raytheon demos new submarine-launched UAV*. The Register. https://www.theregister.co.uk/2008/10/27/raytheon_sothoc_sub_uav/

210 United States Navy. (2017, October 17). *Mine Countermeasures Unmanned Surface Vehicle (MCM USV)*. http://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=1400&ct=2

211 Lt Col McCabe, T.R. (2021). *Chinese Intelligence, Surveillance and Reconnaissance Systems*. Journal of Indo Pacific Affairs, *Spring 2021*. Pg. 3. *https://media.defense.gov/2021/Mar/07/2002595026/-1/-1/1/25%20MCCABE.PDF*

212 Sayler, K. M. (2021, December 21). *Defense Primer : Emerging Technologies.* Congressional Research Service (USA). https://crsreports.congress.gov/product/pdf/IF/IF11105

In sum, unmanned military systems like UUVs, ASVs, AUVs, UUSs, UAVs, USVs and others, are critical platforms and bring with them numerous advantages.

4.5.2 ADVANTAGES OF UNMANNED SYSTEMS

(1) *Better Communications*
Relaxing the stealth constraint allows such systems to surface periodically, which expands options for communications beyond acoustic channels to include broadband Radio Frequency and optical channels. This also enable more robust human-to-system collaboration increasing trust and confidence and lowering costs. Stealth is less critical for low-cost unmanned systems as no human life is at stake and with the ability to provide redundancy through numbers, losing an individual platform is not catastrophic.

(2) *Sea Endurance*
These systems can be operationally deployed for months on end, covering a huge geographical area as they are not constrained by limits of human endurance at sea. This will enable detailed mapping of the sea-bed and identification of maritime features in areas of interest – considerably increasing maritime reliability and safety for manned platforms and crews.

(3) *Increased capacity for Sensors and Payloads*
Deployment in large numbers will allow for specialization within groups of system and greatly increase Maritime Domain Awareness (MDA), creating serious disadvantages for the adversary. For example – in contrast to individual manned platforms (ships, aircrafts, submarines), which must all have a high-end navigation suite, unmanned systems can be *specialized,* with a limited subset of vehicles in a large group providing external navigation aids to the rest of the vehicles, eliminating the need for every vehicle to have a high-end navigation suite. Similarly, energy, data processing, payloads and communications services can be concentrated in a few nodes that share the information with the rest of the group in order to greatly reduce the cost of the overall capability.

(4) *Expendable Deployment and Recovery Options*
Small unmanned systems can be deployed, towed, and carried to the theater by other unmanned systems such as large and extra-large UAVs, USVs; that launch and recover the smaller unmanned systems from different platforms; and the smaller systems can also be made expendable, in order to eliminate the recovery problem altogether. For Example – *Loitering Munitions*.

The collective advances in technology allow these systems to execute more complex missions, with increased autonomy and their own support packages. Thus the application of AI in unmanned systems can extend across a wide range – from general navigational support to complete functioning autonomy. Aerospace manufacturer Rolls Royce is already developing completely autonomous ships, free of human crew. The manufacturer has incorporated the latest in navigation

technology, combining an array of sensors with an AI powered computer.[213] The company has teamed up with Google Cloud and will use Google's Cloud Learning Engine to train its AI-based object classification system.[214] This software will primarily be used for detection, tracking and identification. Therefore unmanned autonomous systems, particularly on sea, undersea are primarily being employed as force multipliers in naval military missions.

OFFENSIVE AI and WEAPONISATION of OCEAN GEOGRAPHY

The weaponisation of autonomous technologies at sea is not new. Highly automated weapon systems have been deployed at sea for over three decades, such as the **Aegis anti-aircraft and anti-ballistic missile systems.** These systems are programmed to detect, track and engage targets that match pre-programmed signatures.[215] At the lowest end of the autonomy spectrum, **automatic submarine contact mines** have been deployed—and regulated—since the early 20th century.[216] Once deployed, there is no human control of the mines location, when it detonates and the selection of the specific target (e.g. this vessel rather than that one) that triggers it. To ensure a minimum level of control, the *1907 Convention Relative to the Laying of Automatic Submarine Contact Mines* requires that free floating mines disable themselves within an hour of deployment.[217] There is also the **tethered anti-submarine torpedoes** (E.g. Mark 60 Captor). Tethered torpedoes are pre-programmed with target signatures (these signatures are never updated once deployed), and lie dormant until an object passes with a matching signature, which activates the torpedo. There is no human "in the loop" at the moment of attack, showcasing considerable weapons autonomy.[218]

The deployment of such weapons has surprisingly not raised concerns about human control. But as AI and autonomy advances, new weapon systems are being deployed that hold enormous consequences for strategic stability, deterrence and future of human command and control. Therefore it is prudent to take a look at just 2 such emerging offensive autonomous systems – *The Poseidon (Russia)* and *The Sea Hunter (USA)*.

---

213 Rolls Royce. (2016). *Autonomous Ships: The Next Ship*. Rolls Royce Marine. https://www.rolls-royce.com/~/media/Files/R/Rolls-Royce/documents/%20customers/marine/ship-intel/rr-ship-intel-aawa-8pg.pdf

214 Ghaswalla, A.N. (2017, October 11). *Rolls-Royce to 'man' autonomous ship with Google AI software*, The Hindu Business Line, https://www.thehindubusinessline.com/economy/logistics/rollsroyce- to-man-autonomous-ship-with-google-ai-software/article9901368.ece

215 Lockheed Martin. (2021, July 27). *Aegis Combat System*. https://www.lockheedmartin.com/en-us/products/aegis-combat system.html

216 Greenwood, C. (1992). Mine Warfare at Sea. *The Cambridge Law Journal, 51*(3), 562-562. doi:10.1017/S0008197300085019

217 ICRC. *Convention (VII) relative to the Laying of Automatic Submarine Contact Mines*. The Hague, 18 October 1907.

218 Truver, S. C. (2012). TAKING MINES SERIOUSLY: Mine Warfare in China's Near Seas. *Naval War College Review*, *65*(2), 30–66. http://www.jstor.org/stable/26397286

POSIEDON Intercontinental Nuclear Powered & Nuclear Armed Weapon : ***Example 1***

Artificial intelligence autonomy has enabled offensive weaponisation of the oceans. In the most destructive weaponisation so far, Russia revealed in November 2015, its plans to develop the ultimate **'Killer Robot'** –a nuclear powered undersea drone designed to carry an enormous thermonuclear warhead. Today understood as the *Oceanic Multipurpose System* ***'Poseidon'***, the weapon is shaped like an enormous torpedo and powered by a compact nuclear reactor.[219]

Poseidon once launched from a Russian submarine will autonomously circumvent antisubmarine defenses and deliver its deadly payload to the adversary's coastline. It is estimated it carries a 2 Megaton Nuclear Warhead,[220] and through a combination of speed and range, the weapon system can outrun almost anything in the ocean.

The "Oceanic Multipurpose System Status-6," shaped like an enormous torpedo and powered by a compact nuclear reactor, would overcome enemy defenses through a combination of speed and range that would enable it to outrun almost anything in the ocean.

Figure 25 – **POSEIDON Intercontinental Nuclear Powered Nuclear Armed Autonomous Torpedo**

(Source: RAND Corporation. How might AI affect the risk of Nuclear War? Pg. 3)

Poseidon is not just a concrete application of weaponised AI in the maritime environment; it is a reflection of AI's potential looming impact on nuclear deterrence. The rate and extent of progress in AI is enabling new ways of delivering nuclear weapons and of defending against nuclear attack.

---

219 Geist, E., and Lohn, A. J. (2018). *How might artificial intelligence affect the risk of nuclear war?* RAND Corporation. Pg. 3. https://www.rand.org/content/dam/rand/pubs/perspectives/PE200/PE296/RAND_PE296.pdf

220 Sutton, H. I. (2022, March 3). *Russia's New 'Poseidon' Super-Weapon: What You Need To Know*. Naval News. https://www.navalnews.com/naval-news/2022/03/russias-new-poseidon-super-weapon-what-you-need-to-know/

ASW CONTINUOUS TRAIL UNMANNED VESSEL – ***Example 2***

The Anti Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) is a US Defence Advanced Research Projects Agency (DARPA) programme, known as **Sea Hunter –** which can loiter at sea and is optimized to robustly detect and track quiet diesel electric submarines.[221] The unmanned system, whose development started in 2010, demonstrates several facets of *advanced autonomous operations*, including autonomous compliance with maritime laws and conventions for safe navigation, autonomous system management for operational reliability, & autonomous interactions with an intelligent adversary.[222] The *Sea Hunter* is an example of how autonomous surface vessels (ASVs) can be deployed for large area surveillance operations, spanning thousands of nautical miles of range and months of endurance to track submarines.[223] It can be equipped with a parasailing sensor array, allowing it to increase its sensory capabilities by more than a thousand feet, augmenting its omnidirectional radio connectivity.[224]

ACTUV's primary goal is –

> *To use its unique characteristics to employ non-conventional sensor technologies that achieve robust continuous track of the quietest submarine targets over their entire operating envelope.*

Figure 26 – **ASW Continuous Trail Unmanned Vessel**
(Source: DARPA, ASW ACTUV Project)

221 Walan, Dr. A M G. *Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV).* DARPA. https://www.darpa.mil/program/anti-submarine-warfare-continuous-trail-unmanned-vessel

222 Ibid.

223 Dillow, C. (2016, April 8). *Inside the Navy's New Autonomous Sub-Hunting Warship*. Fortune. http://fortune.com/2016/04/08/navy- autonomous-sub-hunting-warship/

224 Collie, S. (2016, October 25). *Parasailing payload extends sensor range of DARPA's autonomous boat*. New Atlas. https://newatlas.com/darpa-talons- actuv-towing-sensors/46110/

Both these autonomous unmanned systems demonstrate how profoundly the developments of AI-based naval configurations are enhancing maritime capabilities. With the militarization of the Indo-Pacific maritime space, such systems will increasingly become the norm, not the exception. Both U.S. and China are at the forefront of deploying such advanced technologies and have devoted considerable resources to develop action plans for the implementation of artificial intelligence based systems in their navies.[225] Such plans have been accompanied with innovative operational procedures that support the shift to unmanned maneuvers. Increasingly Russia is also a strategic player in this space as evidenced through '*The Poseidon'*.

This new generation of naval warfare involving intelligent systems holds several complications for India and the Indian navy. Being a 'middle power' primarily focused on economic growth to raise the standard of living of its huge population, India does not have the luxury of spending relatively vast amounts of money on such advanced militarized systems or counter-systems. Yet, the Indo-Pacific maritime geography, and particularly the Bay of Bengal are critical for India's strategic security and stability. The idea of such *autonomous military systems* being deployed in the Bay will have and are having profound implications for Indian security. Further, as a 'frontline' state in the New Cold War between the USA and China + Russia, India will be amongst the first countries against whom such systems will be deployed by China. Autonomous naval systems will enable China to monitor activities of interest and conduct potentially hostile actions over areas (Bay of Bengal). And while the U.S.A will be the first to deploy autonomous vessels, China will be the first to popularize them through mass quantity.

The situation is further complicated as the Law of Armed Conflict – in its current form – does not specify or cover *autonomous weapons,* making this space an ungoverned militarized arena, where the deployments of such configurations are increasingly being seen as *fait accompli*.

On the other hand, there is increasing evidence that Indian strategic and military planners are taking the ongoing revolution in military affairs extremely seriously and considering possible options and strategies. The Prime Minister of India, Narendra Modi, hinted to this evolving reality during his address at the 2018 Defence Expo in Chennai, stating –

> New and emerging technologies like AI and Robotics will perhaps be the most important determinants of defensive and offensive capabilities for any defence force in the future. India, with its leadership in information technology domain, will strive to use this technology tilt to its advantage.[226]

---

[225] Kania, E. (2017, February 23). Testimony before the U.S.-China Economic and Security Review Commission: *Chinese Advances in Unmanned Systems and the Military Applications of Artificial Intelligence. The PLA's Trajectory towards Unmanned, Intelligentized Warfare*. U.S.-China Economic and Security Review Commission. https://www.uscc.gov/sites/default/files/Kania_Testimony.pdf

[226] Pandit, R. (2018, May 21). *India now wants artificial intelligence-based weapon systems*. The Times of India. https://timesofindia.indiatimes.com/india/india-moves-to-develop-ai-based-military-systems/articleshow/64250232.cms

4.5.3 LAW OF ARMED CONFLICT and WEAPONISATION OF AI

The International Committee of the Red Cross (ICRC) describes 'autonomous weapons' as an umbrella term encompassing any type of weapon with *autonomy* in its critical functions, meaning a weapon that can select (i.e. search for or detect, identify, track) and attack (i.e. intercept, use force against, neutralize, damage or destroy) targets without human intervention.[227]

Currently there is no ban on what is broadly termed as **'Lethal Autonomous Weapon Systems'** (LAWS) – and the closest international consensus on the use of *autonomous weapon systems* are 11 'guidelines' issued by the 125 Parties to the Convention on Certain Conventional Weapons (CCW) in 2019.[228] This means that States particularly U.S.A, China, Russia are presently free to pursue research and development, deployment and use of LAWS. The fact that *treaty negotiations* on LAWS have not even started is indicative of how the fast paced development of AI technologies has outpaced international diplomacy.

The United States Department of Defence, *Law of War Manual* clearly reflects this reality and in fact emphasizes the benefits of *autonomy* for Laws of War.[229]

> *The law of war does not specifically prohibit or restrict the use of autonomy to aid in the operation of weapons. In fact, in many cases, the use of autonomy could enhance the way law of war principles are implemented in military operations. For example, some munitions have homing functions that enable the user to strike military objectives with greater discrimination and less risk of incidental harm. As another example, some munitions have mechanisms to self-deactivate or to self-destruct, which helps reduce the risk they may pose generally to the civilian population or after the munitions have served their military purpose.*
>
> *DoD Law of War Manual*
> *Section 6.5.9.2. No Law of War Prohibition on the Use of Autonomy in Weapon Systems.*

Therefore the use of autonomous systems such as AUVs, ASVs, AAVs is here to stay for the foreseeable future, presenting new challenges and limitations for Indian military planners as it is the ocean environments, that are considered the most suitable area for the initial deployment of LAWS, due to easier identification of assets and relatively smaller presence of civilians.[230]

How this will strategically impact Indian SSBNs operations is detailed in the next section.

---

[227] ICRC. (2015, April 13). *International Committee of the Red Cross*. International Committee of the Red Cross. https://www.icrc.org/en/document/lethal-autonomous-weapons-systems-laws

[228] The Convention on Certain Conventional Weapons. CCW/MSP/2019/9. Annexure III. 13 December 2019. https://documents-dds-ny.un.org/doc/UNDOC/GEN/G19/343/64/PDF/G1934364.pdf?OpenElement

[229] Department of Defense. (2016). *Law of War Manual.* United States Government. https://dod.defense.gov/Portals/1/Documents/pubs/DoD%20Law%20of%20War%20Manual%20-%20June%202015%20Updated%20Dec%202016.pdf?ver=2016-12-13-172036-190

[230] UNIDIR. (2015). *The Weaponization of Increasingly Autonomous Technologies in the Maritime Environment: Testing the Waters*, http://www.unidir.ch/files/publications/pdfs/testing-the-waters-en-634.pdf

4. 6 Detection, Tracking and Engagement

" By failing to plan, you are planning to fail.
Every effective performance is based on thorough preparation. "

- **Chanakya** in 'Arthashastra'[231]

The principal function of intelligence, surveillance and reconnaissance (ISR) in modern military affairs is to find, fix and track both friendly and hostile forces in an operational theatre. ISR collects, tasks, integrates, interprets and exploits *sensed information* – to present a comprehensive operational picture.

Thus ISR is an integrated intelligence and operations function, used to **detect** an event,[232] in this context a submarine or a ship or a UAV/ aircraft. This is followed by **tracking,** which is the precise and continuous position finding of the target vessel,[233] resulting in *target acquisition* – the detection, identification and location of a target in sufficient detail to permit the effective employment of weapons against it.[234] Once the target is acquired, it can be **engaged** (fired upon) by the platform/weapon of choice from the military arsenal with the objective of *suppression* or *destruction*.[235] Together, *detection, tracking* and *engagement* is a lethal trifecta that can be employed against a vessel (in this case Indian SSBNs) to neutralize it.

In the Bay of Bengal, which is shaping to be the *Bastion* for Indian SSBN operations, the weaponisation of emerging technologies, as detailed in the previous section, can upset the Indian nuclear strategic deterrence against China by *altering* the playing field for naval operations between India and China. Simply put, **AI enabled ISR,** which entails the use of both *autonomous* and *unmanned* systems by China (an AI Superpower) holds the potential to present an existential threat to Indian SSBNs and their survivability.

Unmanned systems could provoke an unforeseen radical change to the future survivability of India's sea-based nuclear deterrent.

---

231 Shamasastry, R. (1909). Arthashastra.

232 Department of Defense. (2016) *Dictionary of Military and Associated Terms*. Joint Publication 1-02. Pg. 67 https://irp.fas.org/doddir/dod/jp1_02.pdf

233 Ibid. Pg. 245

234 Ibid. Pg. 235

235 Ibid. Pg. 79

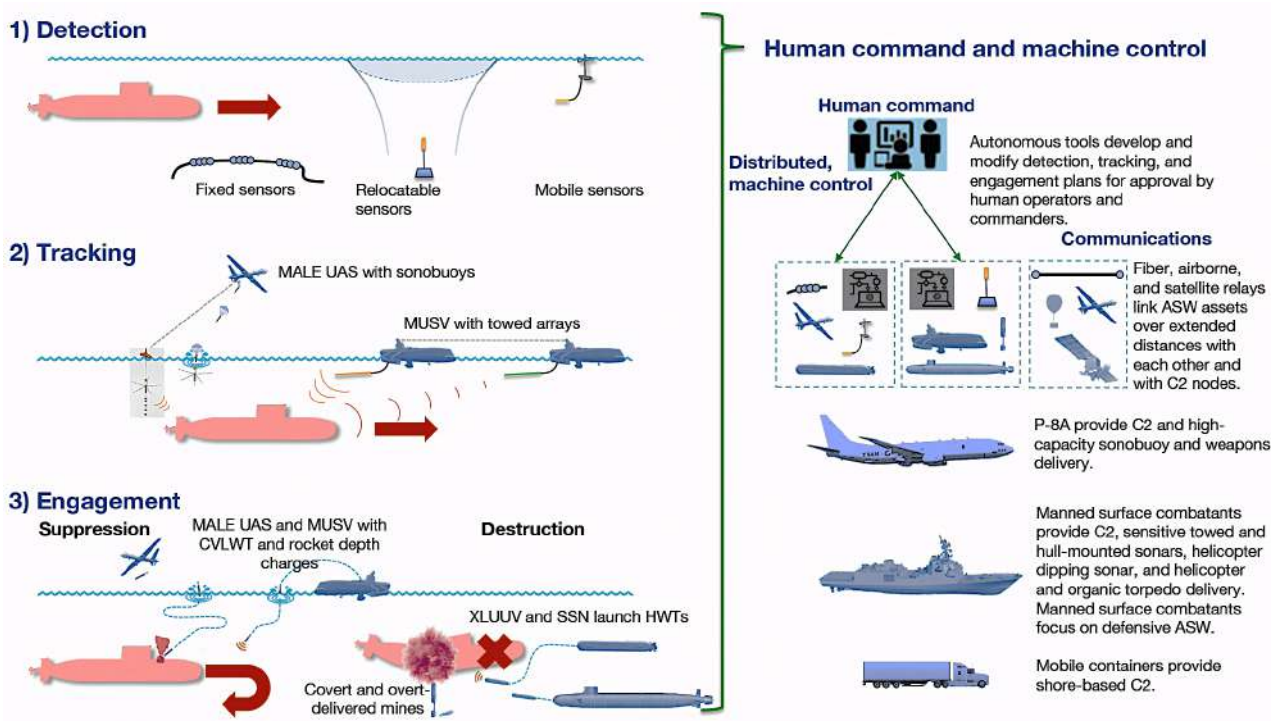


Figure 27 – **Unmanned Anti-Submarine Warfare Concept**

(Source: Hudson Institute. Sustaining the Undersea Advantage, Pg. 7)

MALE UAS : Medium Altitude Long Endurance Unmanned Aerial Vehicle. Sonobuoys : Device used to detect and identify objects moving in the water. MUSV : Medium Unmanned Surface Vehicle. CVLWT : Common Very Light Weight Torpedo. HWTs : Heavy Weight Torpedos Towed Arrays : A system of hydrophones towed behind a vessel on a cable to detect and track faint sounds such as low noise-emitting submarines XLUUV : Extra Large Unmanned Undersea Vehicle. SSN : Submersible Ship Nuclear (Fast Attack Nuclear Submarines)

The extent to which the deployment of unmanned and autonomous systems will change submarine warfare is under intense debate and research. Few parameters though can be positively mapped to analyse this revolutionary change in undersea/sea warfare.

4.6.1 NEW ASW CAPABILITIES of UNMANNED SYSTEMS

Quantity. Once deployed in large numbers, these platforms can make at-sea deterrence obsolete in a defined and restricted maritime geographic area. Think of the case of ICBMs – land-based missiles are understood to be vulnerable to targeting as they can be '*seen*' by aerial ISR systems and their '*mobility*' is restricted by the landmass. Similarly if dozens of relatively cheap autonomous/unmanned ISR systems (UUVs, UAVs, USVs) were to be deployed in a *restricted geography* – like the Bay of Bengal, or the East China Sea, or the South China Sea or the Sea of Japan etc – the SSBNs whose mission is to traverse these waters on *deterrence patrol* – can eventually be detected and tracked – over a period of time. The submarine crew is limited by factors of human endurance, command and control protocols and economic costs, considerations that are not applicable to unmanned configurations with no such limits. Therefore increasing

quantity of such systems will jeopardise the SSBNs *raison d'etre* – **survivability and surprise.**

Sensors. Rapid advancements in sensor technologies will make the oceans more transparent. Be it wave form pattern recognition, automated acoustic processing, deployable sonars, transformational reliable acoustic path sensors (TRAPS) and autonomous target recognition algorithms – augmented with machine learning to identify specific submarine or surface contact frequency tonals from the overall ocean noise. These technologies could exploit the inherent vulnerabilities of submarines – *small numbers, at port AI-ISR mapping, submarine acoustic recognition and identification etc* – especially when the SSBN is deployed in a restricted geography and allow Anti-Submarine Warfare forces to **suppress and marginalize** the submarines with greater effectiveness.

> *" Restricted Maritime Geography refers to a defined maritime geographical area which can be accessed only through certain chokepoints or sea routes. "*
>
> *E.g. –* ***The Northern Indian Ocean***

Range. An SSBNs distinct advantage of solitary extended deterrent patrols will be *denied* under a Bastian Strategy or due to limited range of the Missiles it carries. Nuclear ballistic missile submarines are meant to operate over vast oceanic areas, powered by their nuclear reactors ensuring unlimited range and operationally without the need to re-surface. When on *deterrence patrols* – the SSBNs sail in the area of deployment 'within range of an adversary's targets.' Therefore, if the nuclear tipped missiles carried by the SSBN are of limited range (a few thousand kilometers), the SSBN itself becomes restricted in its area of operations. Further, if a State's Nuclear Forces have adopted a *Bastion Strategy* – operating the submarine close to coastal waters of the State under a protective envelope – then the restrictions on range similarly apply. This means that the submarine cannot *truly disappear in the ocean,* for it cannot use the vast open expanse of waters to hide. By operating in a 'pool' near the landmass, the whereabouts (extent of range) of the submarine can easily be identified by the adversary and a concentrated deployment of AI-ISR systems like autonomous reconnaissance configurations (UUVs), can be used within the specific geography to **detect and track** the submarine.

Therefore **AI enabled ISR** will increasingly play a crucial support role in anti-submarine warfare. If such systems are deployed at choke points or the submarine's exit routes, particularly in the Indian Ocean, Bay of Bengal region, these systems will serve as a virtual barrier that would deter or deny submarines their ability to operate in specific areas, even bringing offensive ASW Operations to Indian home waters.

4.6.2 OFFENSIVE ASW WARFARE in HOME WATERS

Indian SSBN strategy envisions the operation of INS SSBNs in the Bay of Bengal under the protective envelope of the Indian Navy. This *Bastion Strategy* is seen as the most fruitful given India's relatively small SSBN fleet as well as the composition of its enemies (China and Pakistan). The inherent logic to adopting this strategy is –

(1) The Indian Naval dominance of Bay of Bengal will provide a protective envelope for SSBNs

(2) These are familiar and comfortable waters

(3) Guaranteed Command, Control and Communications (C3) Access with the nearby mainland, given India's highly assertive civil-military relations

Similar Bastion Strategies have been adopted by both China and Russia viz the United States.[236]

> *" Home Waters are waters between submarine home ports and sea choke points "*

While the strategic concept of placing SSBNs in heavily defended waters is immensely appealing and feasible, it is coming under increasing pressure due to ongoing global shift from defensive ASW Operations to *full-spectrum offensive ASW Operations,* made possible by AI enabled ISR that combines unmanned systems, vessels, sensors & control mechanisms with human command.

Anti-Submarine Warfare is generally considered a defensive activity because submarines are fundamentally offensive weapon platforms. A submarine is designed *for attack* and for *forward area missions.* They are not defensive platforms; hence they focus on **stealth** and lack self-defensive systems other than acoustic countermeasures.

Offensive ASW operations are designed to force a role reversal, compelling the adversary to keep their submarines at home for defensive purposes, not allowing them to use the offensive capabilities and strengths of these immensely powerful weapons platforms. This strategy relies primarily on unmanned systems for *finding, tracking and suppressing enemy submarines.* Forward offensive ASW can slow or stop the deployment of enemy submarines while reducing the number of large naval forces needed to counter the adversary. Further offensive ASW operations can yield

---

Offensive ASW strategy wants to keep the adversary submarines *bottled up* in their local waters or *busy evading* tracking and attack.

---

[236] Zhao, T. (2018). *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability.* Carnegie Endowment for International Peace. Pg. 93. https://carnegieendowment.org/files/Zhao_SSBN_final.pdf

valuable intelligence on the adversary's training and exercises, mapping their operational concepts and deployment patterns. Such operations will employ a **C2 approach – combining human command with machine control.** Unmanned search and track operations in the adversary's home waters will be highly automated, with sensors following search plans developed and modified in real time by autonomous configurations. Human operators deployed to the region will manage these operations by reviewing search plans before and during an operation and provide direction and guidance to the autonomous systems, including overriding them when necessary. Human Commanders will also direct engagements when necessary. Such C2 mechanisms will drastically cut costs for ASW operations as well as sustain operations in areas of interest for long durations.

This approach will result in an extremely limiting situation for SSNs (attack submarines) and deeply dangerous prospect for SSBN operations, particularly in the Indian naval context. If China with its increasing AI prowess and militarization of AI maritime systems adopts an Offensive ASW operational strategy, roping in the Pakistan Navy too, the consequences for India– particularly in her overarching reliance on the Bay of Bengal as *'secure waters'* can be huge. Once offensive ASW unmanned systems, likely under the command of Chinese Battle Carrier Groups are deployed in the Indian Ocean, Indian SSBNs will become *restricted* in their ability to undertake long deterrence patrols, due to a proliferation of the unmanned ASW systems in the waters. The Indian Navy, even if it engages or captures such systems will only have to return them back to China as the 2016 incident of the U.S. underwater drone, seized by the PLA Navy has demonstrated. But the amount and scope of *sensed information, doctrinal data and INS SSBN specific intelligence* these unmanned ASW systems will transmit to China and Pakistan over months if not years, will result in a depletion of the sea-based strategic deterrence and eventually its obsolescence.

An ASW approach that relies on unmanned systems for sensing and suppression and on manned platforms for command and submarine destruction will achieve this objective.

This approach is already in the making in the South and East China Seas, where the U.S. is increasingly resorting to offensive tactical ASW operations against the PLA Navy in an effort to *limit* Chinese submarines from accessing open waters of the Pacific Ocean.[237]

---

237 Subramanian, A. (2014). *The Emerging Sea-Based Nuclear Deterrence Capabilities of China and India*. Asian Defense Review, Center for Air Power Studies. Pg. 218.

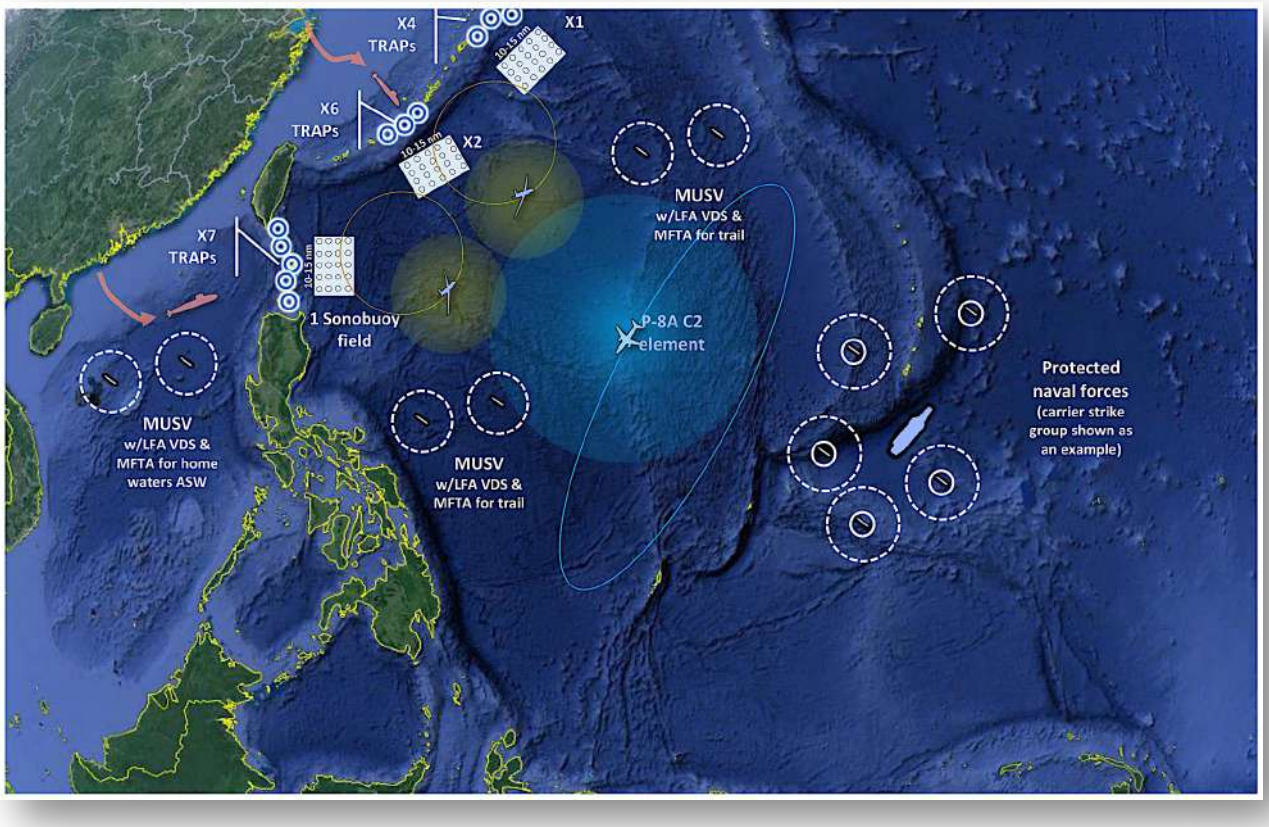


Figure 28 – **Unmanned ASW Approach to China's Home Waters, Choke Point Suppression and Trailing of Submarines in Open Ocean**

(Source: Hudson Institute. Sustaining the Undersea Advantage, Pg. 59)

Sonobuoy Fields : X1, X2, X3. TRAPS (Transformational Reliable Acoustic Path Sensors : X4, X6, X7

MUSV : Medium Unmanned Surface Vehicle. LFA VDS : Low Frequency Active Variable Depth Sonar

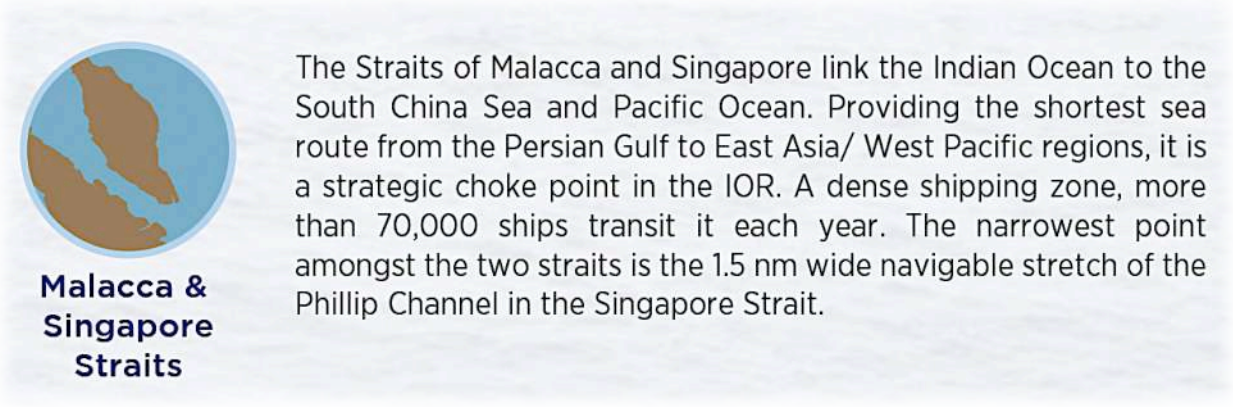
MFTA : Multi Function Towed Array. P8A : Maritime Patrol Aircraft

This offensive ASW approach, was effectively employed by the US and the Allies in both World Wars and during the Cold War. It focuses on suppressing submarine operations rather than destroying submarines, keeping tensions from escalating out of control while strategically disrupting submarine operations. As the new Cold War heats up, there is much chance that China with the support of Pakistan will employ the same strategy against India in the Indian Ocean.

The use of unmanned systems specially, will be extremely useful in these kinds of dull, dirty and dangerous (3D) missions as they remove limitations and give greater reach. Operating in home waters, they will grant adversary access to an operational theatre that was previously inaccessible or too risky for manned operations. This will include the A2/AD areas of the Bay of Bengal, controlled by the Indian Navy.

4.6.3 SEA CHOKE POINT CONTROL

Indian Maritime strategy is focused on *sea control* in the Indian Ocean as highlighted in earlier sections. Therefore in case a major armed conflict between India and China breaks out, a powerful Indian Blue Water Navy, supported by immediate logistics and supply lines – will be in a position to block the *Strategic Choke Point of Malacca and Singapore Straits* through which 60% of world maritime trade transits.



This strategic narrow passage is where the Indian Navy can efficiently conduct detection and tracking and continuously monitor likely PLA Navy submarine *transit lanes*.

But the straits of Malacca and Singapore also provide the optimal maritime geography for the adversary to focus his offensive ASW operations. The narrow straits limit the search geography for unmanned AI-ISR systems, reducing the number of multi-purpose ASW systems needed to detect, track and engage Indian vessels and submarines. And even if Chinese offensive operations are unsuccessful, autonomous ASW systems of systems will enable maritime formations (swarming) to disrupt Indian submarine and ship attacks, creating new vulnerabilities for the Indian navy and Indian nuclear thought.

Further as offensive ASW strategies and concepts greatly emphasize on detecting submarines and engaging them, suppression by such systems will deter Indian diesel submarines/ SSNs from completing their missions by compelling the crews to *promptly evade* and return to home waters. This is because submarines by design have several limitations such as slow speed, lack of self-defense and sensor restrictions that force submarine crews globally, to promptly evade when attacked rather than stay on mission and attempt to fight off or elude attacks.

One has to also consider the fact that when engaged under an offensive ASW strategy, Indian submarines and vessels at choke points will have to contend with extremely low-cost unmanned/autonomous systems which will certainly lead Indian crews to make cost-benefit calculations as well as generate psychological stress amongst them of a yet unknown nature.
(E.g.– Indian submariners will have to judge whether engaging a small unmanned/autonomous platform is worth giving away the submarines location.)

These new ASW concepts (combing Human command with Machine control) will be affordable and provide better result than today's existing concept of *manned operations*. Their significance can also be understood through the effect chain of *detection, tracking & engagement*.

4.6.4 DETECTION

Indian Navy's and submarines sea control strategy requires that it promptly identify detect and deploy its forces to locate, track and potentially attack any adversary. This dependence on identification/detection/cueing creates an opportunity for the adversary operating under an offensive ASW strategy. *If they can degrade or defeat Indian surveillance sensors, their offensive ASW systems can reach Indian SSBNs before substantial Indian defensive ASW forces are in a position to respond*. Similarly, if the PLA Navy can 'flood the Bay of Bengal' with a large number of autonomous/unmanned offensive ASW systems, possibly carried by a Chinese cargo or commercial ship or by a PLA Navy surface vessel crossing the vicinity, Indian defensive ASW forces will likely be **unable** to track them all before at least one of them engages the Indian SSBN patrolling in the Bay. Additionally, these systems could continuously monitor likely Indian submarine transit lanes off Andaman and Nicobar Islands, and when faced with Indian counter-ISR actions like sensor jamming, dazzling, or decoy deployments, enable more rapid and scalable ASW operations like *swarming* to defeat the counter-measures and detect Indian targets.

There have already been detailed Chinese naval surveys of the Eastern Indian Ocean, gathering huge amounts of for possible offensive ASW systems deployments in the region.

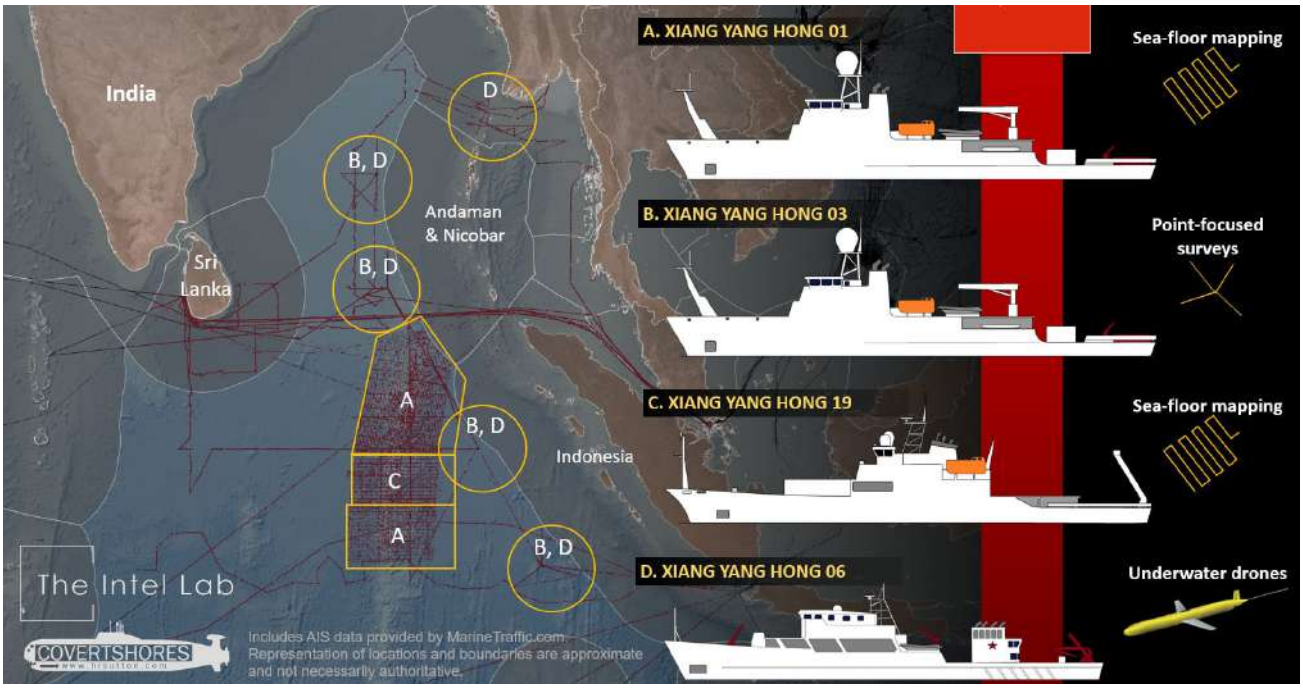


Figure 29 – **Chinese Surveys of Eastern Indian Ocean, 2019-2021**

(Source: The Intel Lab, Covert Shores)

4.6.5 TRACKING

India has reportedly joined the US-Japan '*Fish Hook'* SOSUS Network, with the Andaman & Nicobar Islands linking the Indian Ocean to the Pacific sensor network.[238] SOSUS stands for Sound Surveillance System and is a network of seabed sensors used to monitor straits and channels for submarine movements as part of ASW operations. The *Fish Hook* SOSUS chain is the military bulwark of U.S., Japan, South Korea, Taiwan, Southeast Asian nations and now India; for monitoring and tracking Chinese PLA Navy undersea activity.[239]

In response, China has developed its own underwater surveillance networks in the form of a 'Undersea Great Wall' in the South China Sea, Pacific and Indian Oceans for real-time monitoring of maritime targets.[240] Both the U.S.-Japan and Chinese sensor networks **core aim is to track submarines in the Indo-Pacific.** For India, this is particularly important given its defensive ASW operational concept (stopping Chinese submarines in the Indian Ocean Region), while for China it is crucial in an *offensive* ASW maritime strategy – *breaking out into the large Pacific and Indian Oceans, beyond the island chains*.

Thus as part of its offensive ASW strategy, China could increasingly deploy medium unmanned surface vessels (MUSVs) that will tow low frequency active (LFA) variable depth sonars (VDS) in the Indian and Pacific oceans, with LFA VDS enabling detection and tracking of submarines in the range of more than a 100 nautical miles (185 kilometers) in deep water and dozens of miles in shallow water.[241] Further Chinese unmanned systems could employ non-acoustic sensors such as Magnetic Anomaly Detection or Wake Detectors as part of tracking operations for 'quiet submarines' and UUVs and UAVs could be used to closely approach the tracked submarine for target acquisition, with low/ acceptable risk as no manned vessel will be in the cross-hairs of the targeted submarine.

---

238 Ball, D., & Tanter, R. (2015). *The Tools of Owatatsumi: Japan's ocean surveillance and coastal defence capabilities*. Australian National University Press. Pg. 54.

239 Medcalf, R., Mansted, K., Frühling, S., & Goldrick, J. (2020). *The Future of the Undersea Deterrant: A Global Survey*. National Security College, The Australian National University. Pg. 80.

240 Das, Dr. (Cdr) A. (2019, April 15). *China's 'Undersea Great Wall' Project: Implications Dissecting the Threat and the Possibilities*. Bharat Shakti. Retrieved April 10, 2022, from https://bharatshakti.in/chinas-undersea-great-wall-project-implications-dissecting-the-threat-and-the-possibilities/

Press Trust of India. (2018, January 2). *China develops underwater surveillance networks in Indian Ocean, South China Sea*. Hindustan Times. https://www.hindustantimes.com/world-news/china-develops-underwater-surveillance-networks-in-indian-ocean-south-china-sea/story-HTCvOcnUNLs5fzvKogylbK.html

241 Clark, B., Cropsey, S., & Walton, T. A. (2020). *Sustaining the Undersea Advantage: Disrupting Anti-Submarine Warfare Using Autonomous Systems*. Hudson Institute. Pg. 50. https://s3.amazonaws.com/media.hudson.org/Clark%20Cropsey%20Walton_Sustaining%20the%20Undersea%20Advantage.pdf

If such unmanned systems are deployed in the eastern Indian Ocean/ Bay of Bengal geography, they will have immense implications for the operations of Indian SSBNs and the larger Indian Navy as these systems will be able to monitor and track Indian naval forces on a 24x7x365 basis in peacetime conditions – demanding considerable resources and attention of the Indian Navy, if they are to be expelled from the Bay of Bengal. In the long term, the costs of countering such systems will be prohibitive for a developing country like India, resulting in the shrinking of India's maritime areas of *sea control*.

There have already been multiple incidents of Chinese UUVs being discovered/captured deep inside the maritime territory of Indian Ocean littoral states such as Indonesia. Thus an unmanned ASW offensive system of systems, using human command and machine control will offer *distinct* advantages in tracking submarines.

Figure 30 – **The US 'Fish Hook' SOSUS Undersea Defense Line**
(Source: Australian National University, CAP CartoGIS)

4.6.6 ENGAGEMENT

During peacetime, the Indian Navy will likely detect and track Chinese and Pakistan Naval activities in the IOR. But during periods of heightened tension, as the one currently ongoing since the 2020 Galwan (Kashmir) Clashes, India may wish to deter Chinese submarines from approaching the Indian Ocean altogether. In order to do this, there will be a more overt display of sea control by the Indian Navy, particularly near the choke point of Malacca Straits.

However given the nature of offensive ASW operations, the PLA Navy with its forward deployed unmanned ASW systems could suppress Indian submarine operations and drive the submarines back towards the home port, with air-launched ASW weapons providing an efficient suppression solution, rather than attempting to destroy Indian submarines. In such a scenario, the Indian Navy will certainly maneuver to protect the strategic deterrent – the SSBN – which itself will expose to some degree the location and coordinates of the SSBN, given the persistent focus of adversary's AI-ISR systems in the *restricted geography* of the Bay of Bengal.

Submarine suppression as explained earlier works better than submarine destruction, as the fact that the submarine has been detected and is being actively engaged is enough to disrupt the operations of that submarine for it is compelled to take evasive measures. Even more important is Indian nuclear thought, which views its SSBN capability not as a tactical military asset but as a strategic capability that is increasingly important for maintaining a credible second-strike capability. Thus, the PLA Navy by simply engaging SSNs or diesel submarines, can impose big psychological considerations and doubts on the deployment and operations of Indian SSBNs in the Bay of Bengal.

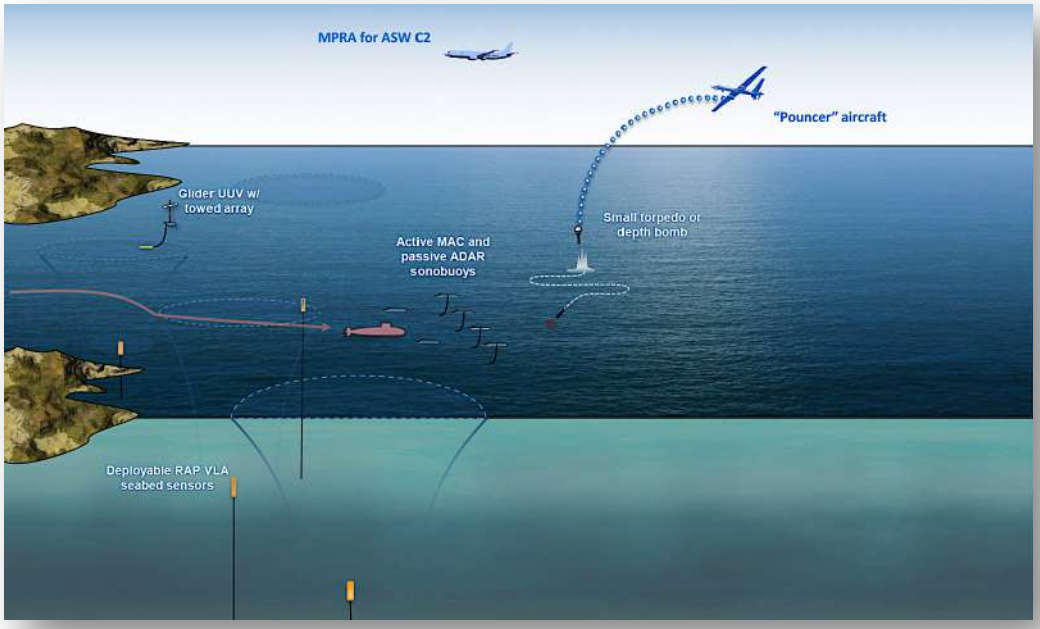


Figure 31 – **Choke Point Submarine Suppression**

(Source: Hudson Institute. Sustaining the Undersea Advantage, Pg. 52)

Therefore in sum, a paradigm shift is underway in ASW concepts – from defensive ASW to offensive ASW and a dual C2 system of **Human Command and Machine Control.**

In the coming time tracking, identification, and engagement of submarines will be automated, while human operators will oversee the actions of unmanned ASW sensors and weapons systems. Such an arrangement is already at play in the maritime domain with the **Phalanx CIWS** (close-in weapon system) and the advanced **Aegis Combat System**.

For India this will hold strategic ramifications as its submarines and it's SSBN nuclear deterrence will face a growing risk of being identified, tracked and engaged by AI AWS systems. The rapid advancement of these new technologies, especially autonomous and unmanned systems, will be driven by the emerging nuclear naval competition between China and the United States and will consequently cause severe instability in the India-China nuclear strategic calculus.

The detection, tracking and engagement of Indian SSBNs in the Bay of Bengal will be an increased likelihood, requiring India to come up with policy and operational changes to meet this new threat challenge. Submarines are an increasingly important element of China and Pakistan weapons systems, delivering key capabilities needed for their 'India Strategy'. Today, submarines – not aircraft carriers – provide the high-end capability in most navies. This is why only a dozen States deploy aircraft carriers, but more than forty countries field submarines.

India must ensure it does not loose its relative advantages in the Indian Ocean Region in the face of these new threats, whose strategic implications are highlighted in the next section.

The deployment of unmanned systems will enable states to engage in more aggressive behavior in a crisis, leading to *crisis instability*.

Chapter 5

Strategic Implications

" In Greek mythology, the gods sometimes punished man by fulfilling his wishes too completely. It has remained for the nuclear age to experience the full irony of this penalty. Throughout history, humanity has suffered from a shortage of power and has concentrated immense effort on developing new sources and special applications of it. It would have seemed unbelievable even 50 years ago that there could ever be an excess of power, that everything would depend on the ability to use it subtly and with discrimination. "

\- Henry Kissinger [242]
Soon after the advent of nuclear weapons

The quintessential quality of nuclear weapons is their 'excess of power.' Their capacity to annihilate life is what makes them special and truly formidable weapons. This is why in the realm of nuclear strategy and deterrence, the *perception* of an adversary's capability matters as much as their actual capability. This inherent characteristic of nuclear deterrence combined with the rapid technological progress of artificial intelligence in warfare, has many potential intersections with strategic stability – one of which, the strategic impact of AI-ISR activities on Indian SSBN operations has been the focus of this book.

Having analyzed focused and outlined the salient aspects, advancements and militarization of AI technologies and their inherent asymmetric strategic nature in relation to nuclear strategy; specific strategic implications for nuclear thought and Indian SSBN operations can be sufficiently mapped in the new epoch of the 4th Industrial Revolution.

---

[242] Topychkanov, P., Kulshrestha, S., Kumaraguru, Y., Meegoda, M., Roy, K., Sial, S. A., Steganovich, D. & Verbruggen, M. (2020 April). *The Impact of Artificial Intelligence on Strategic Stability and Nuclear Risk.* Stockholm International Peace Research Institute. Vol III, South Asia Perspectives. Pg. 46 https://www.sipri.org/publications/2020/other-publications/impact-artificial-intelligence-strategic-stability-and-nuclear-risk-volume-iii-south-asian

STRATEGIC IMPLICATION 1

Artificial Intelligence is an asymmetric strategic technology, which holds increasing potential to change the international balance of power, particularly in the Indian Ocean. As the post Cold War order strategic stability breaks down with the rise of China and the remilitarization of the European Geography; the increasing infusion of AI technologies in the nuclear architectures of the major powers demands new understanding, particularly between U.S.A, Russia and China, if an uneasy peace is to be maintained.

A new nuclear arms race weaponised by artificial intelligence, autonomous systems, and hypersonic missiles; is already in the making. Given the asymmetric nature of these technologies and their extremely fast paced developments, new arms control and treaty agreements are urgently required.

To avoid crisis instability, agreement on **Asymmetric Strategic Stability** is the need of the hour among nuclear powers

For India in particular, the fusion of AI with nuclear deterrence is an extremely destabilizing prospect, for the nuclear-technological path China adopts – Pakistan will also eventually take. This over time will result in a situation of extreme crisis instability, particularly between the 2 strategic nuclear triangles of the 21st century – *China, India and Pakistan* and *U.S.A, Russia and China.*

Therefore it is important that all nuclear-armed states, talk to each other and ensure that they understand the role of AI and automation in the nuclear deterrence architecture of the other state, as well as the constraints of their own systems.

Consensus on evolving paradigms of strategic stability will go a long way in putting much-needed breaks on this spiraling nuclear arms race, which has now come to the waters of the Indo-Pacific. The book, by providing a working definition for a new foundational understanding on *asymmetric strategic stability* contributes original thought in modern deterrence discourse.

STRATEGIC IMPLICATION 2

India is the only State in the world having large contiguous borders with two nuclear powers (Pakistan & China) both of whom are openly adversarial towards India and who amongst themselves enjoy a remarkably enduring relationship with a strong military component.

China with its mammoth size, views nuclear weapons as political weapons, meant for deterrence while Pakistan employs nuclear weapons as war fighting weapons against a conventionally stronger India. Thus –

> Indian nuclear thought must address the China-Pakistan nuclear axis as a **Dyad** of unprecedented strategic scale combined with asymmetric tactical weaponisation of nuclear assets

This **Dyadic** approach will become increasingly important as China strengthens its strategic hold on Pakistan through the China Pakistan Economic Corridor (CPEC) and a client-state relationship between the two countries develops.

Indian nuclear strategy will also have to account for China's critical technology transfers in to Pakistan – such as submarines, missile technology and AI. The deep military-technological relationship between the two countries has given Pakistan the ability to adequately *deter* India all these years, while Indian nuclear thought has been found lacking in dealing with Pakistan.

Therefore a silo approach to China and Pakistan in the nuclear domain may no longer be feasible for India. The country must aim to establish credible nuclear deterrence against China while *suppressing* nuclear threat and blackmail from Pakistan. This can be possible with the tweaking of Indian nuclear posture at the *tactical level* in response to Pakistan's asymmetric behavior, while maintaining the credible minimum deterrence posture on the strategic plane against China.

As asymmetric AI technologies penetrate nuclear processes, a 'one size fits all' approach viz China and Pakistan may no longer be sufficient in providing necessary deterrence against the two immediate and formidable adversaries.

STRATEGIC IMPLICATION 3

Militarized artificial intelligence is redefining the use, function, scope, operability and precision of Intelligence, Surveillance and Reconnaissance activities in warfare – which will have profound implications for the balance of power in the 21st century.

Much like the 20th century, which saw the dramatic alteration in international balance of power *three times* – World War I, World War II and the Cold War – this century too is under strategic flux. Just as military spending financed a technology revolution in WWII – *at the start of the war there were propeller aircrafts and by the end of the war, Jet Engines and Nuclear Bombs ruled the world* – the new strategic competition between China and the United States will also result in unprecedented technological achievements.

Military power is fundamentally a coercive power, and the militarization of AI is bound to change the rules of the game, particularly since such advanced capacities embolden countries to solve geo-political issues militarily.

> 21st century 'Great Power Competition' between China and USA has **financed a technological revolution** in artificial intelligence that will significantly change the instruments and doctrines of war.

The old instruments and dogmas of war fighting will give way to new ones, changing the very nature of war itself once again. The idea of '*contact-less warfare'* and beyond the horizon targeting has already proliferated amongst major powers with a major push in ISR technologies underway.

This combined with the increased range, precision and maneuverability of standoff weaponry, will create new threat challenges that will require new technological counter-measures. Even defensive use of AI will be *perceived* as offensive by other nations given the 'newness' and asymmetric nature of the technology, which will create a new paradigm for warfare.

STRATEGIC IMPLICATION 4

In strategic terms, India's domination of the Indian Ocean Region is not tomorrow's vision but yesterday's reality. The waters of the Indo-Pacific have become the new theatre of contestation for Great Power Competition and the Bay of Bengal its beating heart.

As the Great Game for the Indian Ocean forges ahead, the inherent Indian understanding of the Bay of Bengal being "secure havens" for Indian SSBN operations is increasingly called into doubt. All indicators are of militarized AI systems being deployed to the Indian Ocean in the near future, which will fundamentally put into question, INS SSBNs capability to traverse these waters *undetected, for large intervals.*

The growing salience of anti-submarine warfare in the Eastern Indian Ocean will make this maritime geography a crowded military space where the sea, undersea and air domains will be hotly contested.

> The Bay of Bengal is emerging as a strategic **underwater battlespace**.

This emergence of a new underwater battlespace in the Bay will have profound ramifications for Indian sea-based nuclear deterrent as the Indian Naval force and structure of *sea control* is based around a manned (human) systems environment. The advent of unmanned and autonomous systems in the underwater realm will upset this sea control strategy and constrain the operations of the Indian Navy.

Further, there is now a proliferation of submarines in the Bay by navies of littoral states (Pakistan, Bangladesh, Myanmar) and foreign state actors (U.S.A, France, UK, possibly Russia and increasingly China). This will result in detailed sea-bed mapping, automated systems deployment, and ASW in the Indian Ocean, which can over a certain period *expose* and *reveal* the "safe havens" envisioned for the operations of Indian SSBNs.

STRATEGIC IMPLICATION 5

The success of India's strategic strike nuclear submarine programme is adding to the establishment of a credible Indian Nuclear Triad, which assures the nation of a 'second strike capability' in accordance with the country's declared nuclear doctrine.

The sea-based leg of the Triad is seen as the most survivable component by the Indian policy and strategic community. Thus they will want to secure it with the force of the Indian Navy in familiar waters. The added requirement of maintaining dominant civilian control over the country's nuclear arsenal will give weight to command, control and communication (C3) considerations of keeping the SSBNs near the Indian coastline to facilitate smooth, unambiguous and uninterrupted communication flows. These combined with the fact that Indian SSBNs are still in their 'boomer phase' with years of advancement lying ahead, will ensure that –

> Indian SSBNs will adopt a **Bastion Strategy** as its sea-based deterrence matures and gains credibility

The Bastion Strategy for Indian SSBNs meets the doctrinal requirements of 'relative security' and 'C3 mechanisms' but it will also *restrict* the nuclear submarines from utilizing their foremost capabilities of range and unpredictability.

A ballistic missile submarine capable of deploying SLBMs with nuclear warheads, is by its very character built to traverse vast open ocean geography, using its *stealth* features to 'hide' deep in the high seas, which in return lends it the unpredictability it needs to play the role of an efficient deterrent. By restricting the SSBN in a 'Bastion' both the range and unpredictability of the submarine are compromised as the adversary gets a very good idea on which maritime geography, they must focus their ASW capabilities. Once the Bastion territory is defined, existing sea-bed mapping and the assessed capabilities of the SLBMs the submarines carry, can further narrow down the possible locations of the SSBN deterrent which can then be detected using increasingly unmanned systems. Thus the Bastion strategy while sound in core principles, need additional tweaking to maintain *unpredictability* in an AI-SIR world.

STRATEGIC IMPLICATION 6

Human Command and Machine Control will be the future of ASW operations as they acquire an increasingly important character. Offensive ASW strategy will aim to keep the adversary submarines bottled up in their local waters or busy evading tracking and attack. This development will hold strategic ramifications for Indian SSBNs as they will face a growing risk of identification and engagement by AI AWS systems in the Indian Ocean.

> Unmanned systems will create radical change for the future **survivability** of India's sea-based nuclear deterrent

UUVs are driving pioneering research in AI underwater communication, autonomous navigation and swarming technologies, all of which increasingly threatens the operations of Indian SSBNs even within the Bay of Bengal Bastion. The inexpensive deployment of multiple UUVs, USVs, UAVs in international waters of the Bay of Bengal will impose profound limitations on Indian SSBN deterrence patrols, for quantity has a quality of its own in the sea domain.

India with its slow progress and adoption of AI in the military force structure will face a strategic disadvantage when going up against an AI super power like China, which has the money, technology and reach to flood the Indian ocean with such autonomous naval platforms.

The prospect of a Chinese Aircraft Carrier Battle Strike Group in the Indian Ocean further adds to this growing threat scenario as the deeper India wades into the Quad construct, the more penetrating Chinese naval operations will become in the Indian Ocean.

Core Indian SSBN strategy is centered around "secure waters" enforced by a formidable manned Indian Navy. But the advent of increasingly multiple *unmanned* maritime platforms, which can detect, track and engage with precision and lethality – holds devastating potential to turn these secure havens into '*contested waters' – which puts the very survivability of Indian SSBNs into doubt in the long run.*

These 6 Strategic implications highlight – how the increasingly multipolar nuclear environment is aggravating the asymmetric impact of emerging technologies such as artificial intelligence on India's sea-based strategic deterrent.

In Great Power Competition and military warfare, precedent gives way to behavior setting. As the strategic competition deepens between China and the USA, the pace of AI militarization in the South China Sea will determine the character of Chinese [and Pakistan] operationalization and deployment of unmanned maritime systems in the Indian Ocean.

India must be *prepared* for this military reality

Chapter 6

Conclusions and Recommendations

" To be secure on land, we must be supreme at sea. "

- Jawaharlal Nehru [242]

In the '**Age of AI**' the nuclear Triad's robust deterrence, which has stood the test of time and helped forge a strategic uneasy peace is coming under increasing pressure**.** The neutralization or the *perception* of possible neutralization of any leg of the Triad, seemed a far remote possibility at the dawn of the 21st century. But just two decades later, it is increasingly becoming a grave reality. The indicators of breakdown in strategic peace – major armed conflict (Russian invasion of Ukraine), growing strategic arms race (US-China), nuclear modernization programmes (Russia), proliferation of missile technologies (North Korea, Iran), withdrawal from arms control treaties (US-Russia) and public warnings by State actors of World War III (Russia) – are all flashing red, weakening the global deterrence architecture horizontally.

In this environment of strategic flux, India's nuclear deterrence, especially its sea-based strategic nuclear ballistic missile submarines face new threat challenges. Caught as a frontline state between the 2 principal players of 21st century, U.S. and China – India is in a difficult fix faced with a poverty of choices. The Dyadic China-Pakistan nuclear axis has already forced the country towards the 'Indo-Pacific', which started as a compulsion for India rather than an overt choice. Now the AI Renaissance threatens the weaponisation of asymmetric strategic technologies that can *deny* India crucial operating space in its own backyard: the Indian Ocean. This is compounded by the unsettling reality that India is not a strategic player in AI technologies. The country has been complacent and woken up late to the '*Revolution in Military Affairs',* which has resulted in India falling behind the AI curve. The US and China have emerged as the two great AI super powers of the modern era, both vying for dominance of this powerful technology and fielding increasingly lethal and autonomous militarized configurations – that are changing the nature and conduct of modern warfare.

---

[242] Indian Navy. (2009). *Indian Maritime Doctrine.* Naval Strategic Publication, Integrated Headquarters, Ministry of Defence (Navy). Pg. 155. https://www.indiannavy.nic.in/sites/default/files/Indian-Maritime-Doctrine-2009-Updated-12Feb16.pdf

For India, this holds strategic ramifications, as the country will now increasingly be facing unmanned military systems in the air, land and sea domains, fielded by an adversary like China that wants to hegemonise Asia in order to neutralize the U.S.A. **This book, which focuses on nuclear thought in the maritime domain, illustrates through deep analysis just how vulnerable Indian SSBNs are becoming to detection in the Bay of Bengal.**

Militarized AI has caused greater entanglement between conventional and nuclear realms leading to significant implications for Indian SSBN operations, which in turn impact India's nuclear posture and declared strategy of '*credible minimum deterrence.'* Just the *perception* that Indian SSBNs are vulnerable to detection, tracking and engagement by AI enabled ISR, should be enough to stir policy makers and strategic planners into action – particularly in formulating appropriate military responses to this new threat.

These responses can take the form of *stealth and acoustic quieting technologies* for Indian submarines, *expansion of the SOSUS strategic sensor network across the Indian Ocean, adoption of an A2/AD Indian naval strategy based on unmanned maritime platforms in the Bay of Bengal* among others, which are discussed in detail in the Recommendations section.

The fact is, in the era of 4th Industrial Revolution, humans are overcoming the limitations of the mind, and leveraging and amplifying it to achieve greater dominance of the planet and technology, which means - *the frontier of AI, driven by human zeal will always keep expanding*. What is considered AI today may be considered normal software technology in the near future. Hence a more permanent move towards a new strategic stability will be achieved through legal arms control treaties and dialogue between nuclear powers.

The strategic stability in the subcontinent and the larger Indo-Pacific geography needs to be rebuilt, which requires the 4 key nuclear players of the region: China, US, India and Pakistan to work together in some meaningful way. The logic is that – China, driven by fear of U.S. new generation ASW operations in the South China Sea, will create more lethal militarized AI configurations to counter it; which will lead to India modernizing its own counter-measures and militarized technologies for fear of China; which in turn will result in further *crisis instability between India and Pakistan,* as Pakistan's strategic deterrence comes under increasing pressure from Indian counter-measures advances. Thus stability *within* this strategic quadrilateral is a fundamental key in keeping asymmetric destabilization from spiraling out of control, particularly in the Indian Ocean. One way to achieve this would be to look at arms control measures between these 4 nuclear-armed states :

		China	India	Pakistan	U.S.
2016	Convention on the Physical Protection of Nuclear Material (CPPNM) (with the 2005 Amendment)	X	X	X	X
2007	International Convention on the Suppression of Acts of Nuclear Terrorism	X	X		X
2002	The Hague Code of Conduct against Ballistic Missile Proliferation (HCOC)		X		X
2001	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management	X			X
1997	Chemical Weapons Convention (CWC)	X	X	X	X
1996	Comprehensive Test Ban Treaty	X			X
1996	Convention on Nuclear Safety	X	X	X	X
1996	Wassenaar Arrangement		X		X
1987	Missile Technology Control Regime		X		X
1985	Australia Group		X		X
1976	Convention on Registration of Objects Launched into Outer Space	X	X	X	X
1974	Nuclear Suppliers Group	X			X
1975	Biological Weapons Convention (BWC)	X	X	X	X
1972	Seabed Treaty	X	X		X
1971	Zangger Committee	X			X
1970	Treaty on the Non-Proliferation of Nuclear Weapons (NPT)	X			X
1967	Outer Space Treaty	X	X	X	X
1963	Treaty Banning Nuclear Tests in the Atmosphere, in Outer Space and Under Water (Partial Test Ban Treaty) (PTBT)		X	X	X
1961	Antarctic Treaty	X	X	X	X
1925	Geneva Protocol	X	X	X	X

Figure 32 – **Multilateral Agreements related to WMDs between India, US, China and Pakistan**

(Source: Brookings, Strategic Chains (2017). Data Updated by Author as of April 2022)

Progress in getting the 4 countries to sign the existing agreements, especially those where a single country is a holdout will help in confidence building and strategic stability.

Finally, it must be admitted that the complete ramifications of militarized AI on strategic stability are not yet known, given the 'evolving' characteristic of the technology. But this much is certain; AI does have a composite *negative effect* on strategic stability and deterrence – especially as it undermines a States confidence in their own nuclear deterrence architecture. This indicates that, with the deployment of unmanned maritime systems built for offensive anti-submarine warfare – **India will not continue to enjoy its ability to operate SSBNs *undetected, for large intervals* in the Indian Ocean Region.**

Recommendations

" I know not with what weapons World War III will be fought but World War IV will be fought with sticks and stones. "

- Albert Einstein [243]

The world has entered a second nuclear age. One defined by strategic rivalry between nuclear triangles – *USA, China and Russia* and *India, China and Pakistan.* In the waters of the Indo-Pacific, this competition is being played out primarily between the U.S. and China, who are locked in escalating maritime tensions in the Pacific Ocean. Yet it is in the Indian Ocean that the future of maritime Asia is being determined, based largely on Chinese naval actions and India's (and the 'Quad's') ability to deter them.

The Indian Navy – PLA Navy conflict of interest in the Indian Ocean Region, Bay of Bengal geography, stems from India's core need to '*maintain sea control and ensure unfettered access and freedom to undertake the entire range of maritime, commercial, security and economical activities and operations*' and the PLA Navy's objective to 'deny or dilute India's control of the seas'. In order to achieve its objective, the Chinese are increasingly creating and deploying asymmetric strategic technologies like artificial intelligence in militarized configurations, as analyzed in detail across the preceding chapters, which is consequently not only threatening India's 'sea-control paradigm' but also the Indian strategic deterrent (INS SSBN) in the Indian Ocean.

To deal with this deteriorating security situation, **10 India specific measures are recommended** below, which can ensure India's SSBNs remain *unhindered in their operations* and the credibility of India's sea-based deterrence architecture is firmly established.

Further, **2 wider global measures are also recommended** as a means to *control* a spiraling AI arms race that has taken off across the Indo-Pacific geography, one that is severally damaging strategic stability in the entire region.

---

[243] World Economic Forum. (2018, November 10). *How to prevent a Third World War.* https://www.weforum.org/agenda/2018/11/how-to-prevent-world-war-3/

INDIA SPECIFIC RECOMMENDATIONS

➢ INCREASING THE SLBM RANGE

An obvious measure is to increase the range of the SLBMs that arm the Indian SSBN fleet. The range of the missiles (K-15, even the future K-4 SLBM) being deployed in Indian nuclear ballistic missile submarines *restricts* their freedom of operation even within protective Bay of Bengal Bastion. The constraints of the missile, forces the submarines to certain geographical areas, such as the northern most tip of the Bay of Bengal, in close proximity to the Bangladesh and Myanmar territorial waters, in the case of K-4 SLBM, if they are to target Beijing. (see Figure 19). This makes the SSBN range even more narrow and restricted within the protective bastion. During times of crisis, China could concentrate its ASW forces in these areas, and provide an effective counter to Indian SSBN operations.

Thus India currently lacks true strategic nuclear reach against China's eastern seaboard. This security vulnerability can be corrected by developing longer range SLBMs and operationalizing them, such as the planned K-5 and K-6 SLBMs. But by all accounts this will take a lot of time. Therefore the highest priority should be given to the SLBM project to ensure that Indian Missiles provide the offensive deterrent power they are meant for and do not end up *restricting SSBN operations*. To ensure this –

Setting up of a National SLBM Project in Mission Mode is highly recommended.

In the meantime to balance the vulnerability of SSBNs due to their *restricted SLBM range,* focus should be on the ICBM component of the Triad with *Canisterization* approach being adopted for ICBMs, especially those meant to deter China, so as to enable more rapid deployment, mobility and launch on short notice.

Canisterizing refers to storing missiles inside a sealed, climate-controlled tube to protect them from the outside elements during transportation. In this configuration, the warhead can be permanently mated with the missile instead of having to be installed prior to launch, which significantly reduces the amount of time needed to launch nuclear weapons in a crisis.

This is already a new feature of India's Strategic Forces Command's increased emphasis on readiness in regard to Pakistan, and therefore not something extraordinary or infeasible if adopted against China too.

➢ SLBMs WITH MATED NUCLEAR WARHEADS

While it may seem bizarre for foreign observers to deploy SLBMs on strategic submarines without mating with nuclear warheads, Indian official nuclear policy is to keep nuclear warheads de-mated from actual missiles. Even when INS *Arihant* undertook her first deterrent patrol, there was no information from the Government of India about whether the SLBMs it carried were mated with nuclear warheads. This raises questions and doubts on India's 'Credible Minimum Deterrence Posture' especially in regards to China.

There are signs that the official policy has been changed somewhat as *canisterization* has been adopted for specific ICBMs (in regards to Pakistan), but more clarity is needed in this regard from the authorities. Having joined the exclusive club of Nations operating SSBNs, India is mature enough to operationalize its SLBMs to present a *fully functional credible sea-based deterrent* to the adversary. Civil hesitance on SFC control of SLBM mated warheads should be overcome as there exist multiple protocols such as 'warhead locking mechanisms' that will ensure the warhead/missile is not launched without proper civilian authorization.

Further, if the policy of 'de-mating' the warhead from the missile continues in regard to Indian SSBNs, this will mean that in a crisis situation, the SSBNs would first have to be outfitted with warheads (in submarine pens at port) and then deployed, which will have severe implications on *time constraints, submarine detection and targeting, deterrence and the overall Second Strike Capability.* Additionally, in these circumstances Indian SSBN submariners will have no experience of operating a fully functional SSBN during a real military operation, which opens up its own can of dirty worms.

A crisis by its very nature is *de-stabilizing.* Thus to expect that Indian submariners will be able to operate a fully functional SSBN in a crisis situation without getting affected by psychological pressures of having 'active nukes onboard' – is unrealistic. To push submariners into this quagmire will entail reducing their proficiency and capability, which will negatively effect Indian SSBN operations. Thus –

India must operationalize a fully functional SSBN deterrent with nuclear warheads mated with SLBMs

The more the Indian SSBN fleet undergoes strategic psychological and Command, Control and Communication pressures during peacetime, the better prepared they will be for war.

➢ AMBIGUITY IN NUCLEAR POLICY

The Art of War is to keep the enemy guessing, unsettling them with strategic ambiguity that keeps them destabilized. India's declared No First Use policy has failed to *deter* Pakistan in its asymmetric nuclear escalation against India. The posture has also failed to *deter* China in (1) occupying Indian territory in northern and northeastern India, (2) strategically supporting Pakistan's nuclear ambitions, (3) enabling a low-cost proxy war within India by supplying mass weapons to naxalites and in (4) trying to containing India through the 'string of pearls' strategy.

Therefore the strategic costs and benefits of a NFU posture need to be systematically analyzed and certain conditionality's to the NFU need to be attached, or changes made to it, in order to provide a better deterrence posture for India. A Nation's security policy cannot be set in stone. It must be adaptable and responsive to the changing winds of the world, new faces of the adversary, in tune with advanced technologies and be able to uphold strategic national interests.

India's current defense minister, Rajnath Singh has also publicly hinted to this reality, questioning India's future commitment to its NFU policy. In August 2019 the minister tweeted - *"India has strictly adhered to this [NFU] doctrine. What happens in the future depends on the circumstances"* [244]

Ambiguity in Indian Nuclear Policy is needed to enforce an effective deterrence

Increasingly faced against militarized AI configurations that can target Indian strategic systems such as SSBNs, ICBMs – some flexibility in Indian Posture is needed. While it is entirely possible that such flexibility exists on the operational plane viz. Pakistan – say in counter-force strike options – India till date maintains the same stringent policy in regards to China. This needs to change. This does not entail that India walk away from the NFU, rather it simply implies creating tactical, operational openings that strengthen Indian deterrence viz China.

The same can be communicated to adversaries discretely without having to change the NFU status. Some ambiguity will go a long way in preserving **Credible Deterrence.**

---

[244] Rajnath Singh. (2019, Aug 16). *Tweet on India's NFU nuclear policy.* Twitter. [Tweet]. Defence Minister of India, personal account. https://twitter.com/rajnathsingh/status/1162276901055893504

➢ AI BASED A2/AD INDIAN SYSTEMS IN BAY OF BENGAL

Autonomous weapon systems will become increasingly attractive in the future for A2/AD Missions, such as along extended coastlines or on patrol in 'exclusion zones' at sea. The Indian Navy is far behind in development and induction of UAVs, USVs, UUVs into the fleet and therefore needs to focus on *counter-measures* as an immediate solution for now. Over time, the Navy must conduct its own research and development (R&D), independent of the DRDO, and recruit technologically literate personnel for developing such maritime systems.

By and large, unmanned platforms have the most potential in undersea missions, especially in A2/AD strategies. They can perform a variety of non-lethal actions such as active surveys of shallow water littoral regions, detection and monitoring of mines, jamming enemy communications, providing acoustic intelligence, conducting oceanographic and hydrographic surveys, providing submerged communications to undersea platforms, and carrying out active counter-measures against naval mines. They can further amalgamate and synthesize data, and transform the ISR capabilities of a navy, improving intelligence preparation in the battle-space, and providing fleets protected passage, by adopting clearance, sweeping & protection roles. Thus–

The Indian Navy must adopt an A2/AD strategy, backed by appropriate force structure as a pivot for countering PLA Naval activities in the Bay of Bengal

And the focus of the appropriate force structure should be unmanned maritime systems. India as part of the Quad Grouping can get access to the advanced technological capacities of U.S.A, Japan and Australia – and should focus on acquiring relatively cheap systems in large quantities. These systems do not have to be extremely advanced, as the example of the Turkish Bayraktar Drone in the Russia-Ukraine conflict has demonstrated. The very presence of such systems, especially in quantity, provides a quality of its own in maritime operations.

Further, weaponizing these systems can also equip them to defend against attack and defend critical underwater infrastructure while providing crucial ISR. Essentially, unmanned platforms promise to improve productivity, allowing manned Indian Navy vessels to pursue more specialized tasks, increasing the effectiveness of operations in the Bay of Bengal.

➢ DEVELOPING AI SOFTWARES FOR INDIAN NAVY

The Indian Defence Establishment needs to show some urgency in fostering indigenous innovation and development of software technologies for the Indian Navy in collaboration with private and public sectors. India is a global IT power, yet we have not been able to leverage the deep knowledge of AI, imbibed across the IT sector for national security, particularly maritime security.

The use of machine learning (ML) in combination with neural networks and deep learning algorithmic softwares can present a seamless operating picture to the Naval Command and assist them in taking decisions, enhancing their human capacity. These softwares can even enhance fleet operability, given the naval assets are connected to each other.

In the Bay of Bengal, the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) oriented vessels and systems can be infused with AI and ML, connecting individual naval vessels. Submarines, frigates, aircraft carriers, battleships, unmanned vehicles, can all be equipped individually or as a formation with such software to augment their specific functions. Unmanned assets connected to the 'intelligent software based system' with the ability to relay back smart video analytics will be able to provide Over The Horizon (OTH) mapping and targeting capability, extending the line of sight of the fleet in all directions.

Existing Indian naval ships, vessels and platforms should be infused with artificial intelligence based software to generate a seamless operating picture of the Bay of Bengal

The AI software can also be infused in 'smart torpedoes' to transform them into autonomous 'lay and wait' – *Long Loiter* – mission roles of extended duration at critical points, cutting off enemy access to 'SSBN secure pools' from all directions.

Machine learning software in particular can provide the Indian Navy with (1) *Anomaly Detection (2) Information Management of ISR data (3) Decision-Support Systems* to greatly enhance capability and capacity.

➢ ACOUSTIC SIGNATURE DATABASE: *IFC-IOR*

The recently established Information Fusion Centre for the Indian Ocean Region is the ideal place to establish a military database of acoustic signatures of maritime vessels, if one has not been established already. IFC-IOR currently partners with 21 countries and 22 multi-national agencies, each deputing their International Liaison Officer (ILO) to the IFC-IOR headquarters in Gurugram, India. This place is in a natural position to work on the acoustic signatures database of vessels and systems traversing the Indian Ocean.

Acoustic signatures are the noise and vibrations a maritime vessel and its on-board equipment and systems make in the water. These signatures are acquired in naval operations, to provide specific information on the type of ship/vessel, its speed and direction it is headed. In a mapped database, these signatures are immensely beneficial in identifying 'friend from foe' – that is friendly vessels from enemy vessels, particularly in congested waters.

Create an IFC-IOR acoustic signature database for the IOR

Such a database will be enormously efficient in identification and targeting of adversaries ships/vessels/unmanned systems in the Indian Ocean, especially in the Bay of Bengal. With the help of ILOs the database can be quickly built using existing acoustic records in partner countries.

Figure 33 – **Information Fusion Centre for Indian Ocean Region**
(Source: IFC-IOR Website: www.indiannavy.nic.in/ifc-ior/)

➢ WHITE SKY APPROACH

India's airborne Anti-Submarine Warfare Assets the Boeing P-8I Neptune, Dornier 228, IL38 and MH-60 'Romeo' – provide the Indian Navy with the capability to keep the large sea areas of the Arabian Sea and Bay of Bengal under surveillance. India has been steadily and systematically investing in ASW operations in the Indian Ocean after facing the giant wake-up call of Chinese SSNs showing up in the Indian Ocean in 2014.

Today, 8 years later, Indian Navy is equipped with ASW airborne platforms that have a weapon and sensor suite that is proven and effective against modern submarines, both conventional and nuclear powered. The Indian Navy aims to establish and maintain a '*White Sky'*, a term used in ASW to indicate constant air surveillance over a submarine probable area.

Capable of operating from the Andaman and Nicobar islands these aircrafts provide India with a truly capable and proven ASW Air-Asset. The fact that the U.S. and Australian Navy P8's operate along with the Indian P8I's during the Malabar Exercises establishes India's credentials in operating some of the world's best Multi-Mission Maritime Aircrafts, which have truly been integrated into the Quad's Order of Battle (ORBAT).

However as increasingly unmanned underwater cheap systems proliferate across the Indian Ocean Region, Indian Navy will have to tweak its 'White Sky approach' as shooting down cheap UUVs with extremely expensive missiles/torpedoes is an unsustainable option.

A tweaked 'White Sky' concept could include the ASW Air Assets *identifying* the enemy UUV systems but reserving their destructive firepower for enemy manned submarines only. Once identified, the UUVs can be dealt with militarily through other means such as targeted cyber-operations or 'soft kill' measures.

A *White Sky* approach should be enforced for enemy submarines/ UUVs traversing the Eastern Indian Ocean

➢ MAKE ADVANCES IN CYBER CAPABILITIES

The inherent nature of unmanned systems and autonomy also opens them to new security risks. Such platforms are increasingly vulnerable to cyber-attacks, and simple spoofing of sensors and control systems, which can impact the systems perceptual and decision-making intelligence, corrupting or falsyfing the information they send back.

Additionally, the functioning of unmanned systems can be disrupted in *GPS-denied environments*, either due to constraints of bathymetry (depth of ocean), or through GPS jamming. By hacking and jamming the software of UUVs, USVs, UAVs, a critical advantage can be gained over these configurations and they can be easily captured.

A Special Unit of Hackers and Cyber Specialists should be created within the Indian Navy to conduct offensive cyber operations against enemy systems in the IOR

In order to achieve this, specialized cyber capabilities will need to be developed within the Indian Navy and SFC establishment. This is a long drawn out process as a special cadre of hackers, cyber programmers will need to be created. Once fully developed and skilled though, they will represent the 'Tip of the Spear' in the cyber capabilities for the new generation of maritime warfare.

➢ USE OF INDIAN FISHERMEN FLEET

India can use its enormous human resource and fisherman community in the Indian Ocean Region to its advantage. Hundreds of thousands of Indian civilian fishing boats venture out in the Indian Ocean each day for livelihood. These men and women are experts of the sea and no one knows the sea better than them. Indian Navy can install small military specific radars on these fishing boats, creating a seamless network of 'mobile radar systems' across the length and breadth of the Indian Ocean using a *'networked software'* approach, made possible through AI, which will exponentially increase the maritime domain awareness of the Navy. With the availability of cheap maritime radars, this once impossible idea is increasingly possible and desirable.

Indian Fishermen boats can be turned into Digital Eyes and Ears of the Indian Navy using *networked radar systems* approach

➢ ESTABLISHMENT OF SOSUS SENSOR CHAIN IN INDIAN OCEAN

India has joined the Sound Surveillance sensor chain, called '*Fish Hook',* which is the US-Japan Undersea Defense Line, extending from Japan to the Andaman Nicobar Islands as highlighted in the earlier chapters. This is a good security development as it amplifies Indian ASW capabilities multi-fold, in the face of China's mammoth fleet of 80 submarines, out of which 67 are conventionally powered.[245]

However, as the power differential between the Indian Navy and the PLA Navy (PLAN) increases by the day, the existing SOSUS chain will be inadequate from an Indian security perspective, as it only touches the Indian Ocean at the eastern edge, leaving the wide northern and western Indian Ocean susceptible to PLAN submarine forays and offensive missions. **Therefore it is proposed that India establish a wider SOSUS sensor chain across the Indian Ocean in a two part approach.**

(1) A Bay of Bengal specific SOSUS chain – *Built and managed by India*

(2) An Indian Ocean SOSUS chain – *Built and managed by U.S., Japan, India jointly*

The *first* SOSUS chain is proposed to run from the Andaman & Nicobar Islands to the southern coast of India right above Sri Lanka. Taking into account the deep Indian sensitivities (political and military), sovereignty concerns as well as Indian Navy's envisioned role as a *Net Security Provider* in the Indian ocean, combined with the nuclear salience of the Bay of Bengal, this SOSUS chain should be built and managed by India, with inbuilt data sharing mechanisms for U.S. and Japan. The idea of an Indian owned and managed SOSUS chain will be much more acceptable and palatable to Indian military, political and strategic planners as well as the Indian public, especially since the Bay of Bengal holds *critical importance* for the Indian Nuclear Triad. See Figure 34 for the physical spread of the SOSUS chain.

India can take the technological help of both U.S. and Japan in constructing the chain, as it most certainly will share the data generated from it, just as the U.S.- Japan *Fish Hook* will share their

[245] Horto, L. (2022, February 10). Battle Of Submarines: World's Biggest Navy, Why China Could Be Ill-Prepared For A Deep Sea Encounter With The US. *Latest Asian, Middle-East, EurAsian, Indian News*. https://eurasiantimes.com/china-could-be-ill-prepared-for-a-deep-sea-encounter-with-the-us/

data. It is to take into account Indian military concerns and strategic autonomy, that this SOSUS chain is proposed to be built and managed by India specifically.

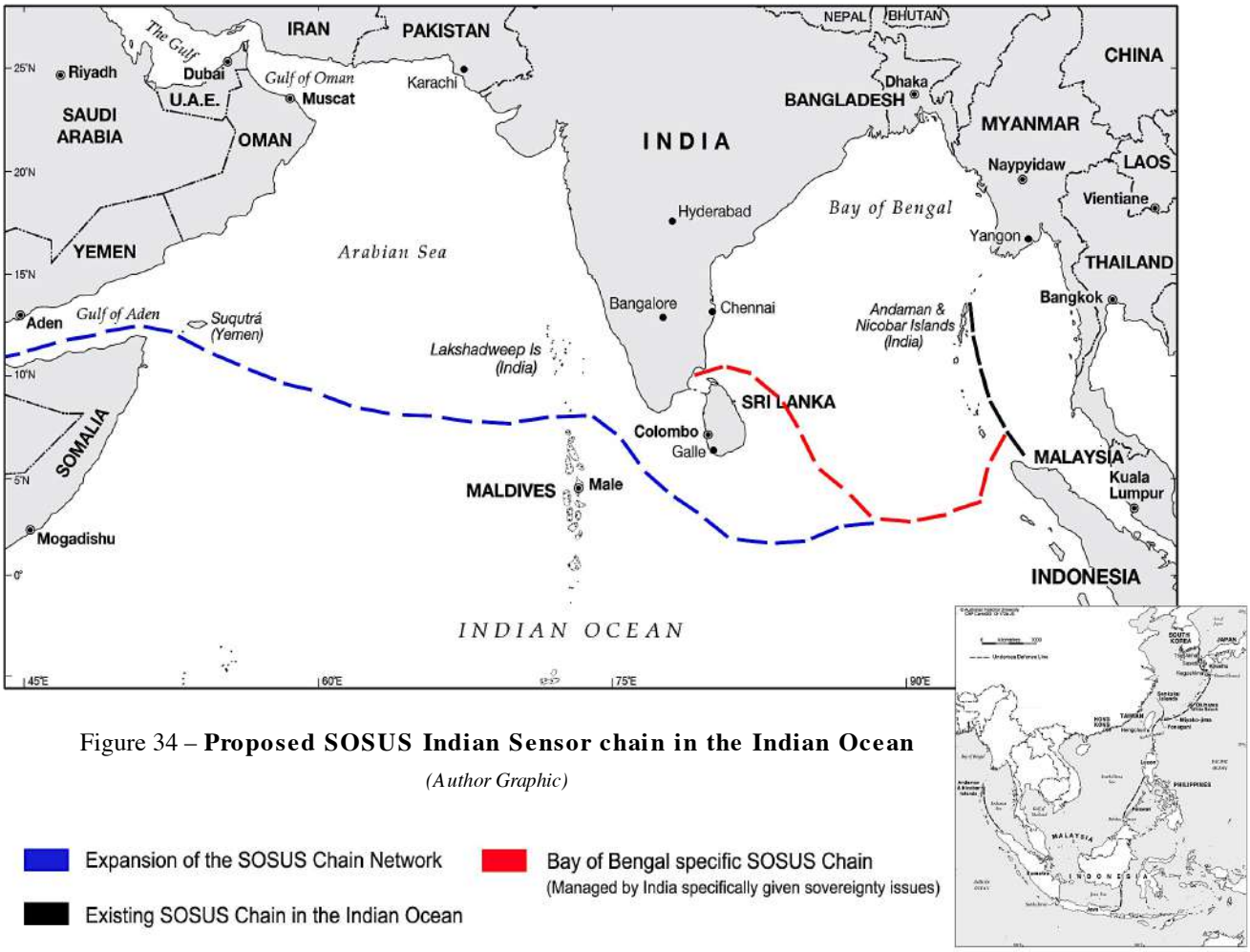


Figure 34 – **Proposed SOSUS Indian Sensor chain in the Indian Ocean**

(Author Graphic)

The 'bulge' in the Indian SOSUS chain is provided to give India **'strategic depth'** in the Bay of Bengal as its SSBN fleet matures and the SLBMs increase their range.

The *Second* SOSUS chain is proposed to run from the Andaman & Nicobar Islands to parts of the Indian SOSUS chain, then right across to Lakshadweep and from there to the *Dijibouti* in the Gulf of Aden. Like the *Fish Hook,* this chain will be built and managed by U.S. and Japan with the addition of India, and will sit astride the main submarine transit channels of the PLA Navy right from their base in Dijibouti to the Malacca Straits in the eastern Indian Ocean.

The trio of India, US, Japan will sufficiently amongst themselves be able to finance, build, monitor and share the data, especially since India and U.S. now have adequately addressed all

data/information and intelligence sharing concerns with the signing of multiple pacts. Over time, Indian military personnel can be trained by Japan to read and interpret the sensor data, creating a new specialization within the Indian Navy.

These **2 SOSUS Indian Ocean chains** will enhance the Quad's emerging geo-strategic calculus for the Indo-Pacific and once operationalized will prove invaluable in **detecting**,[246] monitoring and neutralizing[₮] PLA Navy submarines and unmanned systems trying to sneak into the Bay of Bengal.

India, with its lack of operational submarines and navy scaling capacity, can use an undersea sensor Chain to its strategic advantage and maintain dominant *sea control* over the Indian Ocean, operating its sea-based deterrence with freedom as Indian political, military and naval doctrines envision.

Establishment of 2 SOSUS sensor chains in the Indian Ocean

[246] Garwin, R. L. (1983). Will Strategic Submarines be Vulnerable? *International Security*, *8*(2), 52–67. https://doi.org/10.2307/2538595

[₮] **SOSUS Concept.** Developed in the 1950's by the US Navy against Soviet submarines, the SOSUS is a long-range fixed passive detection system now operationalized against PLAN submarines. The SOSUS deploys a linear array of hydrophones, placed on slopes or mounts within the sound channel. It primarily exploits the deep sound channel or SOFAR, within which low frequency sound travels to extremely long distances. The azimuth beam forming and triangulation for position approximation are processed ashore. The target information is then shared, in real time, with an air or surface asset in the vicinity; which then undertakes the subsequent tasks of classification, tracking and final interdiction. The SOSUS therefore, is a detection system, not a tracking or classification system. When augmented by a mobile 'Surveillance Towed Array Sonar System (SURTAS) or any other Tower Array Sensor System (TASS), the SOSUS it is referred to as an 'Integrated Underwater Surveillance System', IUSS.

Source: Commodore CP Srivastava, Indian Defence Review

GLOBAL MEASURES

➢ LEGAL REGIMES ON THE HIGH SEAS

The legal regime applying to armed conflict at sea is less elaborate than the one governing land warfare. While the basic rules of Law of Armed Conflict (also known as International Humanitarian Law) apply – namely *distinction, proportionality and precaution*, there is less little treaty law (international agreements) specifically addressing the challenges of emerging conflict at sea.

For instance, Article 36 (Additional Protocol I) of the Geneva Convention specifically states the '*need to undertake a legal review of new weapons to ensure their compliance with international law*.'[247] However questions remain as to how effective the review is and as the weapons autonomy *evolves,* does review still remain valid?

Fmr. Special Rapporteur Christof Heyns (UN OHCHR – Office of the High Commissioner for Human Rights) has warned that – **the weaponisation of increasingly autonomous systems might one day blur the distinction between weapon and soldier**.[248]

Therefore the need of the hour is specific *Treaty Mechanisms on Artificial Intelligence,* which can bind nations to legal commitments on the militarization and weaponisation of AI. The 2 AI Superpowers – U.S. and China particularly, need to come to some legal agreement on weaponised AI before these technologies proliferate across the world and eventually even fall in the hands of terrorists and non-state actors.

Treaty Mechanisms are required between the 2 AI Superpowers – U.S. and China

To avoid proliferation of weaponised AI across the world

---

[247] Mcclelland, J. (2003, June). *The review of weapons in accordance with Article 36 of Additional Protocol I.* International Review of the Red Cross. https://www.icrc.org/eng/assets/files/other/irrc_850_mcclelland.pdf

[248] Human Rights Council. (2013, April 9). *Report of the Special Rapporteur on extrajudicial, summary or arbitrary executions, Christof Heyns.* United Nations General Assembly. Pg 7. https://www.ohchr.org/sites/default/files/Documents/HRBodies/HRCouncil/RegularSession/Session23/A-HRC-23-47_en.pdf

➢ UNDERSTANDING AI in the OFFENSE/DEFENSE RELATIONSHIP

As an asymmetric strategic technology, artificial intelligence entangles the conventional and nuclear domains in such a manner that the employment of defensive AI systems by a State party can be *perceived* as offensive AI systems by their adversary and vice-versa.

Therefore it becomes prudent for each nuclear-armed State to ensure that they understand the role of automation and autonomy in the nuclear deterrence architecture of other states, as well as the constraints of their own deterrence systems. AI as a software platform is unpredictable to the outside world, as it employs algorithms that are opaque. For instance, the input and the output of an AI system is observable, but the computational process leading the software, particularly machine learning, from one point to the other is difficult for humans to understand. Consequently oftentimes we do not know what an AI system has learned and how it might react to data (sensors and environment) that is different from the one used during the training phase of the software. This leads to the problem of *predictability,* particularly for the adversary.

The inherent nature of AI technology is thus a major source of the offense/defense problem - **it is a software-based technology that makes a tangible evaluation of military capabilities difficult.** Nuclear-armed states therefore easily misperceive their adversaries' capabilities and intentions and start on a counter-measure path that in turns creates more de-stabilization. Thus it is crucial to –

Establish *transparency* in AI systems, particularly through dialogue and conversation between Political, Military and AI Experts of Nuclear-Armed States

The lack of transparency in AI systems can create fundamental problems as the machine learning platform might fail in ways that were unthinkable to humans, which can be deadly if the platform is weaponised. From a regulatory standpoint also, this is problematic as it complicates the task of identifying the source of a problem and attributing responsibility when something goes wrong.

———————

Thus, the applications of militarized artificial intelligence technologies are enormous, and India must be ready for the upcoming threat challenges to Indian SSBN operations in the IOR. This book has endeavored to highlight one such threat; that of *AI enabled ISR.* ■

Areas of Further Study

In 2010, the acclaimed academician John Arquilla highlighted the 3 new rules of modern war as – (1) ***Many and small beats large and heavy***, (2) ***Finding always beats flanking*** and (3) ***Swarming always beats surging.***[249] It is prescient that more than a decade later, the war between Azerbaijan and Armenia and the Russian invasion of Ukraine, continue to prove these rules as the world undergoes a revolution in military affairs.

In the future, the importance of sea-based deterrence will only grow as the advancement of technology is enabling the possibility of high precision strikes on nuclear assets using conventional means within a limited time window. The improving efficiency and precision of C4ISR networks in locating targets and the speed of strike platforms has reduced the sensor-to-shooter time, which puts land and air based deterrence at increasing risk. Thus, India will only push forward in deploying a credible sea-based deterrent force and ASW capabilities.

This book has mapped the threat of AI enabled ISR systems to detect Indian SSBNs within the Bay of Bengal maritime geography. In doing so, 3 areas of further study have presented themselves which are pertinent to this scholarly debate. They are as follows :

1. *Reactions from Pakistan.* India establishing a nuclear triad has shaken the very foundation of Pakistan's strategic policy. Pakistan's security policy is primarily India focused and it uses its nuclear capability as an umbrella for continuing its anti-India activities, and to deter India from even a major conventional offensive in retaliation to any of these activities. By deploying an effective sea-based deterrent, India is strengthening its retaliatory capability against Pakistan. As a response to this move, Pakistan is planning to deploy its own sea-based deterrence force and deploy its indigenously built nuclear capable cruise missile, the Babur, on conventional submarines. A Pakistani sea-based deterrent based on conventional submarines would, as a platform, be *very effective* against India. Conventional submarines emit very little noise compared to nuclear submarines. Moreover, some of Pakistan's submarines have Air-Independent Propulsion (AIP) making them even more quiet, with all Indian vital targets, from political to economic centres, being within the range of the Babur cruise missile. There is also a possibility of China providing Pakistan the knowhow of SSBN technology.

The development of Indian SSBNs and their strategic impact on Pakistan's nuclear policy need to be further analyzed and assessed in light of South Asia's asymmetric escalation pyramid.

[249] Arquilla, J. (2010, February 11). *The New Rules of War*. Foreign Policy. https://foreignpolicy.com/2010/02/11/the-new-rules-of-war/

2. *Psychological anxiety effect of AI.* Use of artificial intelligence in nuclear deterrence architectures is leading to anxiety over States capability to maintain and secure an assured *second-strike capability.* The concern is that AI technologies and systems will surpass existing nuclear asset defense mechanisms, like detecting SSBNs on the high seas, leading to loss of power status as well as opening up the country to nuclear threats. This psychological fear – about the adversary's capability, particularly when the infused AI technologies are opaque, will result in a blind pursuit for strategic advantage, which will only spur destabilization even perhaps resulting in pre-emptive AI related rulemaking.

Deep thought must be given to the psychological fears of State Actors concerning use of AI in the nuclear realm. The situation of *strategic mutual doubt* – as existed in the Cold War – is not a place where even the major powers want to be again in.

3. *Cycle of Measures and countermeasures.* Induction of offensive penetrating technologies such as hypersonic missiles, Maneuverable Reentry vehicles (MARV), Ant-Satellite Weapons, Multiple Independently targetable Reentry vehicle (MIRV) and others are all sophisticated advancements in warfare, that will lead to cycle of measures and counter-measures between States. The more sophisticated the weapons systems, the more sophisticated counter-measures will become. The frontier of technology is always moving and as technology becomes faster, more automated and intelligent it will start slipping out of human command and control. It is already impossible to recall missiles once they are launched from silos or submarine hatches.

Therefore serious thought needs to be given to automation in the context of *Human Command and Control.* Are we ready to live in a world where the machines decide when to launch or when not to? Will manual control mechanisms even be possible given the hypersonic speeds of incoming ballistic or cruise missiles? These are disturbing questions that only future research can adequately answer.

It is hoped that further research in these areas will help enhance our collective understanding of where we are headed in Great Power technological competition, contact-less warfare and strategic and asymmetric strategic stability.

The Age of AI warfare is here.

The End.

Azadi Ka Amrit Mahotsav

AYUSH GARG

Is a Ministry of Defence - Gold Medalist. He is a Young Professional at Carnegie Endowment for International Peace, a COVID-19 Civil Defence Worker and an accredited Communications Specialist with G20 India and the UN System.

He specialises in the 4th Industrial Revolution, **Strategic Thought**, China Studies & Indo-Pacific; holding a Master's Degree in Defence & Strategic Studies from the University of Madras and a Bachelors in Politics & International Relations from the London School of Economics.

The Age of AI Warfare is here

ISBN 978-3-16-148410-0