



# MILIT'S COLLABORATION WITH MRC AND NDT FOR ENHANCED UDA FRAMEWORK

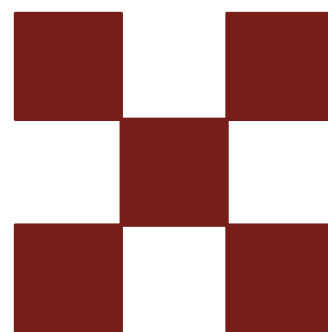
(EVENT HELD ON 9TH AND 10TH JANUARY 2025)



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## 1. EXECUTIVE SUMMARY

This event, held on January 9 and 10, 2025, marked a significant milestone in advancing collaboration between the Military Institute of Technology (MILIT), Maritime Research Center (MRC), and Nirdhwani Technology Private Limited (NDT). It was designed to enhance the integration of advanced maritime research and technology into the training and development of armed and paramilitary forces personnel, particularly those within the Indian Navy and related defence sectors.

The two-day event brought together key stakeholders, including armed forces officers, military professionals, researchers, engineers, and experts, to discuss the latest advancements in maritime defence technology, naval warfare strategies, and operational readiness. To strengthen India's maritime capabilities, the event showcased the vital role of MRC and NDT in providing its research, tools, and training and the crucial alignment of these efforts with MILIT's educational objectives.

### KEY HIGHLIGHTS OF THE EVENT INCLUDED:

- 1. Presentations and Workshops:** Leading experts from our team, including our Founder and Director, Dr (Cdr) Arnab Das, and our Deputy Director, Shridhar Prabhuraman, delivered insightful sessions on emerging maritime threats, technological innovations and advanced defence systems that are essential for modern-day naval forces.
- 2. Technological Demonstrations:** The event featured demonstrations of new technological tools and systems, showcasing their potential to enhance the effectiveness of India's naval operations and maritime security.
- 3. MoU signing ceremony between MRC and MILIT:** This collaboration will provide MILIT officers with advanced training and research opportunities, equipping them with the necessary skills and knowledge to excel in the rapidly evolving maritime and defence sectors.
- 4. Networking Opportunities:** The event provided a platform for stakeholders from various defence and research organisations to connect, exchange knowledge, and explore avenues for future collaboration.
- 5. Collaborative Discussions:** In-depth discussions on how integrating MRC's research findings into MILIT's training modules can elevate the operational competence of defence personnel. These discussions emphasised the need for continuous innovation in defence technology and its application in real-world scenarios.

As demonstrated in this event, the synergy between MILIT and MRC will help ensure that Indian military personnel are well-versed in theoretical knowledge and adept at applying the latest technological advancements in the maritime sector. This collaboration promises to significantly strengthen India's maritime security, enhance operational efficiency, and further the professional development of its armed forces. During the two-day event, we had the honour of

hosting Lt Gen AK Ramesh, Commandant of the College of Military Engineering (CME), at our demo area at the MILIT premises. During his visit, Dr. (Cdr) Arnab Das delivered an insightful presentation on critical topics, including Underwater Domain Awareness (UDA), maritime security, the blue economy, marine environment protection, and disaster management.

This two-day event reinforced the importance of continued innovation and partnership between educational and research institutions like MILIT and MRC. These institutions are instrumental in shaping India's future defence capabilities, especially maritime ones.

## 2. BACKGROUND AND INTRODUCTION

The Maritime Research Center (MRC) is striving to play a pivotal role in strengthening India's defence capabilities, particularly in the maritime domain. We have been progressing the Underwater Domain Awareness (UDA) framework for safe, secure, sustainable growth for all in the tropical waters of the Indo-Pacific strategic space. Details on the UDA framework are available at <https://udafoundation.in/>. The importance of the UDA framework across marine and freshwater systems from a strategic security perspective needs no emphasis. The new personnel of armed forces leadership needs to appreciate the UDA framework, particularly the challenges and opportunities of the tropical waters. As India increasingly emphasises the strategic importance of its vast maritime boundaries, we are dedicated to advancing research, development, and training for its armed forces. With the Indian Navy being a key component of national security, the MRC's initiatives are central to ensuring that personnel are equipped with the knowledge and skills to address modern security-related challenges effectively.

In alignment with these efforts, MILIT, located in Pune, Maharashtra, is crucial in shaping India's future military engineers and technical experts. MILIT's mission is to provide specialised education and training in military technology and systems, focusing on areas such as weaponry, electronics, and communication systems. A close collaboration between the MRC and MILIT is vital in ensuring the seamless integration of maritime technology and defence strategies within the armed forces. It is worth noting that in April 2024, MRC trained over 160 student officers from strategic security backgrounds during its UDA workshop.

The recent event hosted by MILIT underscores the growing collaboration between these institutions. This event brought together armed forces officers, military professionals, researchers, and technical experts, highlighting the importance of fostering innovation and knowledge exchange between the MRC and military educational institutions. It served as a platform to discuss emerging maritime threats, technological advancements, and the ways in which these developments can be integrated into the training curriculum at MIT and other defence institutes.

The collaboration between MRC and the MILIT, Pune, will focus on acoustic capacity & capability building, along with on-ground delivery of technology development projects to serve the strategic security requirements of the Indian Armed Forces and the Allied Services. The acoustic capacity & capability building will include policy & technology interventions along with research & innovation infrastructure on the waterfronts of the Khadakwasla Lake. The capacity & capability building must consist of strategic perspective, domain-specific understanding, including hardware & software and technology appreciation, including AI-based data analytics and user-friendly real-time display formats & hardware/software. Field experimental validation and operational deployment need to be prioritised.

This collaboration will have far-reaching implications for India's defence preparedness. By combining research expertise with hands-on training, the partnership ensures that India's military personnel, particularly those in naval and maritime roles, remain at the forefront of technological and tactical advancements. This ongoing relationship is crucial for developing a skilful, technologically savvy force that can address India's increasingly complex security challenges in its maritime domain.

**MRC is proud to partner with the Indo-Swiss Center of Excellence (ISCE) to lead all skilling-related initiatives.** We extend our heartfelt thanks to ISCE for their support in helping us build capacity within the armed and paramilitary forces.



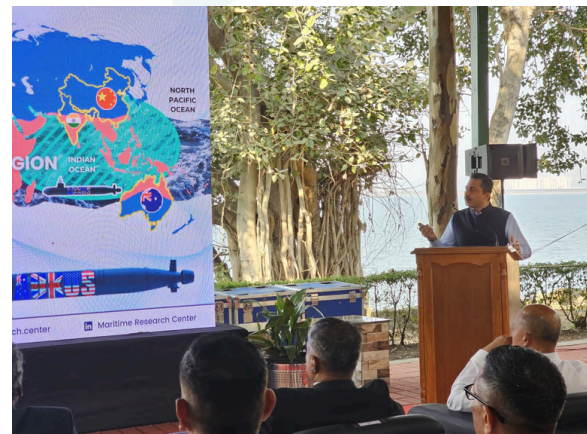
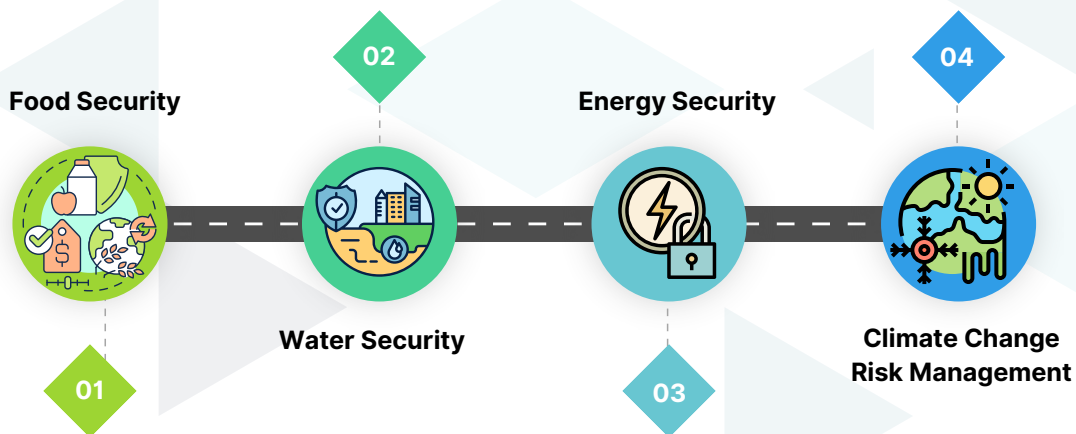
### 3. EVENT DETAILS

This event featured a series of engaging activities that gave way to collaboration between the MRC and MILIT teams. The following section provides a detailed overview of the five key activities conducted during the two-day event. These activities included high-level presentations from the MRC leadership team and demonstrations of advanced technology tools developed by MRC to support the UDA (Underwater Domain Awareness) concept at the national level. Each activity highlighted the shared commitment to advancing India's defence capabilities through innovation, research, and strategic collaboration.

#### 3.1 PRESENTATION ON 'UDA FRAMEWORK FOR SAFE, SECURE, SUSTAINABLE GROWTH FOR ALL IN THE NEW GLOBAL ORDER'

On Day 1 of the workshop, our Founder and Director, Dr (Cdr) Arnab Das, delivered an important presentation on the **"UDA Framework for Safe, Secure, Sustainable Growth for All in the New Global Order."** His presentation focused on the urgency of prioritising the UDA Framework, particularly in the rapidly evolving global landscape and the pressing security challenges India faces today.

During his presentation, Dr Das highlighted the growing complexity of modern-day threats, which are no longer limited to traditional military confrontations but are now deeply intertwined with global issues such as resource scarcity, environmental risk and geopolitical tensions. He mentioned that the UDA Framework is an essential strategic tool that enhances national defence capabilities and integrates critical non-traditional security dimensions, thus promoting a holistic approach to safeguarding global stability. In addition, the core of his presentation revolved around the concept of Strategic Security Dimensions, which are essential for addressing the complex challenges in today's world. These dimensions include:



With the global population increasing, food security has become a central concern. Dr Das highlighted the need for nations to secure their food supply chains to prevent scarcity and mitigate the geopolitical risks of resource competition. Water resources, he said, are increasingly becoming the focal point of international tensions. He stressed the importance of strategic water management, especially for countries dependent on shared water bodies, to prevent conflicts and ensure sustainable access to clean water. As the global energy demand continues to rise, Dr Das outlined how energy security has become a key pillar of national security. He noted the necessity for energy diversification, renewable energy adoption, and securing energy trade routes to avoid geopolitical vulnerabilities. The rising impact of climate change presents new challenges for security, from natural disasters to resource conflict. For this, the presentation emphasised the importance of proactive climate risk management strategies, ensuring that nations are prepared for the unpredictable consequences of environmental changes.

**Overcoming geopolitical challenges:** As described by Dr Das, the UDA Framework provides an integrated approach to address the ongoing geopolitical challenges that threaten global peace and stability. By addressing the above strategic security dimensions, the framework offers a comprehensive strategy for mitigating risks related to economic instability, resource scarcity, and environmental disasters. Dr Das closed his presentation by stressing the importance of global collaboration and mutual understanding in overcoming these challenges. He advocated for nations to include the UDA framework in their existing strategies, ensuring that defence, environmental, and resource management strategies are harmonised to create a collective security environment. Only through cooperation at regional and global levels can the world effectively address the complexities of modern security issues and achieve sustainable growth.



### 3.2 NDT'S IMPORTANT PRODUCT/TOOL DEMOS TO THE OFFICERS DURING THE MILIT EVENT

On Day 1 of the workshop at MILIT premises, our Deputy Director, Mr Shridhar Prabhuraman, showcased the deployment of our Passive Sonar Simulator and Shipping-Related Noise (SRN) models. He provided an in-depth explanation of the methodologies and use cases our team has been developing to address the challenges in Underwater Domain Awareness (UDA).

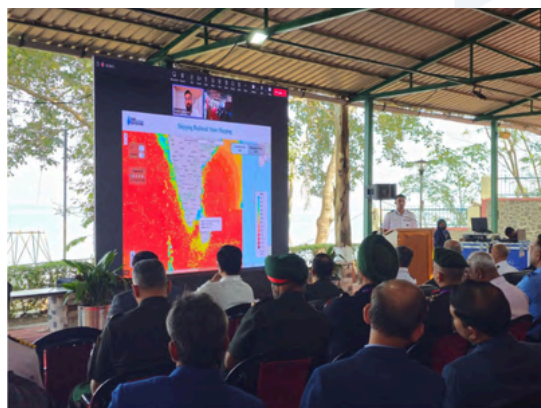


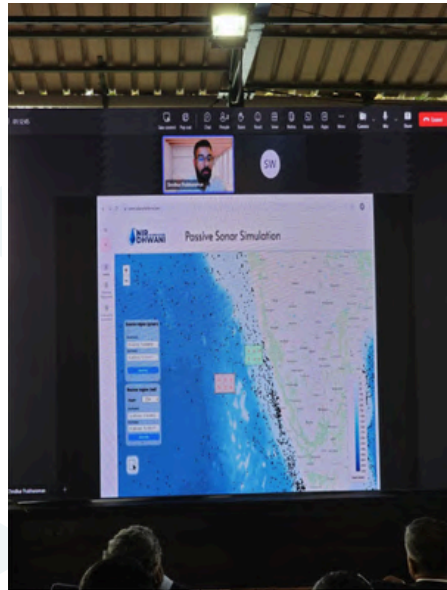
These innovative tools are pivotal in enhancing our understanding of underwater acoustics, advancing marine ecosystem monitoring, and strengthening maritime security. The SRN model, in particular, plays a crucial role in assessing the impact of shipping activities on underwater ecosystems and improving noise management strategies. It is worth understanding the main objective of the SRN tool is to offer solutions for monitoring and managing underwater noise from maritime vessels. It helps evaluate noise effects on marine ecosystems, provides insights to reduce underwater noise pollution, helps shipping companies meet global noise reduction standards, enables real-time monitoring to improve operations and reduce noise, supports marine habitat protection by minimising noise and aids scientific research in acoustics and marine biology.



## SOME OF THE MAJOR FEATURES OF THE SRN TOOL INCLUDE:

- 1. Real-time noise monitoring:** Continuous tracking of radiated noise levels from individual ships or fleets.
- 2. Advanced acoustic analysis:** Precise measurement of underwater noise in decibels across different frequencies.
- 3. Cloud-based and on-premises deployment:** Scalable architecture for deployment in diverse operational environments and access across multiple devices.
- 4. AI-enabled transmission loss estimate:** Powered by Neural network for real-time estimation of sound transmission loss, backed up by MRC Research
- 5. Integration with vessel systems:** Compatibility with Automatic Identification System (AIS) for ship tracking.
- 6. User-friendly data export and reporting:** Export noise analysis reports in various formats for stakeholders. It further involves comparative results depicting changing noise levels for the area of interest over a specified duration.





In addition to the insightful demonstration by our Deputy Director, our on-ground team, comprising Research Engineers, played a key role in showcasing these advanced tools on their electronic devices. They provided hands-on demonstrations of the Passive Sonar Simulator and SRN models, allowing the officers to see the practical applications of these tools in real-time. Furthermore, our team introduced the Area, Production, and Yield (APY) Analysis Tool, which our talented research fellows developed. This tool, designed to support better understanding and management of maritime areas, provides a sophisticated method for analysing area utilisation, production levels, and environmental yield data. By integrating various data sets, the APY Analysis Tool offers insights that can guide decision-making processes and enhance resource management in maritime operations.



The armed forces officers were shown how these tools could be seamlessly used on mobile devices, demonstrating their ease of use and practical applicability in the field. This hands-on session highlighted the technological innovations developed by our team and emphasised their critical role in enhancing operational efficiency, maritime security and environmental monitoring.



### 3.3. COMMANDANT, CME'S VISIT TO OUR DEMO AREA AND THE PRESENTATION MADE BY MRC TO HIM

As part of the collaborative initiative with MILIT, designed for professionals from the armed forces and military, we had the distinct privilege of hosting Lieutenant General AK Ramesh, the esteemed Commandant of the College of Military Engineering (CME), on January 10, 2025. The visit took place at our demo area, where we had the opportunity to showcase some pioneering research and developments our team has been working on. During his visit, Lt Gen Ramesh was guided through our poster presentation area, where our team presented a comprehensive overview of critical topics that are central to our ongoing research efforts. These included areas such as Sediment Management, Digital Transformation (from the environmental context), Underwater Radiated Noise (URN) Management, and the Sustainable Blue Economy. Each of these topics is integral to the strategic and operational challenges faced by the military and is pivotal in fostering innovation in the defence and environmental sectors.

In addition to the posters, our Research Engineering team provided an online demonstration of several advanced tools developed to support the UDA campaign. The tools highlighted were the APY Analysis Tool and the Shipping Radiated Noise (SRN) Tool. These tools are instrumental in mapping and analysing underwater environments with greater accuracy, enabling better management of resources and minimising the environmental impact of naval operations. It is worth noting that these tools are designed to improve understanding of underwater noise pollution, a critical issue for marine life, and also provide valuable insights for sustainable maritime operations and resource management.



The discussions that followed Lt Gen Ramesh's visit emphasised the importance of these tools and research in ensuring the armed forces' continued safety, sustainability and operational effectiveness, particularly in the underwater domains. This event reinforced our collaborative approach to advancing technology and research to support military objectives and the broader goal of environmental stewardship and sustainable development.

**MRC's presentation to the Commandant, CME:** During the visit of the Commandant, CME, our Founder and Director, Dr (Cdr) Arnab Das, made an impactful presentation on the "UDA Framework for enhanced strategic security in the Marine and Freshwater systems." Through this presentation, Dr Das explained the strategic perspective described by the 'People, Economy and Nature' approach set by the MRC. Further explaining this, Dr Das explained how the 'People' component included coastal and riverine communities, the impact of traditional practices, and their livelihood loss. The 'Economy' component included fisheries, aquaculture, damage caused by disasters, and the cost of resilient infrastructure.

On the other hand, the 'Nature' component includes extreme weather events, sustainable blue economy and ecosystem devastation. In addition, Dr Das also spoke about the climate-related challenges faced by island nations, including Kiribati, Tuvalu, Islands of Oceania, and Maldives, and megacities, including Tokyo, Mumbai and Jakarta, that face threats of rising sea levels. He further spoke about the UDA's four key stakeholders, which include Maritime Security (Defence and Security), Blue Economy, Environmental Regulators (for Disaster Management) and Science & Technology. He explained the three significant frameworks designed by the MRC-UDA Framework, Underwater Radiated Noise (URN) Management Framework and the Sediment Management Framework.



### **3.4. MOU HAS BEEN SIGNED BETWEEN MRC AND MILIT**

During this significant collaborative event, the MRC and MILIT formally signed a Memorandum of Understanding (MoU), marking the commencement of a strategic partnership aimed at advancing the capacity-building of Armed Forces and paramilitary forces. This MoU sets the stage for a dynamic collaboration that will focus on providing training and research opportunities to MILIT officers. This will empower them with the advanced skills and knowledge to navigate and excel in the rapidly evolving maritime and defence sectors.

This partnership will bridge the gap between research and practical application, ensuring that military professionals are well-equipped to meet the complex challenges of modern defence strategies. Through tailored educational programs, specialised training modules, and collaborative research projects, MILIT officers will gain hands-on expertise in critical areas such as maritime security, environmental resilience, and emerging defence technologies.



This collaboration between MRC and MILIT aims to enhance individual capabilities and foster a culture of innovation within the armed forces. By combining MRC's extensive research expertise with MILIT's training infrastructure, the two organisations aim to drive forward-thinking solutions that enhance defence capabilities, bolster national security, and support strategic goals in the maritime domain.

This partnership represents a commitment to building a robust security infrastructure. It ensures that military personnel are equipped with the latest insights, tools, and strategies to effectively address emerging threats and contribute to the nation's overall security and defence landscape. By developing a cadre of highly skilled officers, this collaboration will play a pivotal role in strengthening the nation's defence capabilities within the maritime sector and broader defence and security initiatives.

### 3.5. PRESENTATIONS MADE BY THE MRC-TRAINED DSTSC OFFICERS AT THE EVEN

Since November 2024, the MRC has collaborated closely with the MILIT by providing specialised training to student officers enrolled in the prestigious Defence Services Technical Staff Course (DSTSC). As part of their curriculum, these officers (Maj. Ravi Kumar, Maj. Raveesh Attri, Cdr. Atul Tripathi and Cdr. Tejinder Singh) were tasked with conducting and presenting research projects, contributing to advanced maritime and defence-related technologies.

The topics covered by the student officers were diverse, addressing critical research areas with direct applications to military operations and technological advancement. Some of the key subjects explored included:

**1. Underwater Sedimentation Study for Developing an AI-based Application for Estimating Sediment Bearing Pressure for Tri-Services:** This research focused on using artificial intelligence to estimate sediment-bearing pressures. This is crucial for understanding the impacts of sedimentation on underwater structures and amphibious vehicles.

**2. Underwater Sedimentation Study for Enhancing Amphibious Capability Using AI Integration:** This study examined how AI could enhance the amphibious capability of defence forces. The goal of integrating AI with underwater sedimentation models was to predict and mitigate potential challenges posed by varying underwater terrain, thus optimising amphibious operations.

**3. Underwater Radiated Noise Management:** Another officer delved into managing underwater radiated noise, which is critical for reducing sonar detection and ensuring stealth capabilities for submarines and other maritime vessels. This topic is central to enhancing the strategic advantage of naval operations.





One particularly notable presentation was given by an officer who elaborated on **"Developing Correlation Between Overwater and Underwater"**. In this research, the officer sought to establish a correlation between overwater (above the water surface) and underwater (subsurface) parameters, focusing on how environmental factors above the waterline influence underwater conditions. This research is crucial for understanding how weather patterns, surface currents, and acoustic signatures above water may directly affect the behaviour of submerged vessels or sonar systems.



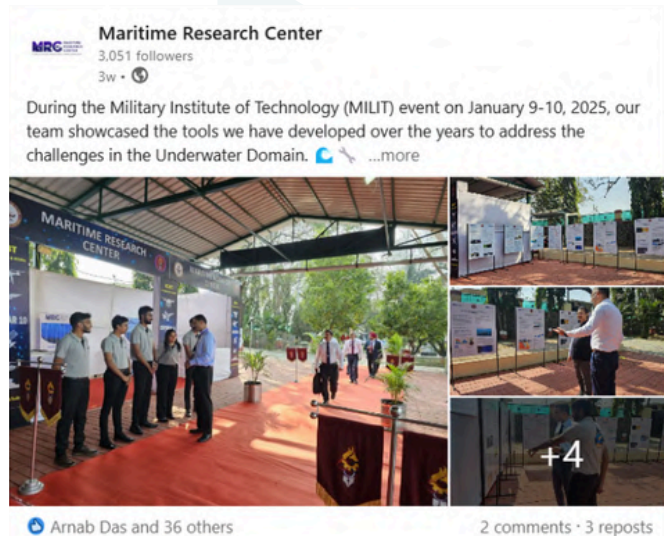
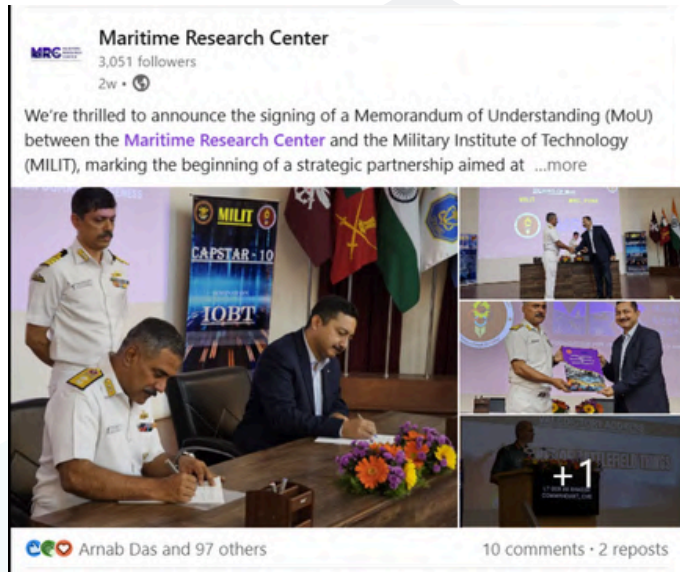
In summary, the DSTSC students at MRC presented research aimed at advancing technological capabilities. They sought to bridge critical knowledge gaps between operational domains, integrating artificial intelligence and environmental studies to bolster defence strategies in complex maritime environments.

## 4. MAJOR TAKEAWAYS

- Innovative tools, such as the Passive Sonar Simulator and Shipping-Related Noise (SRN) models, were showcased. These tools enhance understanding of underwater acoustics and support marine ecosystem monitoring. They are key in managing underwater noise pollution from maritime vessels, improving operational efficiency, and minimising environmental impacts on marine life.
- The APY Analysis Tool and SRN Tool were demonstrated to Commandant CME as solutions to enhance understanding and management of marine environments, which is crucial for defence and environmental sustainability.
- A formal partnership between MRC and MILIT was established to enhance training and research for MILIT officers, focusing on maritime security, environmental resilience, and emerging defence technologies.
- The collaboration between MRC and MILIT aims to bridge the gap between research and practical application, ensuring military professionals are equipped to address modern defence challenges.
- A strong focus should be on technological innovation, strategic collaboration, and advanced training to improve defence capabilities, particularly in the maritime domain, while ensuring environmental sustainability and resilience.
- Through tailored educational programs, specialised training modules, and collaborative research projects, MILIT officers will gain hands-on expertise in critical areas such as maritime security, environmental resilience, and emerging defence technologies.
- Research on managing underwater radiated noise and understanding the correlation between overwater and underwater parameters highlighted the integration of AI and environmental factors in advancing defence strategies.



## 5. SOCIAL MEDIA OUTREACH





## UNDERWATER DOMAIN AWARENESS (UDA) FRAMEWORK

### DR (CDR) ARNAB DAS

The concept of Underwater Domain Awareness (UDA), in a more specific sense, will translate to our eagerness to know what is happening in the underwater realm of our maritime areas and the freshwater systems. This keenness for underwater awareness from the security perspective means defending our Sea Lines of Communication (SLOC), coastal waters, and varied maritime assets against the proliferation of submarines and mine capabilities intended to limit access to the seas and littoral waters. The freshwater systems, particularly the transboundary Rivers, are not defended by the Navy & the Coast Guard, but these waters are equally vulnerable and more complex to manage. However, military requirements may not be the only motivation for generating underwater domain awareness. The earth's underwater geophysical activities have a lot of relevance to the well-being of humankind, and monitoring them could provide vital clues to minimize the impact of devastating natural calamities. The commercial activities in the underwater realm need precise inputs on the availability of resources to effectively and efficiently explore and exploit them for economic gains. Underwater resources include fisheries, aquaculture, seaweeds, pharma ingredients, minerals, and others with significant market value. The regulators, on the other hand, need to know the pattern of exploitation to manage a sustainable plan. The connectivity through the water bodies has been recognized as the most effective and efficient mode of transportation, however, ensuring navigability in these water bodies requires a massive amount of UDA. With so many commercial and military activities, there is a significant impact on the environment. Any conservation initiative needs to precisely estimate the habitat degradation and species vulnerability caused by these activities and assess the ecosystem status and climate change risk. The scientific and research community needs to engage and continuously update our knowledge and access of the multiple aspects of the underwater domain. The global community is looking at the Indo-Pacific strategic space for their geopolitical and geostrategic engagements. The Indo-Pacific region, by definition, is the tropical waters of the Indian and Pacific Oceans. The tropical waters present unique challenges and opportunities regarding rich biodiversity and resource availability. However, the sub-optimal sonar performance is the biggest issue, limiting the UDA in these regions. The sonars that were designed for the temperate & polar waters of the Greenland, Iceland, United Kingdom (GIUK) gap during the Cold War era suffered 60% degradation when deployed in tropical waters. The developing nations in tropical waters need to customize these technologies to suit their conditions. The Western nations that are pushing this hardware do not have the manpower to deploy it. In contrast, the tropical nations, have the manpower but lack the appreciation of the technology and the know-how. The proposed UDA Framework, presented in the figure below, can optimize resource deployment and provide nuanced policy and technology intervention, along with acoustic capacity & capability building to manage the tropical challenges and opportunities. There is significant fragmentation among all four stakeholders, namely Strategic Security, Blue Economy, Sustainability & Climate Change Risk Management, and Science & Technology (Digital Transformation), and the UDA framework provides a comprehensive way forward for the stakeholders to engage and interact.

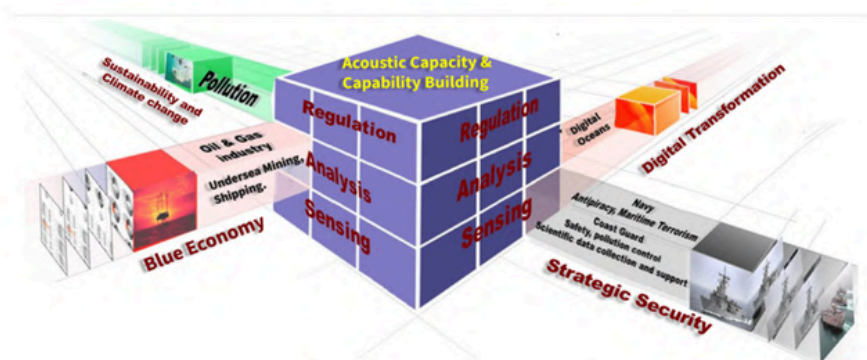


Figure. Comprehensive Perspective of the UDA Framework

On a comprehensive scale, the UDA Framework needs to be understood in terms of its horizontal and vertical construct. The horizontal construct would be the resource availability in terms of technology, infrastructure, capability, and capacity specific to the stakeholders or otherwise. The stakeholders represented by the four faces of the cube will have their specific requirements, however, the core will remain the acoustic capacity and capability. The vertical construct is the hierarchy of establishing a comprehensive UDA. The first level, or the ground level, would be the sensing of the underwater domain for threats, resources, and activities. The second level would be making sense of the data generated to plan security, conservation, and resource utilization strategies. The next level would be to formulate and monitor regulatory framework at the local, national, and global levels. The individual cubes represent specific aspects that need to be addressed. The 'User-Academia-Industry' partnership can be seamlessly formulated based on the user requirement, academic inputs, and the industry interface represented by the specific cube. It will enable a more focused approach and a well-defined interactive framework. Given the appropriate impetus, the UDA Framework can address multiple challenges being faced by the global community today. Meaningful engagement of the young and aspirational population is probably the most critical aspect that deserves attention. Multi-disciplinary and multi-functional entities can interact and contribute to synergize their efforts towards a larger goal seamlessly.

The UDA Framework is a structured, comprehensive, and inclusive framework to drive the underwater domain effectively and efficiently. The structured approach will minimize the fragmentation among the stakeholders, regional players, national authorities, and local bodies.

The multiple entities will have divergent interests and priorities, thus, converging them into one single and focused governance mechanism will be a challenge. The governance mechanism must be comprehensive and recognize all dimensions of the stakeholder requirement. The dimensions include varied layers that are instrumental in building a strong governance mechanism. The first layer would be five pillars: research, skilling, academia, innovation, and policy. The second layer is its translation into policy & technology intervention, along with acoustic capacity & capability building. The inclusive aspects include varied socio-economic, socio-political, and socio-cultural native groups in the larger governance framework. The varied socio-economic strata of the society, particularly the coastal & riverine communities, get excluded in the conventional development models. The students need to prepare for real-world challenges and get very late before they get exposed to the nuances of real-world issues. The political spectrum is always driven by the social structure, based on left or right leanings. The governance mechanism has to address the concerns and aspirations of both sides. The cultural divide translates to the traditional practices and beliefs that drive their livelihoods and social structure. The governance mechanism has to address these divides and integrate everyone into one national, regional, or global framework.

The global community is also professing the triad of people, economy, and nature for enhanced governance mechanisms. The people component includes the livelihood, well-being of the native communities, social dynamics, and more. The economic component is the growth and prosperity associated with the activities. The nature component addresses sustainability and climate change risk management. This is also measured in terms of the Environmental, Social, and Governance (ESG) formulation. The UDA Framework is consciously addressing all these varied measures of global good parameters.

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UDA Framework Page

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