Latest Technology: Best Choice to Develop Future Navy

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Abstract

Latest technology is the most modern, smart and advance technology and which is usually considering as an effective and useful tools to monitoring, managing and decision making to optimize maritime resource extraction, ocean health and develop smart maritime organization by preserving environment, safety and security in modern era. Latest and smart technology facilitates to analyze huge data, track vessels or marine resources by ensuring environmental issues intact. Artificial Intelligence (AI) and other smart-powered solution with advance sensors, satellite images, smart models, etc. are supreme in furnishing scientists and researchers with the tools essential for real-time surveillance, tracking and early recognition of maritime safety or security issues, vessel traffic, surveillance, extending their observational reach and maritime warfare. AI, Machine Learning (ML) and other smart technology will lead and dictate the future to preserve the sea and its resources for the mankind and safe operation of maritime industry by ensuring safety and security. We can utilize AI and other advance technology at its full potential to make the health of oceans better and solve many maritime security and safety issues as we don't know but which may rise in future. We need to train our man and future generation with the knowledge and skill of AI and other advance technology in 21st century to develop modern maritime sector including Navy. We need to accrue knowledge, intelligence and wisdom along with useful skill to build purposeful navy for prosperous Bangladesh. It is an analytical study to evaluate that the latest technology is the best and effective option to enhance maritime sector and develop future and modern navy.

Keywords: AI, ML, Advance Technology, UAV

Introduction

Latest technology usually is the modern, smart and the best technology. Now latest technology like AI and ML is considered as an effective and useful tools to monitoring ocean health. Now oceans play vital role in captivatin.g carbon

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dioxide from the atmosphere, regulating climate, and providing home for marine living. However, ocean and it's contents are under threat from pollution, accident, and rising temperatures since recent development of civilization. Now a day, AI algorithms and smart technology researchers can monitor and model ocean environment with extraordinary accuracy, tracking changes over time and space that are important to the health and existence of marine life. Oceans encompass around three-fourth of earth surface, and our creator has designed earth for life to better living with sustainability. The future of humanity is highly dependent on the oceans. The oceans are always not only important for our planet but also for human being. Beautiful earth is the home for all living organisms. The presence of seas is crucial for life and that is the mystery of creation. Again, seas play a fundamental role in regulating the global climate by ensuring habitation for a diverse array of marine life as well as influencing weather patterns. Again, oceans support a wide variety of ecosystems, like coral reefs, deep-sea vent, deep sea mountain, terrain, etc, and which are home to countless species of plants, fish and animals. Sea is threatened from maritime activities, pollution, marine accident, and rising temperatures since recent development of civilization. Advance technology including AI and ML is considered as effective and useful tools to monitoring, managing and decision making to optimize maritime resource extraction, maintain ocean health, ensures safety and security in modern era. Today, the meticulous surveillance and monitoring of sea is a massive task where AI and ML play a crucial role than before. AI-powered solution with advance sensors, satellite images, smart models, etc, are supreme in furnishing scientists and researchers with the tools essential for real-time surveillance, tracking and early recognition of maritime safety and security issues, monitoring vessel traffic, and extending their observational reach. AI, ML and other advance technology will lead and dictate the future to preserve the sea and its resources along with safety and security for the mankind and safe operation of any navy. So, Advance technology is the effective solution for smart maritime safety, security and prosperity for any maritime nation. Bangladesh has been gradually investing and developing in technology-driven solutions to enhance its maritime security capabilities. The action is slowly enriching its AI-based maritime security system with limited resources. However, in 21st century, AI, ML and other advance technology based maritime security initiatives and solutions are indispensable for us. Bangladesh can utilize AI driven real time data gathering, tracking, monitoring, surveillance and processing systems to monitor, manage and make decision by its maritime borders, ports, coastal areas or even EEZ safely and effectively. Today, we can improve Maritime Domain Awareness (MDA) in our water by successful implementing AI algorithms and ML

for vessel tracking and identification. AI or ML powered solution can help to identify and classify ships or craft, track their trajectories, and detect doubtful activities in real-time. Intelligent surveillance cameras equipped with AI algorithms can also help monitor port perimeters, improve surveillance and identify security breaches promptly.

Latest and advance technology is that technology which is still immature but promises to deliver significant value, or that has some technical maturity but still has relatively few users. Such as: AI, ML, virtual reality, 3D printing and visualization, smart cards, real-time collaboration, data mining, and so on. Again smart is something used as memorization tool or "mnemonic device to set up criteria for efficient goal-setting and objective advancement" (Doran, 1981). Anything SMART means it is "Specific, Measurable, Assignable, Realistic, and Time-Bound." Smart technologies naturally more energy efficient, easier, accountable in the functions they perform, and more powerful when synchronized or collective. Automation and technological development made the job of industrial operators easier, faster, smarter in terms of physical efforts, but at the same time more complex and challenging, in terms of cognitive and mental efforts (Demant et al., 1999). AI is the generic term for intelligence displayed by machines, particularly computer systems (Copeland, 2004). AI is a versatile technology with a wide range of uses. Examples include credit scoring, e-banking, e-healthcare, e-commerce, e-agriculture, e-business, automation, industrial robots, language translation, image recognition, decision-making, and many other fields (Shapiro et al., 2001). As a branch of AI, ML uses data-driven algorithms to enhance the precision and functionality of AI systems. Again, Deep Learning (DL) is a subfield of ML which utilizes Artificial Neural Networks (ANNs) that encourages by the human brain's configuration to process and learn from huge amounts of data. Natural Language Processing (NLP) is a discipline of computer science, exclusively related to AI (Guida et al., 1986). Main uses of machine vision are automatic inspection, industrial robot, organizational process guidance, etc. DL is a subfield of ML, whereas ML is a subfield of AI (Hossain, 2018a). Again, the field of Data Science (DS) involves the achieving of useful knowledge and insights from structured and unstructured data. Data Mining (DM) is commonly a part of the data science channel and used to unfold patterns and make data more functional for analysis. Sophisticated AI and other smart technology introduce autonomous, independent and almost crewless ships, which can operate independently without human dealings and the mistake rate is lower than that of human operated ships (Lee et al., 2019). AI is gradually transforming the conventional operational process of the maritime industry into self-governed

system. Therefore, the amount of research on the application of AI, ML or other smart technology has increased significantly since 2012 (Liu et al., 2018). Following this movement, data-centric innovative technologies and many new innovative organization or business models has been developed (Munim et al., 2019). This transformation is reshaping and converting the entire maritime industry and providing new opportunities to progress productivity, efficiency, user friendly and sustainability along with new challenges (Heilig et al., 2017). Studies on the combination of AI, ML or other smart technology application in maritime sector are not usual. This has created a gap in the academic literature. ML, AI, and other advance technology for maritime operations, surveillance, preservation, management, safety and security issues. Such technology has improved maritime surveillance, monitoring and operation. These can contribute to the economic, commercial and environmental aspects of the maritime business (Sanchez-Gonzalez et al., 2019). Maritime trade accounts for about 80% of world trade (UNCTAD, 2018). The industry faces many challenges due to its vastness diversity (Brouer et al., 2016) and even growing regulatory requirements. Advance technology is offers viable and sustainable solutions to some of these challenges.

Today, AI and data about ship performance and navigation systems can help shipping companies and modern navy to monitor and control warships or vessels' performance and take necessary steps to improve the operational efficiency of the ships or vessels and ease the shipping and fleet management system (Mirovic et al., 2018). Maritime industry generates large amounts of data and diverse information globally. If we can properly utilize those data and information, this will help us in decision-making process. This will also improve maritime safety, security, ship operation, advance maritime warfare. This is expected to minimize impacts and will optimize expense. To the best of today's knowledge. There have been very few review studies on AI, ML, big data and digitalization in the maritime context (Fruth et al., 2017). Most of the investigative study and evaluation is more comprehensive than previous studies in terms of quality. Most of the previous study seems to have used only Automatic Identification System (AIS) data and limited use of such technology in maritime sector (Perera et al., 2017). Some researchers did not follow any systematic approach to literature selection, and that usually lead to biased or as usual findings. Few researchers overtly focused on digitalization, although they used AI and big data in their keyword search. Future researcher need to consider and include AI and other aspects of advance technology in the maritime domain and navy more widely using contemporary development and examples for better understanding of the specific objective and setting goal. AI and ML driven technologies are reshaping

and optimizing conventional practices, improving operational performance, and finding the way for a more useful, connected, committed, intelligent, and flexible maritime system, warfare, and warship management or deployment for a modern navy. It is an analytical study to evaluate the idea that latest smart and advance technology is the best option to develop future navy for prosperous Bangladesh.

Future Ship

Latest and modern vessels, whether merchant or warship, have numerous sensors attached to gather data about the vessel's condition which convert normal ship to smart ships. It is a new age which is calling us. Digital data, computer code, and new technological infrastructure which propel the modern world will be the components of smart ships (catawiki). These forces will unavoidably innovate and move the supply chain toward sustainability and environmental responsibility. In modern era, many global commercial contracts might be the computer-coded smart contracts. We may refer to it as modern or smart shipping together. Unlike Digital Twin, all of the data gathered from the ship is combined in one location, such as an office on land or the captain's bridge, and decisions are made only on the basis of real-time readings, without further scenario simulation. However, an IoT or AI platform that simplifies such procedure is required for this idea to succeed (Marine & Offshore). To run shipping in an intelligent, safe, and cost-effective manner, there is a sharp increase in the demand for automation in navigation and control technologies. Moreover, the development of information technology for intelligence, named as 4th industrial revolutions is encouraging the visualization of autonomous ships. Due to greater access to these technologies, nations like USA, China, EU, Korea, Japan, etc., are influencing the development of environmentally friendly autonomous ships through public-private partnership. Smart ships transform key areas like ship design and operation, redefining the global maritime industry and the roles of fundamental components. After full implementation, smart ships intend to provide multi-layer optimization in fuel consumption, carbon or GHG emissions control, and energy efficiency by addressing maritime regulations and using global economic principles. However, we need to solve few problems in the way of broad adoption and practical application of smart technology; like fear of job replacement, time and energy constraints, cybersecurity, data privacy and integration, talent shortage, skill in smart technology, reduced acting employment regulatory compliance, etc., (Felski et al., 2020). Future warfare scenario will be more complex due to inclusion of smart technology. So, future naval platform will be smart and operated by very smart and skill sailors.

Latest and Smart Shipping

In modern era majority of ships have developed into remote offices that provide the captain and crew with a variety of tools and applications, including email, virtual networks, route planners, and dependable internet connectivity. But at present is the moment for shipping firms to consider better business solutions and long-term growth (Leloudas, 2021). Now, AI and ML enter the scene and successfully solve every shipment issue as well as improve management (Mitchell, 1997). Ship owners, business community, and other stakeholders that use AI and ML algorithms first will have a significant advantage due to their high intellect and industry knowledge. Algorithms using AI, ML, and DL can manage data spanning a vessel's operational history (Marine Digital, 2024). Many shipping companies today have effectively reduced the number of passenger and crew accidents, minimized fuel consumption, improved shipping management, crew management, and solved many other issues by utilizing AI, ML, and DL solutions. An ML-based method is used by the port of Rotterdam to estimate the time of arrival of boats (Zimek, 2012). Today, users can apply sophisticated algorithms and analyze data using AI or ML, which helps to inform the reasoning behind potential issues with maritime transportation. Improved voyage optimization will be possible with the use of advanced AI and ML algorithms. These algorithms will be able to predict voyage costs more accurately, minimize personnel performance, calculate the best route in under a minute, and provide recommendations for route, speed, and direction, among other things (Frey et al., 2017).

Latest Shipbuilding

As we know that, shipbuilding is always a vast and advanced form of primitive engineering that is designed to survive in the vast open seas. It integrates cutting-edge technology, which have always been significant in approaching the frontiers of what is possible. Many improvements will take place in the shipbuilding industry to control environmental pollution (Hossain, 2018b). In the near future, we will witness ultra-modern or smart ships as well as various vessels that are extremely cost-effective and environmentally friendly. We are all aware that Industry 4.0 has caused significant changes in the manufacturing industry (Inbuilt Data Newsletter). Now, vessels are made from advanced, complex or even composite materials. Augmented Reality (AR), Virtual Reality (VR) and robotics are used to create many types of ships or vessels virtually and that is useful to ship design. AI or ML has given substantial benefits to the shipbuilding industry in terms of efficiency, accuracy, and safety. One area where AI is making great progress is design optimization and simulation. Naval architects and engineers can

use AI algorithms to test many design changes and evaluate their performance in real time. AI has also been utilized to enhance the building process, with AI-powered robots which performing many critical and hard work like welding, cutting, and painting AI-powered technologies can be used to monitor and optimize ship performance, recognizing potential concerns before they face problems and recommending corrective actions. This can assist to minimize fuel usage, promote safety, and extend the vessel's lifespan (Frey et al., 2017). AI-powered simulation tools can consistently forecast a vessel's behavior under different scenarios, allowing for the optimization of critical characteristics including hull form, propulsion systems, and structural integrity (Specht et al., 2017).

Advance technology has the potential to transform the shipbuilding industry by increasing efficiency, cost-effectiveness, and safety through predictive maintenance, automation, data analysis, better management, effective monitoring and better decision making (Kim et al., 2022). Carbon and other GHG emissions can be managed and reduced, and environmental contamination can be optimized by using advance technologies. Such technology in shipbuilding will readily improve the safety and security of the maritime industry (Hossain, 2024). Different types of equipment on the ship can be linked together via sensors, and we can also use AI-powered sensors to examine the quality of the devices and their performances (Sharma et al., 2021). Fleet members on shore can operate ships using AI-powered sensors. On the other side, 3D printing technology is used to generate virtual images of various objects. It would be extremely beneficial to design multiple pieces of equipment, as it might lower manufacturing costs. The virtual image would be extremely valuable in reducing manufacturing costs in the shipbuilding industry. The primary benefit of using the 3D printing feature is that we can cut development costs. Robotics plays an important part in many industrial operations, including manufacturing. It can also be used to do dangerous and monotonous duties. There are various dangerous duties in shipbuilding, like welding, cutting, grinding or tank inspection. We can use robots to complete these task (Robotnik). Use of robots is suitable and effective in maintaining ship security, inspecting vessels, and preventing defects. Engineers can deploy robots in ship to work in hazardous areas where human life is at risk. Robots can perform a variety of activities in shipbuilding, including blasting, cutting, welding, painting, lifting massive weights, assembling and other construction work (Hossain, 2023d). The ship's engine can be operated by using AI or ML power software, allowing the captain and engineers to monitor the ship's state (wartsila).

Latest and Modern Port Operation

Today, most of the modern ports are enriched with advanced technology like specialized cargo-handling equipment and facilities, like gantry cranes, portable heavy lift crane, straddle carrier, reach stackers, forklift trucks, etc., as well as with AI-power data acquisition, monitoring and operation system. Ports usually have specialized functions like some cater mainly for passenger liners, ferries and cruise vessels; some specialize in container traffic; some cater general cargo or bulk; some ports mainly play an important role for nation's military or navy; some focus on other purpose. Now, it is normal for ports to be either publicly owned in many developed countries, or port may be owned both by the state partly and by the partly cities themselves (Port of Retterdam). Today modern or smart ports are a new generation of digital ports that are designed to be more efficient, sustainable, and innovative than traditional ports. Modern ports are always augmented by smart and advanced technology. They use advanced technologies like Internet of Things (IoT), AI, ML, DL, DS, DM, big data, blockchain, and automation to improve their operations, optimize profits and reduce their environmental impact (SINAY). One of the key features of such modern ports is their automation and inclusion of AI, which allows them to operate 24/7 without human intervention. AI or ML powered solution can track vessel trade routes by integrating real-time data from blockchain databases and IoT sensors into AI algorithms. A port might maximize berthing time by following a vessel's trade path, which would provide an accurate Expected Time of Arrival (ETA). The application of AI technology to precisely schedule a ship's arrival and departure could result in cost savings, minimize environmental effect and port congestion, and facilitate adherence to rules and standards. AI-driven digital modern or smart ports can manage increased freight and traffic, streamline staff work schedules, reduce human error, and boost supply chain efficiency. However, by using AI algorithms, the maritime sector will be able to see their operations from every angle.

Latest and Advance Vessel Traffic System and Maritime Safety

Safe and effective Vessel Traffic System (VTS) is paramount and now acts as heart of modern maritime operations. As example, NeuralBoost is an AI based VTS invented by MakarenaLabs which enhances vessel traffic services by offering real-time analysis of maritime data, significantly improving safety measures. Such modern and advanced technology swiftly pinpoints potential collision risks, navigational hazards, and anomalies, enabling proactive steps to avert accidents and guarantee the uninterrupted flow of vessel traffic. Integrating Neural Boost

advanced tools into any vessel traffic services is necessary and useful to oversee and manage the complexities of modern maritime traffic (Pietrzykowski, 2011). Neural Boost's technology transforms the way maritime data analyzed and turning vast amounts of information into actionable insights and that ensures vessel traffic services work effectively and can anticipate or mitigate risks before they escalate. It also ensures fostering a safer maritime environment. It ensures a safer, more efficient pathway through the busiest waters, protecting vessels, cargoes, and crews against the dynamic challenges at sea. It is providing the clarity, but more foresight needed to navigate the future of maritime operations confidently. However, few benefits of Neural Boost for vessel traffic services have been given below.

• It can help to identify risk and detect potential dangers in real-time, from collision risks to navigational hazards for marine platforms or vessels.

• It can enhance navigational safety for vessel by making comprehensive insights to navigate away from hazards and ensure vessels operation in safe waters.

• It can help to optimize traffic flow and use as aids in maintaining a smooth and efficient movement of vessels and minimize delays and improve operational timelines.

Latest and Smart Surveillance

Today, the amount of data in the maritime domain is rapidly increasing due to the increase in devices that can collect marine information, like weather, port, sensors, buoys, ships, satellites, etc. It is difficult to manage vessel and marine related data due to high heterogeneity and AI or other modern solution comes as a blessing. Maritime surveillance encompasses the monitoring, detection, and tracking of vessels, activities, and threats within maritime domains. Effective surveillance is essential for various purposes, including national security, law enforcement, environmental protection, and maritime commerce. However, traditional surveillance methods, such as radar, AIS, and visual observation, have limitations in terms of coverage, accuracy, and efficiency (Ahmed, 2022). The dynamic nature of maritime environments, characterized by vast expanses of open sea, diverse vessel types, and complex operating conditions, further complicates surveillance efforts. AI and other advance technologies like ML, DL and big data analytics offer new opportunities and viable solution (Lecun, 2017) to enhance maritime surveillance capabilities. By analyzing large volumes of diverse data from various sources, AI algorithms can identify patterns, anomalies, and potential threats in real-time. AI powered systems can augment traditional surveillance

methods by providing advanced data processing, decision support, and predictive analytics capabilities (Xiao et al., 2022). Moreover, AI enables autonomous and adaptive surveillance systems that can continuously learn and improve over time. AI applications in maritime security cover a wide range of tasks, including followings.

Latest and Smart Maritime Security

Maritime security is a wide and vital as well as unformulated concept. However, it has become a large task linking many entities from global, local, public and private sectors. The object was to preserve the freedom of Navigation and to facilitate and to protect trade/commerce, as well as to maintaining good governance at sea or ocean (Hossain, 2023e). The utilization of AI in maritime surveillance offers several potential benefits. AI algorithms can analyze data from multiple sources and identify subtle patterns or anomalies that may be missed by human operators or traditional surveillance systems (United Nations Convention on the Law of the Sea, 1982). AI driven surveillance systems provide real-time insights and alerts, enabling maritime authorities to make informed decisions and respond promptly to security incidents (Roell, 2011). Automation and optimization of surveillance tasks through AI technologies help streamline operations, reduce false alarms, and allocate resources more effectively. AI systems can adapt to changing maritime environments and evolving threats, continuously learning from new data and improving performance over time. There are several examples, successful and case study from around the world that demonstrate the effectiveness of AI in enhancing maritime security.


Source: https://www.tradewindsnews.com/
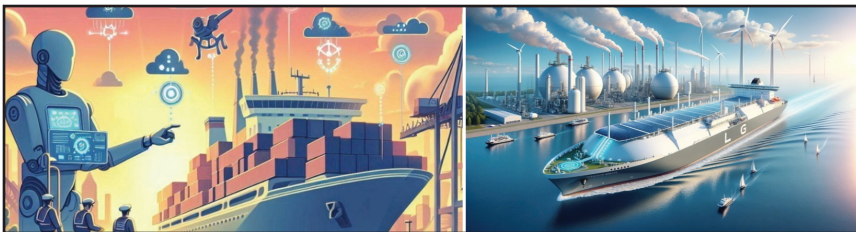
Figure 1: AI has Both Opportunity and Challenge in Maritime Industry

Latest and Advance Cybersecurity

Today, AI is changing basically the way of IT solutions which are implemented and operated across both application and geospatial domain. This contribution outlines AI-driven techniques for 3D point clouds and geospatial digital twins as generic parts of geospatial AI (Qi Q et al., 2018). Now, AI

technology can be used to simplify and accelerate workflows for geo-data processing and geo-information systems (Alpaydin, 2014). Geospatial AI leverages high-resolution satellite imagery to monitor maritime activities. Algorithms detect vessels, track their movements, and identify anomalies like illegal fishing, smuggling, drug trafficking, etc. Real-time analysis enhances situational awareness. AI models learn from historical data to recognize patterns. As maritime systems become increasingly digitized, AI can play a crucial role in identifying and mitigating cybersecurity threats, like hacking attempts on port infrastructure or maritime communication networks. The rolling threat of cyber-attacks got a shacked from the recent advancements in AI (Bozinovski, 1982). Now, AI has been applied in almost every discipline of different sciences and engineering matters. The involvement of AI not only automates a meticulous task but also improves effectiveness by many times (Cybersecurity Ventures, 2022). AI-driven cybersecurity solutions can detect anomalous network behavior, prevent cyber-attacks, and safeguard critical maritime assets along with ensure vanguard defence arsenal in complex maritime war scenario (Hossain, 2021). AI-driven solution is going to become a game changing system in maritime industry.

Source: https://marine-digital.com/
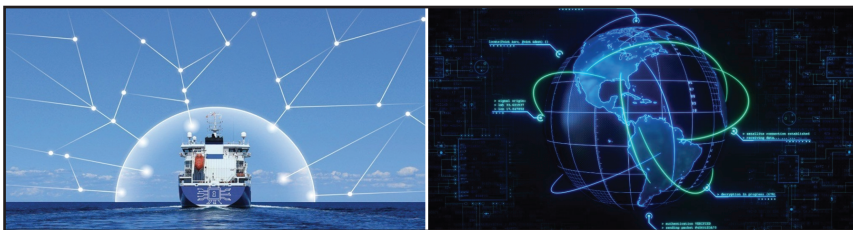
Figure 2: Cyber Threat and Cybersecurity in Maritime Sector

Develop Modern Bangladesh Navy for Future

The security environment in 21st century is becoming more complex and uncertain, and we now face a wider spectrum of threats and security issues. This is particularly true for a maritime nation in general and any littoral navy in particular situated in dynamic and vast water like Indian Ocean and having to deal with an absorbent maritime security environment. In addition, as a maritime trade hub, the waters that Bangladesh Navy (BN) protects are extremely crowded with many merchant vessels and other maritime activities. The BN is constantly looking at how we can harness the latest and advance technological developments, like robotics, AI, ML, digital twin, data analytics, blockchain, to enhance our

capabilities and operational effectiveness managed with very limited budget and resources.

Latest Design and Building of Advanced Ship for BN. The BN's need purpose oriented and revolutionary smart warships in line of global technological development. We need to develop partnership and enhance our ship design and to build ship by BN operated three shipyards. We need to accommodate important features like innovative design concepts for both operations and engineering support. The design process adopted a modern design the requirement and support sequential approach, where key downstream engineering and logistics support considerations were factored sincere in the vessel's design. Its stacked mast maximizes sensor coverage while allowing maintenance to be carried out more efficiently, induct configuration management, and has led to the reduction of time spent at dock for mast-related defects. In addition, future ship designed to be more capable than the existing old-age BN ships as they will be replaced in course of time. Key features of future smart ship will include:

• Re-location of the Bridge, Combat Information Centre (CIC) and Machinery Control Room (MCR) in the Integrated Command Centre for more effective and efficient maritime safety and security operations in future maritime scenario.

• Automation, sense-making and decision support systems for both combat and platform systems. Future platform should be capable to perform effectively in multi-mission environment with optimum output.

• Future warship will be larger, stable, more complex, automated vessels with inclusion of smart technology. Life span of future ship will be optimum and cost-effective platform, with less manpower and less maintenance.

• Advance and modern ship hull will be enable to good seakeeping, allowing the ships to operate in Bay of Bengal even during monsoon seasons.

• Advance or smart ship will enable to navigate safely and operate autonomously in proximity with other vessels with the in-built collision detection and collision avoidance system. Those ships are also able to maneuver autonomously by waypoint navigation and maintain its position relative to other vessels. This reduces the workload and frees up the capacity of the operator remotely controlling the ship in our coastal water, which is one of the busiest shipping lanes in the region, to have increased situational awareness and ability to detect any illicit and suspicious activity.

• With the high level of autonomy and integrated C6ISR (command, control, communications, computers, cyber-defense and combat systems and intelligence, surveillance, and reconnaissance) systems on board, the operator control station located ashore or on-board platforms at sea, can control the movement and payload of the ship with minimal manpower required.

Unmanned Ships and Aircrafts. Now, the BN operates manned ships to patrol in the Bay of Bangla and scan the seabed to keep our shipping lanes safe for navigation. The BN need to develop need base AI-power Unmanned Surface Vessels (USVs) in future. It may be for Coastal Defence USV to conduct coastal patrols, for Mine Countermeasure USV with Towed Synthetic Aperture Sonar (TSAS) to conduct underwater scans of the seabed to detect mines, for Mine Countermeasure USV with Expendable Mine Disposal System to conduct mine disposals, for Survey USV to conduct effective hydrograph survey, for R&D to undertake smart and useful research. Again, the fully automated detection and classification system on board the USV can rapidly detect and classify mines and other under water threat and reduce the time required for countermeasure operation. Equipped with advanced sensors and software, future USVs will provide comprehensive maritime security and ensure defence for Bangladesh. BN is going to enhance her surveillance capability with Unmanned Air System (UAS) in very future.

Operational Effectiveness. BN is going to leverage AI-driven data analytics for predictive maintenance system in future. Equipment maintenance on board the ship is currently conducted according to pre-planned schedules. Defects are rectified as and when they occur, which impacts readiness and increases costs. The BN is going to conduct trials to use data analytics on key equipment parameters like engine health, vibration and temperature data on critical systems to predict when defects may occur. Ship crew will then be triggered to take pre-emptive steps to prevent defects and avoid costly repairs. BN is going to conduct trials for predictive maintenance of the PC or LPC's diesel engine and generators. The resultant cost savings will be projected soon by identifying amount of cost-saving, with the potentials to adapt it for other systems in future. BN is going to leverage on AI-driven purposeful base access system in future. Currently, the base security screening process is labour-intensive and time-consuming. The BN is going to start Purposeful Base Access project that utilizes a combination of facial recognition and digital identification to simplify the process while maintaining high security standards. Without the need for laborious verification

methods, the Purposeful Base Access project will reduce the number of security personnel required and will be cost-effective.

Maritime Security. BN is going to leverage on AI-power data analytics to enhance maritime security in future. BN is trying to continually refine the system and leveraging AI-power data analytics to improve detection of anomalies and its sense-making capabilities in near future. The BN is going to set up AI-driven platform to comprehensive network of coastal surveillance sensors to detect any maritime threats in our water in near future. BN is trying to find out the solution and collaborating with capable support and technology providers to develop data and video analytics to automatically classify vessels and flag out anomalies, which will increase situational awareness and reduce human error. This will increase the BN's operational efficiency and translate to manpower savings distinctly, as ships and personnel who were previously conducting manual scanning. BN is going to establish AI driven purposeful fusion center to develop a sense-making system that collects and fuses information from other government and maritime agencies and open sources and applies data analytics to uncover maritime threats and activate operational responses to deal with possible safety and security anomalies. BN is also needed to work with other military forces, CG, BGB, Police and related agencies to collect, process and analyze, historical, real-time data and parameters to obtain the movement of craft, vessels and other activities within our water and coastal area. Engineers will integrate the various surveillance and sensor feeds and that can be monitored remotely at the command center. We can develop and place Unmanned Watch Tower (UWT) in vital point along the coast and that can enhance and ensure following advantages more effectively with optimum cost:

• To enhance operation.

• To collect, process and use Real-time data and information.

• To enhance monitoring, managing and decision-making.

• To support 24/7 coastal surveillance operations.

Modern Leader and Skilled Human Resource for BN

Today, advance technology profoundly influences every aspect of our lives, transforming the way we interact, manage daily affairs, and conduct with others. Such technologies are likely to change the way that future leaders cooperate with their teams and stakeholders. Today, the typical leadership strategy of being "The Boss" and imposing control, power, and authority is going to be

ineffective, especially when followers or teams are working remotely. Now, leaders empower and encourage their colleagues and followers to achieve great things by leveraging advanced technologies with zeal, initiative, honesty, flexibility and vision. Before embarking on any technology-driven effort, a leader must ensure that their plan, strategy and decision to meet three important criteria: technical feasibility, financial viability, and legal acceptability (Hossain, 2023f). Modern leadership is a way an individual lives to convince, influence, motivate and inspire others and it has huge difference with the title or position, or rank based classical or conventional leadership. Again, command is limiting which can also result in people conflicting and objecting as they are not convinced or motivated or influenced by the visions, missions, goals, ideas and views. A modern leader who is able to inspire people by providing the pros and cons of the actions, strategies, plans in practice or on ground is more accepted and is followed as followers or team-mates can relate to it and get convinced (Hossain, 2015a). As a result, modern leadership must derive its existence through communication, relationship, consideration and care in opposition to influence, control, command and order. It is true that, modern leadership does not come from any status or position or title; rather it is a complete behavior, attitude, outlook and lifestyle (Hossain, 2015b). Collaborative is the new leadership paradigm and that has been called by a number of different names like shared, participatory, collective, collaborative, cooperative, democratic, fluid, inclusive, roving, distributed, relational, and post heroic. On the other hand, toxic leadership is a dysfunctional style of leadership that uses autocratic and overbearing management tactics, creating a negative work environment. Due to this hostile work culture, toxic leadership often results in long- and short-term consequences for an organization (Hossain, 2023g). Again, morals and values are important in every aspect of life, when we have to make a choice between two things, wherein morals determine what is right, values determine what is important. Individual beliefs is also part of values that motivate people to act one way or another and serve as guides for behavior considered right and wrong (LEADERS). We need to develop and raise purposeful and useful modern leader to face future challenges in 21st century.

Purpose oriented training for purposeful knowledge and skill: Today, Human Resource (HR) is one of the most valuable assets for any organization which is some for defence forces. Now, HRs is encircled to develop the unique and dynamic aspects that reinforce their competitive advantage to continue in an always ever strategic and global scenario and environment. We need to recruit quality candidates and train perfectly for our organization, to develop skill and

knowledge to optimize human involvement and ensure effective output (Hossain, 2023h). We need to formulate and enhance training to develop purpose oriented formal sailor and officer. Basic education from educated institutions (SSC, HSC, bachelor's degree, Master, etc.) and task-oriented education from training institute (in different level with the technological advancement) is necessary to develop purpose-oriented BN personnel. Purposeful trainer or instructors are the pre-requisite for purpose-oriented training. We need following revolutionary changes and inclusions:

• Purpose-oriented syllabus which need to be meticulously upgraded.

• Purpose-oriented reading materials like books, BR, publication, etc.

• Purpose-oriented training school, institute, college, university, simulator, etc.

• Purpose-oriented instructor, teacher, on ground trainer, etc.

• Purpose-oriented classroom and training aid.

BN need to adopt and conduct simulation technology to ensure more effective training. It has two distinct advantages. It ensures greater training efficiency as trainees go through scenarios on the simulator to hone their skills before, they embark on field training. Again, it increases training pragmatism as the simulator provides trainees with experience on scenarios that cannot be executed during field training due to safety constraints. We need to adopt and arrange Purpose-oriented joint training among the different trades, branches, levels, forces, military, para-military, and civil components to enhance effective operational knowledge and skill. We need to conduct purpose-oriented combined exercise at national key installations like port, airport, headquarters, secretariat, forward bases, and other important organization to boost more vigilance and ensure defence against any threats from any corners.

Conclusion

Maritime sector has already adopted advance technologies to achieve sustainability, efficiency, and cost-effectiveness to some extent. But we need to solve regulatory compliance issues carefully. The maritime industry already has come a long way since the days of oars and sail, although we need to go further. All technology and development have replaced its predecessor as new one is found to be more efficient, effective, more benefecial, user friendly, better, cheaper, cost-effective and safer. AI optimization follows same trend in modern era. It's already helping to optimize fuel, maintenance, operations, tracking, monitoring,

paperwork, port calls, logistics, voyage planning, managing, decision-making, etc. So, with regulatory and commercial endeavor towards optimization, these uses will only expand further in future. Again, the maritime industry by its nature is the most dangerous work environments among other industries due to the very nature. Seafarers at sea and other maritime workers at ashore are involved in high-risk tasks, like oil-spill cleanup and Search-And-Rescue (SAR) operations, firefighting, tank inspections carryout maintenance, faced accidents and incidental problems. AI-driven robotics and advance technology can take over high-risk and problematic tasks, from tank entry to underwater hull inspection to deep ocean activities. In modern age, automation will reduce the number of crew exposed to the dangers. In future, unmanned or smart vessels might even eliminate the risk of crew life going to sea at all. At present, AI drones are being used for hold, hull and tank inspections, saving time and money along with ensuring safety. In future, cargo loading, unloading, inspection, tracking planning and stowage and management will be done safely and effectively by AI-powered tools and system. So, the use of AI in marine sector holds massive promise, revolutionizing safety measures, optimizing operational management, and contributing to a safer, sustainable and accountable maritime industry. By accepting AI and other advance technologies, maritime organizations like shipping, shipbuilding, port, coast guard, navy, solution provider can improve operational efficiency, reduce maintenance and fuel costs, optimize benefits and enhance safety as well as minimize their environmental impact and move towards the green industry.

Advance technology has become a transformative force which is revolutionizing all aspects of everyday lives in various industries including. Maritime stakeholders may examine huge amounts of data, extract valuable insights, and make data-driven decisions in real time by effective use of AI algorithms and ML techniques. Today, shipping, shipbuilding and ship recycling industry including navy must steer and manage complex regulatory frameworks during ensuring the secure collection, storage, managing and analysis of vast data and information. Moreover, the additional costs required to implement and adopt AI solutions, needs many skilled man-powers to understand and to manage AI-driven insights, and which creates a challenge for shippers and sea-fearers in this industry and naval personnel in navy. However, maritime sectors need to establish precise regulating framework, augment cybersecurity measures, and promote a culture of innovation, skill development, effective management and implementation. In 21st century, integrating AI and other smart technology into the maritime industry marks a central shift and transform towards more efficient

operations, better safety, security, sustainable growth and optimize other benefits. It is obvious that, the role of AI will expand and grow further and will offer new solutions for future challenges. By properly utilizing and controlling AI and advance capabilities in maritime sector, we can work together to create a more sustainable and viable future for our beloved earth and ensure and conservation of the oceans for future generations. However, AI may present various risks and challenges, such as job displacement, privacy concerns, complex technical problem and potential misuse of technology. Addressing such challenges requires a multidisciplinary approach involving collaboration, cooperation between researchers, industry professionals, policymakers, business people, government, whole community and society.

Bangladesh will be benefited from establishing partnerships and collaboration with regional and international organizations to share maritime information and intelligence along with AI-driven modern security initiatives. Modern and advance ship designing and shipbuilding, modern hull-machinery-weapon-sensor, overall smart and modern ships, along with AI-driven information sharing set up can facilitate the exchange of real-time data, analysis and process among maritime agencies or stakeholders, enabling more useful and efficient responses to maritime safety and security threats and other contemporary maritime issues. Nation can invest more in training and AI-skilled development programs for maritime personnel on advance technologies and big data analytics to understand and effective use of smart and AI-power maritime security solutions. We need to build local skilled and expertise in advance technology like AI and cyber security device and solution and that will enable Bangladesh to enhance and maintain its own AI systems customized to its specific maritime security requirements. Nation needs to address legal and ethical considerations related to the use of AI in maritime monitoring, surveillance and security, along with data privacy, algorithmic bias, and human rights implications. We need to develop own auditing and accountability system on our own AI and modern solution. We also need to develop, promulgate and establish clear instructions, guidelines, roles and regulations to govern responsible and safe use of AI and other advance technologies and which will help to mitigate possible risks and ensure simplicity, effectiveness and accountability. By this way, advance technology including AI-driven maritime surveillance and smart platforms to ensure better defence for optimum solution for us in near future. Modern navy need to have modern fleet, modern sensors and weapons, modern maintenance, modern man power and other modern and advanced systems. BN needs modern

training, modern HR, modern equipment, modern machinery, modern weapon and sensor, modern accommodation and advance strategy and planning. In future, for modern navy, BN need modern intension, modern attitude, and finally object-oriented, purposeful, smart, dedicated, sincere, balanced, modern and patriotic leaders. We need to prepare us by accruing knowledge, intelligence and wisdom and skill to build modern and purpose-oriented navy for a wealthy, successful, and happy nation in near future.

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