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IIRE Journal of Maritime Research and Development

Maritime sector has always been influencing the global economy. Shipping facilitates the bulk transportation of raw material, oil and gas products, food, and manufactured goods across international borders. Shipping is truly global in nature, and it can easily be said that without shipping, the intercontinental trade of commodities would come to a standstill.

Recognizing the importance of research in various aspects of maritime and logistic sector, IIRE through its Journal of Maritime Research and Development (IJMRD) encourages research work and provides a platform for publication of articles, manuscripts, technical notes, papers, *etc.* on a wide range of relevant topics listed below:

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- Inland Waterways Transport
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Editorial Board

Editorial

IIRE launched the ‘International Maritime Research Confluence’, a decade long project, at the first symposium at the IRS Auditorium in Powai, Mumbai on 13th and 14th February 2020. This major initiative brought the maritime industry players and the academia on a common platform for effective dialogue and deliberation on the need and ways to support achievement of Sustainable Development Goals established by the United Nations in 2015 and promote quality research in the direction. The motto adopted being Research with a Purpose!!

True to the words of following it up every two years, IIRE organized the first follow-up event, online this time, in February 2022, on the very same areas of research panning the entire industry spectrum. The Confluence strives to create amazing platform for industry and academia professionals to explore themselves while interacting in real-time and convert research ideas elegantly and efficiently into actionable initiatives for the industry.

This issue of the IJMRD carries outcomes of three such sessions impacting Ecology & Environment, Ports & Logistics and Human Resource Systems. Conference Proceedings highlight cutting-edge research by revealing emerging trends and new ideas and allow other researchers to influence and get involved in early stages of research. Conference Proceedings are subjected to robust peer-review by suitably qualified experts in the field thus enhancing the value to abstracting and indexing services.

In addition to the above Conference Proceedings there are two original research manuscripts. One is in Social Sciences pertaining to the influence of Power-distance in Emergency Response in the safety- critical ship operations. The other is in Energy Management onboard with molten salt thermal energy storage. The novel feature of the work includes its ability to utilize the wide range of sources already available onboard.

Happy reading!

Dr. (Capt.) S. Bhardwaj *fics, fni, fcmmi*
PhD (Denmark and UK),
Resident Director and Principal,
MASSA Maritime Academy, Chennai.

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ROBUST AND EFFECTIVE HUMAN RESOURCE SYSTEMS FOR MARITIME INDUSTRY

Dr Suresh Bhardwaj[1], Dr. Rajoo Balaji[2], Captain Sankalp Shukla[3], Captain Belal Ahmed[4], Captain MP Bhasin[5], Captain Pradeep Chawla[6], Captain (Dr) Ashutosh Apandkar[7] & Mr Abdullah Siddique[8].

Abstract

The progression of the marine sector toward digitization and decarbonization over the last several years has caused a gap between curriculum, syllabus, and course content vs industry expectations, which has had a detrimental influence on employability. On 17th of February 2022, IMRC (International Maritime Research Confluence) hosted a panel with **Capt Belal Ahmed** *(Chairman of IMEC, & MD of Western Shipping based in Singapore)*, **Capt Sankalp Shukla** *(Chairman of FOSMA)*, **Capt Bhasin** *(Chairman MASSA, Secretary General CMMI, MD M.sc Crewing Service)*, and **Capt (Dr) Ashutosh Apandkar** *(Principal of T. S. Rahman)*, discussing the aforementioned and more issues on Maritime HR and Training that the industry is facing at the moment. This paper covers some topical queries and issues that were discussed and a few solutions for them.

Keywords: IMRC, Maritime, Human-resource, Training, Marine, Automation, MET, Education.

[1] Resident Director & Principal of MASSA Maritime Academy, Chennai.
Email: capt.s.bhardwaj@gmail.com
[2] Director at Indian Maritime University, Chennai.
Email: rajoob@imu.ac.in
[3] Designated as Director in FOSMA Maritime Institute & Research Organization.
Email: sankalp.shukla@bs-shipmanagement.com
[4] Designated as Director in FOSMA Maritime Institute & Research Organization.
Email: BelalAhmed@westship.com.sg
[5] Chairman of International Maritime Employers' Council Ltd. (IMEC)
Email: mpbhasin@msccs.com
[6] Chairman at GlobalMET.
Email: chawlapk@angloeastern.com
[7] Serving as Principal at T.S. Rahman.
Email: a.apandkar@tsrahaman.org
[8] Designated as Research Consultant at ISF Group under the Division of IIRE, Inner Search Foundation.
Email: abdullahsiddique07@gmail.com

1. COMPETENCY OF COMPANIES TO TRANSFORM MARITIME EDUCATION AND TRAINING TO BEST FIT THE NEW TRENDS IN INDUSTRY:

Major developments are placing a lot of strain on the marine industry. Simulator-based training is evolving in response to new advances, and cloud-based simulators can be viewed as a tool for overcoming the ever-increasing obstacles in human resource training. In terms of fuel adjustments, corporations appear to be responding effectively to the IGF code, which was recently amended in India for ethanol fuels.

Under the framework of the execution of rules and IGF Code revisions, new projects and research are giving outstanding instruments to counteract the ever-increasing concern of climate change. The new hybrid fuel system and GHG strategy, which aim to reduce CO2 emissions by 70% by 2050 compared to 2008, have imposed additional laws and restrictions that seafarers may not agree with. Following a rigorous examination of previous courses given by some of the world's most prominent institutes, a paper published in the Australian Journal of Maritime & Ocean Affairs suggests a complete course (Omer Berkehan Inal, 2021).

On the technological front, Adonis AS and Tritan Software Corporation's new integrated Human Resources, Health, and Safety Solution, which combines Adonis' crewing and payroll systems with Tritan's Health Information and Incident Management platform, enables cruise and ferry organizations to re-enter the market safely and aggressively as the global economy recovers from the COVID-19 pandemic (AJ Gutierrez, 2021).

IBM's Maximo Software for the Maritime and Offshore Sectors, which just received DNV GL accreditation, is a solution that assists ship owners in keeping their vessels in compliance with international rules. This will be an incredible tool for seafarers. As a result, technological improvements have always kept the marine sector abreast of industry trends (Carrie, 2021).

However, given the current rate of advancement, MET in India has yet to demonstrate to the world that it has a strong MET basis, as the entire world is looking for better trained officers for these contemporary ships.

2. EVOLUTION OF MET TO PROVIDE TRAINING AND RETRAINING AND MONITOR ACADEMIC DRIFT:

With technological innovation and the rapid adoption of automated systems, the maritime sector is facing significant changes. To keep up with rising industry demand and rapid technological progress, the worldwide standard for marine training and certification will need to be revised and adapted.

According to research conducted by the Arab Academy for Science, Technology, and Maritime Transport, the existing training module is only relevant for seafarers for the next 20-30 years. It recommends that maritime universities, colleges, training institutes, and maritime authorities actively monitor the development of MASS, supply relatively new information, and enhance modes of maritime education in order to generate talents fit for the advancement of navigation technology (Aboul-Dahab, 2021).

As the economy has quickly digitalized, the use of blockchain appears to be increasingly successful in providing a decentralized supply chain capable of combating the newly emerging problems. MASSA, a significant figure in the sector, has recently been at the forefront of blockchain research, as well as focusing on offering LNG fuelling courses to satisfy the needs of every seafarer in terms of understanding modern fuelling systems, vessel operations, and efficient trading.

Although the competency matrix remains a key barrier for organizations, and despite the progress that the MET in India has achieved so far, there is still a lot that has to be done in terms of addressing the gaps between the Certificate of Competency and real requirements on the field.

3. HR CPABILITIES OF MARITIME INDUSTRY TO GRAPPLE WITH THE REALITY OF COVID-19:

Throughout the duration of COVID-19, the wellbeing of crew members and their mental health has been especially tricky. The human challenges that mariners experience is no different from those others face in an office or political setting, hence the necessity for leadership has become apparent and critical.

According to research conducted by the ITF Seafarer's Trust and Yale University, 25% of seafarers who completed a patient health questionnaire had scores that indicated depression. Around 17% of sailors were found to have anxiety disorder, and around 20% of seafarers polled reported suicide ideation, either many days (12.5%), more than half of the days (5%), or practically every day (2%) in the two weeks before to conducting the survey (Rafael Y. Lefkowitz, 2019).

Maritime employees face a number of physical and psychological challenges. Recent study has concentrated on particular issues such as fatigue and discontent, as well as disorders such as depression. Post-traumatic stress disorder (PTSD) is common among mariners (piracy, accidents, threats). Coronavirus disease 2019 (COVID-19) has an impact on seafarers, with an estimated 400,000 once trapped aboard ships throughout the world, with extended time on board, problems with repatriation, and financial issues of the unexpectedly unemployed. The International Maritime Organization established the Seafarer Crisis Action Team to aid them. In the previous ten months, a specialized contact centre in France received 142 calls from 32 mariners for psychiatric phone consultations, the vast majority of which were connected to this era. As the COVID-19 scenario worsens, seafarers will seek psychological health treatment, repatriation, and financial solutions (David Lucas, 2021).

4. COMPANIELS APPROACH TOWARDS MAXIMIZING PERFORMANCE FROM ITS COMPETENT SEAFARERS:

With an average of 2.3 problems per inspection, the Ship Inspection Report Programme inspection, also known as SIRE, had reached its constraints and served its purpose. However, SIRE 2.0 with a completely new perspective — human views – has demonstrated encouraging outcomes. However, people fail in a particular eco-system, and the culprit has always been deemed to be the seafarer. Only a thorough investigation will establish whether the seafarer was deliberately set up to fail rather than succeed.

The reality of the industry as it stands is for a CEO, their company is like a beautiful picture, but for other managers, it's like a Whack-A-Mole game in which children sit with a hammer striking a mole that appears from nowhere. Competency matrix, which has already been phased out due to a greater awareness that age and experience are not the only elements to consider.

The systems that surround the seafarer must be improved. As an industry, we are better understanding Human Factors; more research is being conducted, and rules are being developed with this focus in mind.

5. SOLUTIONS FOR MARITIME EDUCATION & TRAINING – THE STATE OF TRAINING AND INTERNSHIP PROGRAMMES:

If a new generation of seamen and women are to be recruited, seafarer training must improve. Fewer young people regard shipping as a viable career option, which is one reason why new methodologies and technologies must be implemented – whether for training, marine recruitment, or improving candidate engagement, and of course, actually running and navigating vessels.

Internship programmes, as they now exist, do not provide interns with on-the-job training. The practical environment is critical in knowing and learning about the obstacles and risks that a seafarer may experience. Furthermore, a key concern created by these internship programmes is the absence of real exposure to a more functional sector in the vessels or bunking operations. The theoretical paradigm may be insufficient as we move toward a more digitally enhanced and sophisticated work environment based on cutting-edge technologies and vessels. The typical industrial internship training also does not provide enough time, particularly for students, to comprehend the technical aspects of a practical work environment in the business. For eager potential mariners, a more demanding and maybe longer internship programme is required (NMF),

5.1 The Intelligent tutoring and training system

Learning ultimately could possess its own reward, but many businesses have long realized that it is also important to their commercial success. As a result, they spend billions of dollars on intensive training each year.

About 20 years ago, Prof. Benjamin Bloom and his colleagues discovered that students who get one-on-one teaching outperform pupils in typical classes by two standard deviations. That is, the mean tutored student outperformed the top 2% of classroom instruction students. However, in most circumstances, it is too expensive to assign one trainer to each student. The problem therefore is to encapsulate in software the subject matter expertise and teaching abilities of a company's finest instructors or mentors in order to give the benefits of intelligent, one-on-one training at a low cost.

Consider each learner in a classroom or WBT situation to have a personal training assistant who attends to the participant's learning requirements, examines, and diagnoses difficulties, and gives assistance as required. Many basic instructional interventions might be performed by the assistant and learning issues that are too challenging for it could be reported to the instructor. The helper would free up the instructor's time to focus on training topics that required more knowledge by taking on simple support responsibilities. Most firms' training budgets do not allow for providing a personal training assistance to each student. A virtual training assistant, on the other hand, which captures the subject information and teaching ability of professional trainers, offers an enticing new alternative. The concept, known as intelligent tutoring systems (ITS) or intelligent computer-aided instruction (ICAI), has been explored for more than three decades by educators, psychologists, and artificial intelligence researchers.

Nowadays, prototype and functional ITS systems assist corporate training, K-12 and college education, and military training through practice-based learning. The technology is indeed ready for prime time. Adapting such technology is a reasonable investment that can deliver a much stronger future for Maritime Training and Education (James Ong, 2003).

5.2 The need to move with the times

In a traditionally conservative industry, the new generation of mariners is defying convention. After all, these are individuals who have grown up alongside computers in their classrooms and homes. It is inconceivable for them to live without a smartphone and to be continually switched on, hooked in, and unattached. So, if there is a variation in the way we converse and obtain information, and fresh generations have shorter attention spans but are content to spend much of their free time gaming, doesn't it make logical sense for the shipping sector to modify itself in the way it attracts and develops new crew members and adjust towards a more interactive learning environment?

Millennials and Gen Z are frequently lambasted in the media, but the reality is that if our sector, or any industry, wants to teach the next generation of employees, it must connect with them on their terms. Millennials and Gen Z are, on the whole, enthusiasts of technology; they've grown older with it and utilize it in their everyday lives.

As a result, it stands to reason that adopting technology such as virtual, augmented, extended, and mixed reality, as well as everything that the experience of learning in that environment can give, makes learning a skill such as sailing more desirable. The VR, AR, XR, MR, Gamification and simulations will not merely deliver a more engaging learning experience for young sailors, but they'll additionally aid to increase their confidence due to the risk-free atmosphere they present.

5.3 Value opportunity that lies with adaptation of VR training

Classification societies and training organisations regard VR technology as the next step in using innovation to improve seafarer's skills and abilities. It takes design simulation and gaming technologies and modifies them for marine operations.

There is only so much that virtual reality training can provide. As beneficial as it has been in other areas, it may not have the same impact in maritime since a skilled sailor requires more practical expertise. We must also not dismiss the use of virtual reality training entirely. In sectors like as safety training, ship survey training, firefighting/rescue operations, E-learning, and so on, VR learning is already providing significant success to the industry for firms that are willing to adopt new generation training and learning methods.

The Immerse SDK allows businesses to manage and expand VR training, and it is at the heart of the Immerse Platform's architecture. The platform streamlines the user journey and makes IT system management immensely easier. Users can be verified onto the platform with Single Sign On (SSO), giving them safe accessibility to all of available learning programmes. You may also export quantitative data assessments to your LMS, learning record store, or any other sort of business intelligence tool (Immerce - Content Overview).

VR, very much like its benefits, has certain restrictions. Due to the lack of more modern technologies that were required, some students may experience motion sickness. VR also fails to give a more authentic learning experience, which is necessary for certain mariners to avoid trembling with dread when confronted with a vast ocean, which is very different from a scanty virtual screen.

5.4 The new-age technology and VR alternatives

The next focus is on XR (extended reality learning), which delivers the finest real-time experience throughout the training. Varjo's technology innovations and its Varjo XR-3 and VR-3 headsets deliver the best resolution (over 70 ppd) ever seen in a simulation and learning environment. Users can read displays, controls, text, symbols, and distant elements with absolute clarity thanks to their human-eye resolution Bionic Display. The XR-3 and VR-3, which include Ultraleap hand tracking, delivering the most intuitive interactions and immersive training experience possible (Varjo Solutions - Training and Simulation).

Varjo Aero has 35 PPD edge-to-edge clarity, variable resolution aspheric lenses that eliminate God rays, and the same industry-leading Varjo eye tracking as the XR-3 and VR-3. Because of the lower hardware requirements, it is an excellent solution for bigger training operations and for example classroom instruction.

In practically every industry, XR technologies have the potential to increase security, productivity, and cost-effectiveness. As XR technology becomes more widely adopted in other areas, it is unavoidable that it will find its way into the marine business. Many segments of the marine business, in comparison to other industries, rely on risky, outmoded, or inadequate technologies for training. XR may assist to solve these issues, and the benefits of XR training will help to move the marine sector into the contemporary era – and keep it there.

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AUTHOR

Captain Suresh Bhardwaj is Resident Director & Principal of MASSA (Maritime Association of Shipowners, Ship managers & Agents) Maritime Academy, Chennai.

Dr. Rajoo Balaji is Director at Indian Maritime University, Chennai.

Mr. Sankalp Shukla is currently designated as Director in FOSMA Maritime Institute & Research Organization.

Capt Belal Ahmed is Chairman of International Maritime Employers' Council Ltd. (IMEC)

Capt MP Bhasin is Chairman of MASSA (Maritime Association of Shipowners, Ship managers & Agents).

Capt Pradeep Chawla is Chairman at GlobalMET.

Capt (Dr) Ashutosh Apandkar is serving as Principal at T.S. Rahman.

Abdullah Siddique is designated as Research Consultant at ISF Group under the Division of IIRE, Inner Search Foundation.

POWER DISTANCE AND EMERGENCY RESPONSE AMONG DECK OFFICERS

Ms. Delna Shroff[1]

Abstract

Merchant shipping is an occupation with a high rate of fatal injuries caused by organizational accidents and maritime disasters. In most accident investigations, the leader's actions are under scrutiny. Several accidents have been suggested to have occurred as a result of issues arising from multicultural crewing within the industry. The influence of culture on a workplace could be predicted to be an important factor for the merchant navy, given the fact that a large proportion of the world's merchant fleet are manned by multicultural crews. Studies have found that power distance between crew members has been observed to be the cause of accidents within the maritime sector. This study examines the relationship between power distance among seafarers and their response during an emergency. The data gathered by way of a survey will be used to analyse the relationship between power distance and emergency response of the team members.

Keywords: Power distance, Emergency response.

1. INTRODUCTION:

The international shipping industry is responsible for the carriage of around 90% of world trade, so the safety of vessels is critical. According to the latest data, there were 49 large ships totally lost in 2020 (Allianz). Safety & Shipping Review 2021 reports that annual shipping losses are now half of the total recorded ten years ago. However, 2020 was the first year in the last five that shipping losses have not fallen from a year ago, possibly signalling those losses are stabilizing around this level.

Importantly, when analysing the data and trends it is important to remember that behind each statistic lie the lives of crew, who are putting their own safety at risk to keep our industry running. When accidents occur, it is not just seafarers who are impacted, but the lives of their

[1]*Experienced Senior Psychologist with a demonstrated history of working in the maritime industry.*
Email: delna.shroff@gmail.com

families and loved ones too. With a reported average of 14.2 injuries per million working hours, seafarers are up to 27.8 times more likely to suffer work related fatal injuries compared to the general shore-based workforce (Håvold, 2010). Recent reports on work safety in container shipping operations highlight high frequencies of human failures. Several accidents have been suggested to have occurred as a result of issues arising from multicultural crewing within the industry. The influence of culture on a workplace could be predicted to be an important factor for the merchant navy, given the fact that a large proportion of the world's merchant fleet are manned by multicultural crews (Bocanegra-Valle 2010). Multicultural crewing is not unique to the maritime industry. However, research involving the presence of multicultural crews onboard has identified challenges in relation to leadership being present. Around 70-80 % of world's merchant fleet has multicultural crews (Hanzu-Pazara and Arsenie, 2010). Multicultural crews on board with a lack of a common language or cultural difference could result in a high-risk work environment on ships (Theotokas and Progoulake, 2007).

Several researchers examining the concept of national culture have recognized and highlighted Geert Hofstede's cultural dimension model as a tool to explain culture. National culture can be defined as "… the collective programming of the mind which distinguishes the members of one group or society from another …" (Hofstede, 1980, p. 25). Based on the studies of Hofstede (1980) and Hofstede and Bond (1988), national culture consists of five dimensions, namely power distance, individualism/collectivism, uncertainty avoidance, masculinity/femininity, and Confucian dynamism/long-term orientation.

Based on the study of Hofstede and Bond (1988), Lu et al. (2012) investigated the impact of national culture on human failures in container shipping and found that there will be fewer human failures when seafarers have low national culture with respect to power distance, and high national culture dimensions such as collectivism and uncertainty avoidance.

Studies have found that power distance between crew members has been observed to be the cause of accidents within the maritime sector. This was the case for the Bunga Teratai Satu, a container ship that grounded onto the Great Barrier Reef. The accident was determined to have been caused as a result of an able seaman's navigational error. Whilst the able seaman was noted to have several years of experience at sea and was used to plotting the ships GPS position, he was not familiar with charting symbols (Pyne and Koester 2005). At the time leading up to the incident, the able seaman had been left to navigate on his own, whilst the mate made a personal phone call (Pyne and Koester 2005). The able seaman was unaware of the ships dangerous course, and unfortunately by the time the mate returned it was too late to rectify the able seaman's mistake. Following the accident, 'accident investigators noted that there existed a strict hierarchy between the Pakistani senior officers and the Malaysian, Indonesian and Myanmese junior officers and crew' (Pyne and Koester 2005). Pyne and Koester (2005) further added that 'It was important in the national culture of the crew that the AB although he knew something was wrong - did not question the decisions of his superior'. When sailing on board with a multicultural crew, it has been insinuated that one of the 'greatest challenges in dealing with a multicultural crew is leading in a way that effectively motivates and inspires those with different work-related values and beliefs' (Horck, 2008; Xiang n.d). Therefore, this highlights the importance for both leaders and managers to be culturally aware when sailing on board with or managing a multicultural crew.

With the exception of the studies of Lu et al., (2012) and Håvold (2007), relatively few research studies have been done to examine national culture in shipping and how these national cultural differences influence seafarers' safety behaviours. There is a scarcity of previous studies examining whether seafarers' safety behaviours are related to their perceptions of national culture and the captain's leadership in the dry bulk shipping context.

Is national culture important for the enhancement of safety behaviour? How is it related to seafarers' safety behaviours? This study examines a dimension of national culture called power distance and its relationship with emergency response among seafarers.

2. POWER DISTANCE

Past literature has confirmed that power distance orientation (PDO) is a dimension of culture and can influence the behaviours of individuals and groups in organizations. Power distance orientation is defined as the extent to which people accept inequality between classes and this concept has been applied to evaluate the individual difference between countries. Hofstede (1991) defined power distance as the degree to which people accept interpersonal inequality in power and organizational institutionalization of such inequality. Employees possessing low power distance consider themselves to have the same rights as their leaders will be more likely to have a positive attitude to carry out in safety issues.

Individual Power distance refers to "the extent to which an individual accepts the unequal distribution of power in institutions and organizations" (Clugston, Howell, and Dorfman, 2000). The term power distance orientation is used to indicate an individual level construct. It deals with individuals' beliefs about status, authority, and power in organizations. (Bradley, L. K. et al, 2009) Power distance orientation has a more theoretically direct relationship to leadership reactions than other cultural values. For example, followers with a high-power distance orientation expect more, and are more receptive to, one-way, top-down direction from their leaders (Javidan et al., 2006). Though there are differences among countries and regions in Asia, Asian culture has generally been characterized by high levels of in-group (or family) and institutional collectivism (House et al, 2004), power distance (Hofstede, 2001) and paternalism (Chen & Farh, 2010). These cultural characteristics have played an important role in shaping business leadership styles as well as their effects and outcomes in Asian countries (House et al, 2004; House et al, 2013).

Hofstede adopted the term 'power distance' from the research done by a Dutch experimental social psychologist, Mauk Mulder. Mulder's research (1977) was based on numerous laboratory and field experiments with simple social structures. The experiments examined the emotional distance that separates subordinates from their bosses. Mulder (1977) defined power distance as the degree of inequality in power between a less powerful individual and a more powerful other, in which individual and other belong to the same (loosely or tightly knit) social system. Hofstede (1991) defined power distance as the degree to which people accept interpersonal inequality in power and organizational institutionalization of such inequality. Employees possessing low power distance consider themselves to have the same rights as their leaders will be more likely to have positive attitude to carry out in safety issues. Hofstede (1997) extended Mulder's notion of power distance from a dyadic, social-psychological concept to a broader, cultural concept by defining power distance as the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally.

In a study in 2016, it was found that power distance, uncertainty avoidance, collectivism, and long-term orientation are positively related to safety behaviour. (Chin-Shan Lu, Chen-Ning Hsu, Chen-Han Lee, 2016)

In 2003, Khatri reviewed literature on power distance orientation and its impact on a variety of organizational behaviours such as employee participation, nature of job descriptions, organizational communication and decision making, discipline and control, deference to senior employees, management development, and organizational structure. It was felt that there would be less employee participation in a high-power distance organization than in a low power distance organization. Employees, in a high-power distance context, over time, develop a mindset of unwillingness to participate in decisions. They are content with their managers making decisions and giving them instructions, which they follow passively. Jobs are narrowly and tightly specified, giving employees little discretion. Communication also takes place vertically downwards; informal and horizontal communication is quite limited. A greater communication gap is likely between the superiors and their subordinates because it is very hard for the subordinates to air their views to their senior managers. Because of the lack of participation of employees in decision making, in a high-power distance culture, decisions are made by a few at the top autocratically. A result is that decisions can be arrived at rather quickly. Further, because of little resistance or questioning from lower-level employees, decisions are implemented faster in a high-power distance organization than in a low power distance organization. However, because of the lack of input from lower-level employees as well as poor communication and information sharing, quality of decisions is poor in high power distance organization than in a low power distance organization.

In organizations operating in a high-power distance cultural milieu, a superior is expected to make decisions without consulting his or her subordinates, because subordinates may view their involvement in decisions by their superiors as a sign of incompetence or weakness on the part of the superior (Francesco and Chen, 2000). Subordinates are also unwilling to express their opinions and disagreements openly due to fear of losing face or making someone else loses face. Unsurprisingly, such behaviour results in a major communication gap. Senior management becomes disconnected from what is happening at lower levels in the hierarchy and lower levels employees become uncertain about the management's expectation of them (Mintzberg, 1993).

Khare (1999) points out that, due to the organization's spatial configuration in Indian organizations (India is a high-power distance culture), the communication between superiors and subordinates is limited to formal channels. Moreover, detailed, and tight job descriptions for each employee give rise to a compartmentalization of work. This results in few informal interactions between superiors and subordinates. Hofstede (2001) too argues that organizations and cultures characterized by high power distance lack informal communication across levels in the hierarchy and favour the concentration of authority and decision-making in a few hands at the top.

Sinha and Tripathi (1994) found autocratic decision-making in most of the Indian organisations in their study. In a high-power distance organisation, the problem of communication gap between the superiors and the subordinates as discussed in the previous section tends to hamper the reaching of effective decisions (Mintzberg, 1993; Khatri, 1996). Senior managers are always right even when they are wrong, and usually take it affront when contradicted (even correctly) by their juniors; and the best way for employees to survive is to say the expected thing (Prendergast, 1993). Managers who are surrounded by 'yes men' are unable to benefit from the diverse perspectives, experience, and knowledge of their subordinates. Worse still, with stress on conformity, ideas are unlikely to be refined and improved through group discussion and debate.

In the organizational context, the difference in PDO will influence employees' perceptions and behaviours. If individuals have high PDO, they will keep a longer distance from their supervisors and obey the orders more.

A study by Zheng et al (2019) focuses on the moderating effect of power distance at the individual level, namely power distance orientation (PDO). Power distance orientation means the degree of acceptance of unequal distribution inorganizations among people. Individuals with high power distance orientation feel that the subordinates should obey supervisors without query and keep a proper distance from the supervisors. However, people with low power distance orientation believe that members in the groups should be generally equal and the relationships between subordinates and supervisors should not be estranged.

3. EMERGENCY RESPONSE

Emergencies are incidents that occur suddenly, unexpectedly, and are life threatening. They come in various forms and sizes such as in the form of floods, hurricanes, earthquakes, fires, hazardous material, terrorism, and nuclear accidents (Ford and Schmidt, 2000). To mitigate these losses, emergency responders or emergency response teams, such as firefighting teams, medical teams, police, and civil defence are vital. Their speedy, quick, and prompt responses under these circumstances may determine one's life and death and the degree of destruction on property involved. The slower the response, the worse the damage caused. While each phase in the emergency management is unique, it often overlaps in its execution with each other. (Subramaniam, C., Ali, H., and Shamsudin, F. M., 2014)

The second phase of emergency management is "response". It involves activities conducted during emergency and immediately after the emergency so that the situation following the impact can be stabilized. The response phase ends when the situation is stabilized, which means that the risk of loss of life and property has de-escalated back to the pre-crisis level. The response phase is actually the phase that puts the plans in the planning phase into action.

In 2002, an employee safety perception survey was conducted, (O'Toole, 2002) and injury data were collected over a 45-month period from a large ready-mix concrete producer located in the southwest region of the United States. The results of this preliminary study suggested that the reductions in injuries experienced at the company locations was strongly impacted by the positive employee perceptions on several key factors. Emergency Response was identified as one of the key factors to influence employee perceptions. Those perceptions, in turn, influenced employee decisions that relate to at-risk behaviours and decisions on the job. (O'Toole, 2002)

Taking from the above study, the proposed research examines the emergency response of the bridge team members. Emergency response (actions taken to save lives and prevent further property damage) is the behaviours displayed, that can be explained by the process of symbolic interactionism. According to symbolic interactionism, workplace socialization and learning involves constant comparison of bits of information and cues, discussing possible interpretations, and attempting to reach consensual interpretation of the meaning of events, procedures and practices at the workplace. As a result, group members' perceptions are expected to converge over time (Schneider and Reichers, 1983). Because workers within a ship by nature will interact more often with each other, their individual perceptions of the situation will over time shape safety focused behaviour onboard (Schneider and Reichers, 1983; Zohar, 2000, 2002, 2010).

For the purposes of the current study, an attempt is made to analyse emergency response at the team level. Team performance during an emergency was observed and scored. The maritime industry includes the construction, repair, and scrapping of vessels, as well as the movement of cargo and other materials. Hazards include slips, trips, and falls, machinery and equipment hazards, hazardous chemicals, confined/enclosed spaces, and fire hazards.

Emergency management was institutionalized in 1979 with the creation of the Federal Emergency Management Agency (FEMA). Five Federal agencies that dealt with many types of emergencies consolidated to form FEMA. Since that time, many state and local organizations have changed the names of their organizations to include the words: emergency management. (Heath, S., 1998) Current thinking defines four phases of emergency management: mitigation, preparedness, response, and recovery. The following diagram illustrates the four phases of emergency management. Table 2.4 below briefly describes each of these phases. (Bullock, J.A., Haddow, G. D. and Coppola, D. P., 2013)

PHASES	
Mitigation: Preventing future emergencies or minimizing their effects	Includes any activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable emergencies. Mitigation activities take place before and after emergencies.
Preparedness: Preparing to handle an emergency	Includes plans or preparations made to save lives and to help response and rescue operations. Preparedness activities take place before an emergency occurs.
Response: Responding safely to an emergency	Includes actions taken to save lives and prevent further property damage in an emergency situation. Response is putting your preparedness plans into action. Response activities take place during an emergency.
Recovery: Recovering from an emergency	Includes actions taken to return to a normal or an even safer situation following an emergency. Recovery activities take place after an emergency.

Table 1.1: The Four Phases of Emergency Management

Source: Heath, S. (1998)

Taking from the above, the term "emergency response" is operationalized for the purpose of the study as 'actions taken to save lives and prevent further property damage in an emergency situation. Response is putting your preparedness plans into action. Response activities take place during an emergency.' Response is taking immediate action upon the occurrence of a disaster or emergency. By taking this action you are attempting to protect yourself and others from harm or further harm. How you respond depends on the onset of the event. The onset of a disaster is the amount of warning time you have before it strikes. (Hanus R, 2012).

Key characteristics of Response:

- Takes place during the emergency.
- Immediate action steps to save lives and prevent further damage.
- Puts one's preparedness plan into action.

Emergency response is the phase of the disaster-management cycle that often attracts the most attention and resources. The emergency response phase should therefore be seen as a critical part of the disaster management cycle (Wisner, B. and Adams, J, 2003). Whilst preparation is key in all stages of emergency management, the current study looks at examining the second stage i.e., "emergency response" because this is the stage where the moment of truth actually takes place. In emergency, time is essence to mitigation. The faster the emergency responders in responding to emergency situations, the more loss of life and property could be prevented. Emergency response then becomes crucial to any emergency efforts and activities. In the context of the current study, "emergency response refers to collaborative effort of broad range agencies through effective deployment and coordination to minimize effectively "(Flin and Slaven, 1996; Granot, 1997; Kelly, 1995) "the impact of a life-threatening situation, which usually occurs suddenly and unexpectedly (Goetsch, 2005)." In an attempt to propose a model of emergency response, this paper looks at the group/team level analysis since emergency response activities are a collective effort (Goetsch, 2005; Granot, 1997).

4. THE STUDY PARITICIPANTS

The study participants of this phase are sailing officers, both operational and management level officers. The sample was sailing officers comprising the Master, Chief Officer, Second Officer. A typical team of sailing officers called the Bridge Team consist of the formal leader (Ship Master), Officer of the Watch (OOW), Lookouts man and an Able-Bodied Seaman (AB). Either Chief Officer or Second Officer played the roles of the Lookouts man and the AB. 30 plan fully aligned leadership groups, and 30 authoritarian leadership groups participated in the simulation exercise. The inclusion criteria for the sample in the quantitative phase are as follows:

- The sailing officers are of Indian nationality.
- The sailing officers are all Deck Officers.

- The sailing officers have sailed for at least two contracts with their present company without a gap of one year between any two contracts.

5. MEASURES USED

5.1 Power Distance Orientation Scale

Ensuing previous individual-level research (Brockner et al., 2001; Earley, 1999; Kim & Leung, 2007), we measured power distance orientation with an eight-item individual-level measure taken from Earley and Erez (1997). The scale was administered to analyse individual power distance orientation among seafarers and its relationship with taking action during an emergency situation. A 7-point Likert scale was used ranging from 1 (Strongly Disagree) to 7 (Strongly Agree).

5.2 Leadership Scale

A series of related research summaries over the past three years have described the "Core Practices" or "Basics" of successful school leadership (Leithwood & Jantzi, 2005; Leithwood & Riehl, 2005; Leithwood, Seashore-Louis, Anderson, & Wahlstrom, 2004). The four broad categories of practices identified in these research summaries include:

- Setting Directions
- Developing People
- Redesigning the Organization
- Managing the Instructional (teaching and learning) Programme

The bulk of available evidence indicates that these categories of practice are a significant part of the repertoire of successful school leaders, whether working in a primary (elementary) or secondary school, a school or a school district/LA, a school in England, the United States, Canada or Hong Kong. Many of the core practices have their genesis in several different models of transformational leadership, the early work of Burns (1978) and the follow-up empirical work of both Podsakoff, MacKenzie, Moorman and Fetter (1990) and Bass (1985).

There are recently more than 40 published studies and some 140 unpublished studies which have focused on many of these leadership practices in schools and LA contexts since about 1990. The accumulated evidence now available tells us a good deal about their relative contribution to organizational improvement and student learning. Core practices are not all that people providing leadership in schools do. But they are especially critical practices known to have significant influence on organizational goals. Their value lies in the focus they bring to what leaders attend to.

6. RESULTS

	Minimum	Maximum	Mean		Std. Deviation
			Statistic	Std. Error	
Age	24.00	48.00	30.4833	.64899	5.02702
Contract Period	2.00	16.00	6.0333	.40753	3.15673

Table 1.2 Descriptive statistics of Demographic Variables

Note: N= 240

The descriptive statistics are shown in Table 1.2. The participants' mean age, measured in the number of years, was 30.5 years (SD= 5.02). All the seafarers were male. Organizational tenures were measured based on the number of contracts completed with the present company. One contract consists of 4 months onboard the ship. The participant had to have completed a minimum of two contracts to be included in this study. The average score on tenure was six years (SD = 3.16).

Hierarchical OLS regression analysis was performed between emergency response as the criterion variable, power distance as predictor variables in the first block, and leadership as a predictor variable in the second block. Table 1.3 displays effect size measures (*R*2), change in *R*2, adjusted *R*2, F Change and its Significance level for the entire model. Table 1.4 displays pooled unstandardised regression coefficients (*B*), standardised regression coefficients (β), and model significance p-value. R2 was statistically significant for both blocks.

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.551[a]	.303	.291	.56536	.303	25.239	1	58	.000
2	.727[b]	.528	.512	.46921	.225	27.207	1	57	.000
a. Predictors: (Constant), PD									
b. Predictors: (Constant), PD, L Mean									

Table 1.3 Regression analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.067	1	8.067	25.239	.000[b]
	Residual	18.539	58	.320		
	Total	26.606	59			
2	Regression	14.057	2	7.028	31.925	.000[c]
	Residual	12.549	57	.220		
	Total	26.606	59			
a. Dependent Variable: ERM						
b. Predictors: (Constant), PD						
c. Predictors: (Constant), PD, L Mean						

Table 1.4 ANOVA

Coefficients								
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.817	.257		10.970	.000	2.303	3.331
	PD	-.262	.052	-.551	-5.024	.000	-.366	-.158
2	(Constant)	.602	.475		1.266	.211	-.350	1.553
	PD	-.115	.052	-.242	-2.231	.030	-.218	-.012
	L Mean	.427	.082	.566	5.216	.000	.263	.590
a. Dependent Variable: ERM								

Table 1.5 Coefficients Results

The adjusted R2 value in the first block indicates that about 29.1 per cent variability in emergency response was predicted by power distance. The change in R2 for the second block when leadership was introduced was 51.2 per cent, and the R2 change was 22.5%. It indicates that the strength and direction of the relationship between leadership (L) and emergency response (ER) are positive and robust after controlling for power distance. The variability caused by power distance on emergency response is 29.1 per cent which is statistically very significant. The coefficient results in indicate a negative and significant relationship between power distance and emergency response.

7. DISCUSSION

The coefficient results indicated a negative and significant relationship between power distance and emergency response.

A recent study by Platenkamp (2021) explored safety perspectives among various ranking crew members of a heavy lift and shipping company. The concept of psychological safety was explained, and interviewees were questioned about how they experienced psychological safety aboard. The analysis revealed that one of the hindering themes related to psychological safety involves the `hierarchical composition` of the maritime industry with its old-established culture. Hierarchy can further be connected to culture since Philippine crew members emphasize the importance of someone's hierarchical position and score high on power distance. To illustrate, it happened once that a Philippine on the bridge thought that when I (i.e., Master) entered the bridge, I immediately took over his work … this almost went wrong!'. This example proves how easily bad events can happen when there are no questions asked or explanations given, and a high-power distance exists. In this study, several interviewees stated that there is still a lack of open communication between crew members. Crew members are less likely to correct someone from a higher hierarchical position. Individuals with national cultural backgrounds high in power distance (i.e., Asian) were even said to do this rarely. Furthermore, they try to save face while being in the presence of others. For example, Philippine crew members were told not to admit it when they do not understand an explanation; they instead say 'maybe' when they mean 'no'.

A study by Lu et al. (2016) aimed to examine the effects of national culture and leadership style on safety performance in bulk shipping companies. The results indicated that power distance, one of the dimensions of national culture, positively influenced safety behaviour.

Building on previous research on transformational leadership and cross-cultural management and psychology, Kirkman et al. (2009) attempted to examine the unique and combined influences of individually held power distance orientation and transformational leadership on employee cognitive and behavioural reactions to leaders in the People's Republic of China (PRC) and the United States (U.S.). To distinguish between power distance at the country and individual levels of analysis, they used the term power distance orientation to indicate an individual-level construct. A study comprising 560 followers and 174 leaders in the People's Republic of China and United States found that individual followers' "power distance" orientation and their group's shared perceptions of transformational leadership were positively related to followers' procedural justice perceptions. Power distance orientation also moderated the cross-level relationship that transformational leadership had with procedural justice; the relationship was more optimistic when power distance orientation was lower than higher (Kirkman et al., 2009).

Hofstede's (2001) study has ranked India relatively higher on masculine and power dimensions, which indicates an appreciation for hierarchy and a top-down structure in society and organisations. Indian culture has been ranked high on collectivistic values. India's high-power distance culture shows the lower significance of leadership practices, but collectivistic values indicate the opportunity for its place in Indian organisations.

8. CONCLUSION

The current study aimed to examine the relationship between power distance among seafarers aboard merchant ships and safety performance. Based on the quantitative results, the relationship between power distance and emergency response is negative and significant. When there is a low-power distance between superior and subordinate and the prevalence of informal relationships, there is more scope for distributing leadership onboard. Further, a horizontal organisational structure may help create trust in the managerial process and practices of top management. Thus, a high-power distance context may inhibit trust building. Thus, national culture also affects the safety culture; People from cultures with low power distance cultures participate in contributing to a safer work environment and risk reporting.

9. IMPLICATION AND LIMITATIONS

As noted in this study, there is a negative and significant relationship between power distance and emergency response of the team members. The findings indicate the importance of establishing a low power distance which will then lead to a better safety performance and an enhanced response during emergencies. This study strengthens the importance of measuring power distance among different ranks of officers which can be a good predictor of open communication and active participation in contributing to a safer work environment and risk reporting. It can also serve as a good predictor to implement best practices in shipboard operations. Further, this study also supports three other studies which have examined power distance dimension and its relationship with safety behaviours. (Platenkamp, 2021; Mintzberg, 1993; Khatri, 1996; Lu et al., 2012)

However, the results are correlational in nature and based on a single nationality. Furthermore, power distance may even interact with other factors to affect safety perceptions and behaviours. Future studies may focus on exploring the relationship between power distance and other dimensions of national culture viz. uncertainty avoidance and its impact on safety performance. The major limitation of this study is a small sample size and limited to Indian deck officers. Future studies may focus on other nationalities and power distance among both deck, engine officers and shore personnel. Nevertheless, the findings support the current literature on power distance in the field of shipping and aviation. Future research may be focused on specific dispositional and other contextual variables such as the role of leadership as a practice within high or low power distance cultures in professional work organizations.

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AUTHOR

Delna Shroff is an experienced Senior Psychologist with a demonstrated history of working in the maritime industry. She is currently working as Senior Marine Psychologist with Anglo-Eastern, a global provider of ship management services.

ADVANCED ANALYTICS-BASED ENERGY EFFICIENCY MANAGEMENT

Dr. Jai Acharya[1], Mr. Anuj Chopra[2], Mr. Sanjay Verma[3], Mr. Pawan Kapoor[4], Dr. Anantha Subramanian[5] Mr. Jairaj Kumar[6] & Ms. Yogyata Kapoor[7].

Abstract

The article analyses the GHG emissions and analyse and detect the current possible harm that maritime industry needs to cut back on. The need to move towards a more sustainable future is growing crucial day by day. It has become imminent for the maritime industry to move towards an environmentally friendly path for the growth of the industry and betterment and safety of this planet and us human beings. This article was well constructed after taking points from an HSE session held by IMRC with great masters of our industry.

Keywords: Environment, Maritime, Sustainability, GHG, Carbon emissions, Health.

1. INTRODUCTION:

Broadly air pollution consists of two parts: Smog, Particle Matters (PMs), Oxides of Nitrogen and Sulphur (NOx, SOx) and its variants that are visible locally up to certain extent, however, the other part, the GHG emissions that are on a global level and largely invisible. Greenhouse

[1] Principal Consultant at International Maritime Management & Consultancy Services (IMMC) & Director at International Ocean Institute (IOI) HQ, Malta (Singapore Focal Point).
Email: jaiacharya@gmail.com
[2] Co-Founder & CEO at ESGPlus LLC.
Email: anuj.chopra@esgplusllc.com
[3] Director of Decarbonisation Solutions at Wartsilla, Singapore.
Email: sanjay.verma@wartsila.com
[4] Managing Director at ISF Maritime Services & Founder & Trustee of Inner Search Foundation.
Email: pawankapoor@isfgroup.in
[5] Faculty at Department of Ocean Engineering, IIT Madras.
Email: subruiitm@gmail.com
[6] Chairman & Managing Director, Ocean Sparkle Ltd.
Email: jairajkumar@oceansparkle.in
[7] Director of Global Marketing & Business Development at ISF Group & Convener of International Maritime Research Confluence (IMRC).
Email: yogyatakapoor@isfgroup.in

gas emissions have harmful effects which can be broadly categorized into: Climate change related effects and Health related effects. Some of the health impacts have been observed and closely monitored in the western world and there is a huge amount of awareness in that area and appropriate actions are being taken. But the attention on the aspects of climate change side of it is still lagging and it largely depends on the factors such as the industry clusters, nature of the industry, nature of local legislation and its degree of enforcement.

It is worth noting that NOAA - the U.S. government’s National Oceanic Administration released a study on ocean rise where it's very accurately predicted the ocean rise for the next 10 to 50 years until the end of the century and those numbers are alarming because that would explain to us what would happen to the coastal regions where nearly half the population of the world lives.

International shipping is a large and growing source of greenhouse gas emissions. The EU supports global action to tackle these emissions and has put in place EU-wide data collection measures. Maritime transport emits around 940 million tonnes of CO_2 annually and is responsible for about 2.5% of global greenhouse gas (GHG) emissions (Smart Ship Hub, 2021). These emissions are projected to increase significantly if mitigation measures are not put in place swiftly. According to the 3rd IMO GHG study, shipping emissions could under a business-as-usual scenario increase between 50% and 250% by 2050, undermining the objectives of the Paris Agreement. Despite such reports being released, the awareness among decision makers of the industry is pretty low (International Maritime Organization, 2014).

Additionally, there is a limited number of studies on global shipping emissions which contain estimations on the in-port emissions, which is ship emissions on ports. Ports represent a source of atmospheric pollutants that can contribute significantly to jeopardize air quality of port cities. NOx, SOx, PM, and VOCs (Volatile Organic Compounds) are emitted by ships during manoeuvring in ports at arrival or departure and during hoteling when moored at wharves. Several methods exist to estimate emissions in function of ships' activity and engine parameters. However, there is still a certain degree of uncertainty in these calculations. There is a considerable limitation to develop effective plans of mitigation of air pollution in port cities.

2. INTERNATIONAL REGULATIONS AND POLICIES:

It may be worthwhile to explore some of the policies and regulations for the maritime industry across the globe:

2.1 Energy Efficiency: Existing Ship Index (EEXI): is for the existing vessel to comply with a design requirement. It is a one-time requirement which once achieved, the ship is approved to operate.

2.2 Carbon Intensity Index: is the carbon intensity which will need to gradually reduce over the years for IMO to achieve its 2030 and 2050 ambition which is a 40% reduction compared to 2008 levels and in reduction in total GHG emissions of at least 50% by 2050 compared to 2008 levels. There are two ways to achieve these targets for lowering the carbon intensity – change the fuel OR improve the ship's operational efficiency so that less fuel is consumed (or switch over to alternative fuel or renewal energy source).

2.3 The Marine Environment Protection Committee (MEPC): by IMO established the MEPC 74 resolution invites member states to "*encourage voluntary cooperation between the port and shipping sectors to contribute to reducing GHG emissions from ships*". However, this resolution talks about ships and does not talk about Ports.

2.4 Model Port Authorities (MPA): In countries like Singapore, government has committed to reduce its carbon intensity by a certain percentage. All port emission comes under the national inventory in Singapore. now the government has looked at different sectors and given them their target of reduction. Maritime and Port Authority (MPA) has been given a target of 37 reduction of carbon dioxide inside now. The MPA is looking at all the areas where it can do the emissions reduction and have come with some of the following action plans:

- *Electrification* of all the trains and vehicles which are moving the containers
- *Cold Ironing* - Supplying shore power to the ships which are visiting port facilities in order to minimize the emissions.
- *Revised Logistic Strategy* to avoid waiting of trucks, an attempt to reduce the air pollution in the process before they offload the cargo – offloading to be a fully automated process.
- *Electrify and/or reduce fuel consumption* of harbour crafts in and around Singapore. And further, implement just-in-time arrival for the ships.

2.5 USA's Policy: A policy in the USA states that ports have been directed to monitor the emissions on a regular basis because ports have the ships visiting them, port vessels, trucks and trailers, cargo hunting equipment, etc.

3. INDIAN POLICIES AND CHALLENEGES IN INDIA:

The Marine Environment Protection Committee (MEPC) by IMO established the MEPC 74 resolution invites member states to encourage voluntary cooperation between the port and shipping sectors to contribute towards reducing GHG emissions from ships. The government of India has been the signatory to this resolution, and they have made commitments in the COP26. However, this resolution talks about ships and does not talk about Ports. There are a lot of areas where ports must themselves help and reduce the emissions of GHG gases.

There is no shortage of plans even in India - The maritime vision 2030 (MIV 2030), The national action plan, and there have been eight key interventions, and twenty-one green initiatives which have been identified to support the national action plan and the commitments which have been made at COP26.

The Indian government is committed to a reduction of 40 percent of GHG by 2030 which includes all sectors including the ports. The national action plan includes a part on the port segment which states that by 2023 ports should be able to implement just in time arrivals. It also states that incentives should be offered to less-polluting vessels by 2023, battery charging stations to be provided to less polluting fuels (such as methane, LNG), along with bunkering facilities for technological requirements (like shore power). Interestingly, this action plan only considers the major ports and does not account or offer these incentives to private ports. It is important to note that more than 45% of the cargo is managed by the private ports.

Some players have made attempts to go green in a small way. However, these efforts have not met with an encouraging response from the port developers. For example, some players who operate in the LNG Terminals in India, have tried to convert their tugs to use LNG as a fuel which is an expensive undertaking. Such an undertaking does not receive any additional advantage or incentive but is rather rejected as the cost of the tug construction rises exponentially. On the other hand, banks, financial institutions, and venture capitalists pressurise operators to go green to receive funding and loans. In such situations operators find themselves sandwiched between two ends with no sustainable and promising solution in sight.

Some governments like the Singapore government have taken on itself to say to fund the difference in cost for operators and players who are working towards going green. However, gap funding is not a long-lasting solution.

With 2023 being only a year away, Indian ports have not yet commenced on any major efforts or initiatives to take advantage of the national action plan. Unfortunately, the port authorities and or the port developers are not aware of the requirements by 2030. So, while there are several key action plans, the first step required to be taken is to initiate the measurement and monitoring process of the emissions. However as of today, none of the Indian ports are collecting any data on emissions.

4. INTRODUCTION TO DATA ANALYSIS:

ln the context of Indian ports, there are hardly any research attempts made on emission assessment and develop the methodology to assess and manage the inventory of ship emissions (including emissions caused by port operations machinery/equipment, motor vehicles and logistics within the port facilities, its vicinity and around the coastal areas. While prior to 1970s and 80s, when port facilities were governed by the government authorities or autonomous port trusts, there were no effective policies towards combating the air pollutions due to ships exhaust emissions and impact on ocean/ coastal environmental.

However, after 1990s, under various UN Agencies and IMO Regulatory Framework, the importance of Climate change, Global warming and emissions caused by road, rail. aviation, maritime and other industrial activities caught the serious attention resulting the adoption of strict policies and effective enforcement on each sector respectively. The progressive global attention and requirements of mandatory compliance played a key role in effective implementation of regulatory framework.

There are some basic steps to begin with, such as emissions data collections from the vessels directly, AIS reports, engines operating parameters and daily logbook noon report. Also, ports always maintain records of fuel consumption and how much they have spent on fuel. This can be used to calculate the amount of CO_2 released.

However, it is particularly important for Indian port management and administrative authorities to adopt a long-term strategy on emissions assessment and inventory management to formulate the effective policy on environmental shipping and attainment of the energy efficient green port status. The concept of Green Port Strategy itself would be rewarding in many aspects, which will bring international and national applauds/accreditations, economic benefits, preferred ports of prominent shipowners and entitlement of relatively higher tariffs, etc.

The proactive approach of port facilities towards the development of database on emission inventory around its vicinity would enrich it with emission database of various type of ships and logistics equipment which could be shared for the academic research and database can be shared/exchanged for the commercial purposes whenever required Ship emissions can be divided into land-based (Florian Kattner, 2017). airborne-based, marine-based, satellite-based (Jun Ding, 2017), and Unmanned Aerial Vehicle (UAV) based measurements according to different platforms.

Ship emissions are calculated by multiplying the AIS-based fuel consumption by emission factors. The AIS based tracking also allow for calculating sailed distance for individual ships and aggregated. Drone based ship emissions data collection are calculated by analysing the collected exhaust sampling in a suitable laboratory using the test kit attached with a UAV (drone).

A typical overview of emissions inventory by ship types for the ASEAN region in 2017 (DNV GL, 2018) from the findings by AIS based emission modelling are:

- CO_2 emissions are 112 million tonnes, representing about 14% of the global ship emissions.
- Emissions of NOx and SOx are 2320 Kton and 1730 Kton, respectively.
- Emissions of PM10 and PM2.5 are 214 and 194 Kton, respectively.

Shipping emissions in ports are substantial, accounting for 18 million tonnes of CO_2 emissions, 0.4 million tonnes of NOx, 0.2 million tons of SOx and 0.03 million tonnes of PM10 in 2011.

Around 85% of emissions come from container ships and tankers. Container ships have short port stays, but high emissions during these stays.

Most of CO_2 emissions in ports from shipping are in Asia and Europe (58%), but this share is low compared to their share of port calls (70%). European ports have much less emissions of SOx (5%) and PM (7%) than their share of port calls (22%), which can be explained by the EU regulation to use low Sulphur fuels at berth.

The ports with the largest absolute emission levels due to shipping are Singapore, Hong Kong (China), Tianjin (China) and Port Klang (Malaysia). The distribution of shipping emissions in ports is skewed: the ten ports with largest emissions represent 19% of total CO_2 emissions in ports and 22% of SOx emissions. The port with the lowest relative CO_2 emissions (emissions per ship call) is Kitakyushu (Japan); the port of Kyllini (Greece) has the lowest SOx emissions (Merk, 2014).

Other ports with low relative emissions come from Japan, Greece, UK, US, and Sweden. Shipping emissions have considerable external costs in ports: almost EUR 12 billion per year in the 50 largest ports in the OECD for NOx, SOx and PM emissions, the emissions most directly relevant to local populations. Approximately 230 million people are directly exposed to the emissions in the top 100 world ports in terms of shipping emissions (Merk, 2014).

A reliable and up-to-date ship emission inventory is essential for getting overview of the trends and challenges, and for assessing the effect of different emission control options. It is therefore recommended to establish an environmental accounting model for continuous monitoring of ship traffic, air emissions and impacts in the region. The model could provide stakeholders with updated status for the most important air emission components, both local pollutants and GHG emissions. Furthermore, it is recommended that the Drone sampling of exhaust gases from ships and AIS-based emission inventory is further detailed to categorize emissions as domestic, international or transit. This could help and guide port facilities administration, coastal administration authorities in making targeted policy choices to fulfil national obligations relating to domestic emissions.

5. ACHIEVING THE GOALS:

The initial IMO GHG strategy envisages a reduction in carbon intensity of international shipping (to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008);

and that total annual GHG emissions from international shipping should be reduced by at least 50% by 2050 compared to 2008. Initiating efforts to assess and manage inventory of ship emissions can be leapfrogged with international cooperation. Working across borders and trying to treat this as a global village problem rather than a regional or local problem can expedite efforts to achieve the goals because there is a lot of very good research work being done, availability of the emissions data inventory, the emission assessment methodologies and the algorithms which have already been developed. Further, the introduction and implementation of easy port incentive programs to reward and monetize emission reduction efforts so that there is some incentive for the good actors to work in that direction. This ambition cannot be met without a carbon zero fuel; and so, the 2050 ambition must be met with development of a green fuel.

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AUTHORS

Dr Jai Acharya is Principal Consultant at International Maritime Management & Consultancy Services (IMMC) & Director at International Ocean Institute (IOI) HQ, Malta (Singapore Focal Point).

Anuj Chopra is Co-founder & CEO at ESGPlus LLC.

Sanjay Verma is Director of Decarbonisation Solutions at Wartsila, Singapore.

Pawan Kapoor is Managing Director at ISF Maritime Services & Founder & Trustee of Inner Search Foundation

Dr Anantha Subramanian is currently positioned as a faculty at Department of Ocean Engineering, IIT Madras.

Mr. Jairaj Kumar is the Chairman & Managing Director, Ocean Sparkle Ltd.

Yogyata Kapoor is Director of Global Marketing & Business Development at ISF Group & Convener of IMRC (International Maritime Research Confluence).

MOLTEN THERMAL EMERGY STORAGE ONBOARD SHIP

Mr. Gaurav Kumar[1]

Abstract

The growing concern of limiting the negative impact of shipping on the environment mean that clean technologies are becoming more and more important. The trend to design more efficient and versatile ships have increased the variety in energy management systems. The objective of the work is to enhance the energy management systems onboard with Molten Salt Thermal Energy Storage (MSTES). The energy storage system providing a buffer source of energy, and ability to utilize the stored energy accordingly. The operation includes passage of salt through heat exchangers gaining thermal energy. Liquid salt is kept in an insulated storage tank, where volumes can be adjusted to provide the necessary storage capacity for every application and location. It is a reliable option for storing renewable energy, and a flexible, cost-efficient addition to existing infrastructure and systems. Additionally, providing benefits including peak shaving, enhanced dynamic performance, and spinning reserve. The novel feature of the work includes its ability the utilize the wide range of sources available onboard that would otherwise go unused and providing the ability to be future proof to the ships considering existing and upcoming regulations.

Keywords: Molten salt, Thermal energy storage, Waste heat recovery, Boil-off gas, Renewable energy.

1. INTRODUCTION:

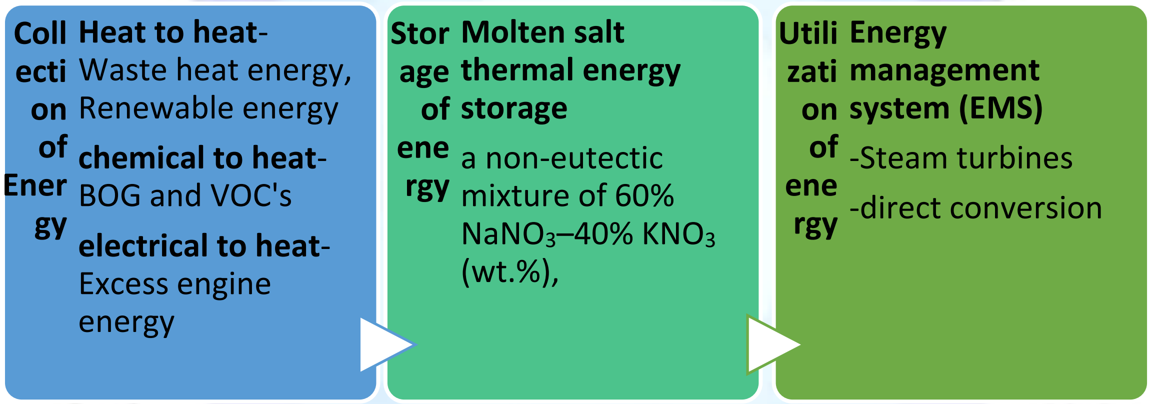
The decarbonization debate from shipping is heating up as an outcome of enormous emissions that it causes, and regulations imposed on shipping for sustainable development. To comply with these regulations technological advance is taking place in the industry.

Since the demand on the ship operating varies and machineries are supposed to work at part load leading to the excess fuel consumption. Additionally, varying loads reduces overall efficiency. Ship propulsion and power generation is a most eminent area of technological development it has scope for large innovations which includes future engines, alternative fuels, propulsion energy saving devices, renewable energy sources of energy, hybrid power generation and emission abatement technologies. Considering all technologies as stated energy

[1] *Esteemed student of BTech in Marine Engineering from Marine Engineering and Research Institute, Mumbai. Email: gauravkr892@gmail.com*

conservation and management is the most important aspect for effective operation of all (Danfoss, 2019).

Today's marine ESS is incredibly versatile. Available in many configurations and used for a variety of purposes, a modern battery, usually made of li batteries, helps the ship to ensure compliance with emission regulations and attain savings on operating costs, from various type of vessels. But the battery energy storage has its own disadvantages like high storage space and safety risks. To overcome such situations, The proposed concept includes the thermal energy storage system that will store the excess energy generated by allowing machineries to work at optimal load along with collection from other available sources. Providing flexibility, versatility, reduced cost, and low environment risk. Chart shows approach followed.



2. MOLTEN SALT THERMAL ENERGY STORAGE (TES)

The sensible heat of molten salt is utilized for storing energy at a high temperature. It is termed Molten-Salt Energy Storage (MSES). Molten salts are employed retain thermal energy. Molten salts are salts have high boiling points, low viscosity, low vapor pressure, and high volumetric heat capacities.

While selecting a chemical mixture, it is good to prefer mixture having lowest attainable melting point to enhance the temperature range of molten salt. Nitrate Based Material, the most popular TES material used in CSP is Solar Salt which is a non-eutectic mixture consisting of 60% $NaNO_3$ and 40% KNO_3 (wt.%).

Parameter	Value	Unit
Required charge temperature	>500	°C
Charge and discharge cycles	50 000 - 100 000	Repetitions
Thermal efficiency	95	%
Energy efficiency	52	%
Heat transfer coefficient, fixed bed	25	W/m^2K
Heat transfer coefficient, fluidised bed	250	W/m^2K
Storage period	6	months

Table 1 - Characteristic of MSTES

Source - (Gustafsson, 2020).

However, there exists other options taken from Solar Salt. The main reason for its acceptance includes low cost, good chemical safety (non-toxic and non-flammable), and its compatibility with materials which allows ordinary stainless steel to be used without suffering high levels of corrosion. However, its operating temperature range is restricted by crystallization temperature of about 240°C and with highest operating temperature of about 565°C, after which it decomposes and the reactions of salt degradation initiates. Usually, while considering alkaline and alkaline earth nitrate generic combination, the following main key decomposition reaction can occur:

$$MNO_3 \leftrightarrow MNO_2 + \frac{1}{2}O_2$$

$$5\,MNO_2 \rightarrow 3\,MNO_3 + M_2O + N_2$$

$$M'(NO_3)_2 \rightarrow M'O + N_2 + \frac{5}{2}O_2$$

$$M'(NO_3)_2 \rightarrow M'O + NO_2 + NO + O_2$$

Commercially available "HITEC" salt which is used in the solar plants contains potassium nitrate (53% by weight), sodium nitrite NaNO2 (40% by weight) with sodium nitrate (7% by weight) having a liquid temperature range of 149 - 538°C (Dariusz Karkosinski, 2021).

Liquid salt is circulated through panels or heat exchangers and heated up to 570°C before it is transferred to a hot storage tank or steam generator. Here, it produces superheated steam to power the turbine. Molten salt is stored in an insulated storage tank, where volumes can be adjusted accordingly to provide the necessary storage capacity for every application and location. It's a reliable option for storing renewable energy, and a flexible, cost-efficient addition to existing infrastructure and systems.

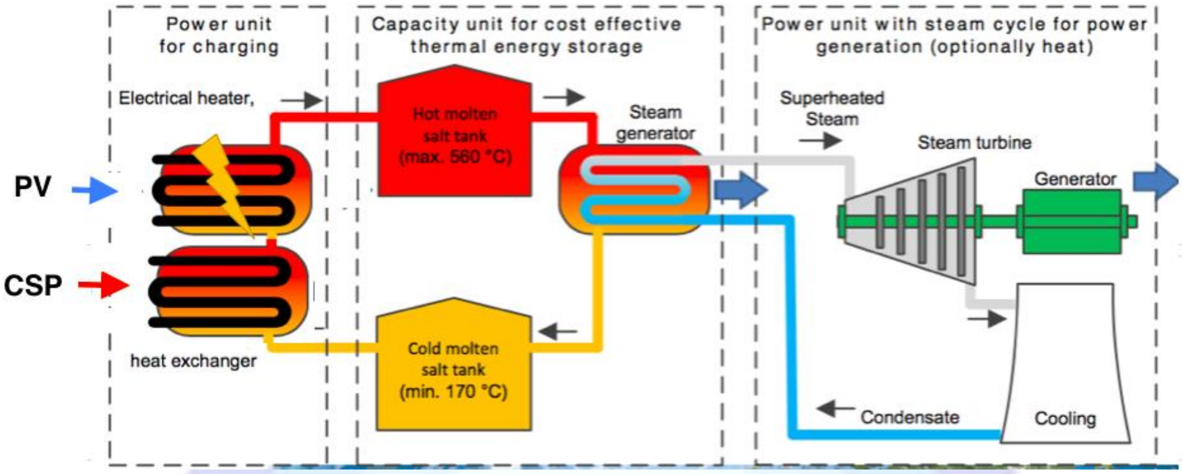


Figure 1 - Molten Salt Thermal Energy Storage System (MSTES)

The energy storage capacity for the salt can be seen with respect to the volume and with respect to the mass. The energy density ratio is 0.62 MWh/ton and 0.6 MWh/m3. A data about storage along with capacity is provided.

Property	Volume [m^3]	Mass [ton]	Stored energy [MWh]
Value	130.4	78.2	48.5

Table 2 - Properties of salt to store available energy per day-
Source - (Prause, 2020)

3. COLLECTION OF ENERGY

Versatility and flexibility are the demand of today's ships systems. Industry is heading towards utilizing the available sources onboard ship efficiently. The energy storage system provides the way to channelize and utilize the wide range of energy sources available onboard. The energy available in heat, chemical and electricity can be fed to the molten salt providing efficient utilization.

3.1 Heat-to-heat conversion

3.1.1 Waste Heat Recovery (WHR)

Waste heat is part of the heat generated by fuel ignition process, where this heat is dumped into the ambient without any use. The energy accounts for around 25.5% of the total energy. Waste heat temperature from an internal combustion engine is considered richest sources of waste heat, due to the heat flow and temperature. The temperature ranges from 315 to 600°C depending on multiple variables. WHR is the use of thermal energy that would otherwise be transferred to the environment to accomplish a useful function. In certain cases, the need for any additional fuel energy input can be reduced to some extent or eliminated by using Waste Heat Recovery System. The liquid salt is passed through heat exchangers between exhaust passage to gain the thermal energy.

Waste Heat Recovery/Utilization systems while retaining the ship's basic design. Fuel accounts among the top of a ship's operating costs. Reusing the waste heat from engines can lead up to 20 % of a ship's total annual fuel consumption saving, thereby reducing CO_2 emissions, and saving fuel costs. Also, studies show that recovering waste heat as electrical power can save up to 8 tons of fuel oil per day for a tanker that would normally use 42 tons per day. In tests, emissions were reduced up to 14 % by recovering otherwise wasted heat as electrical power

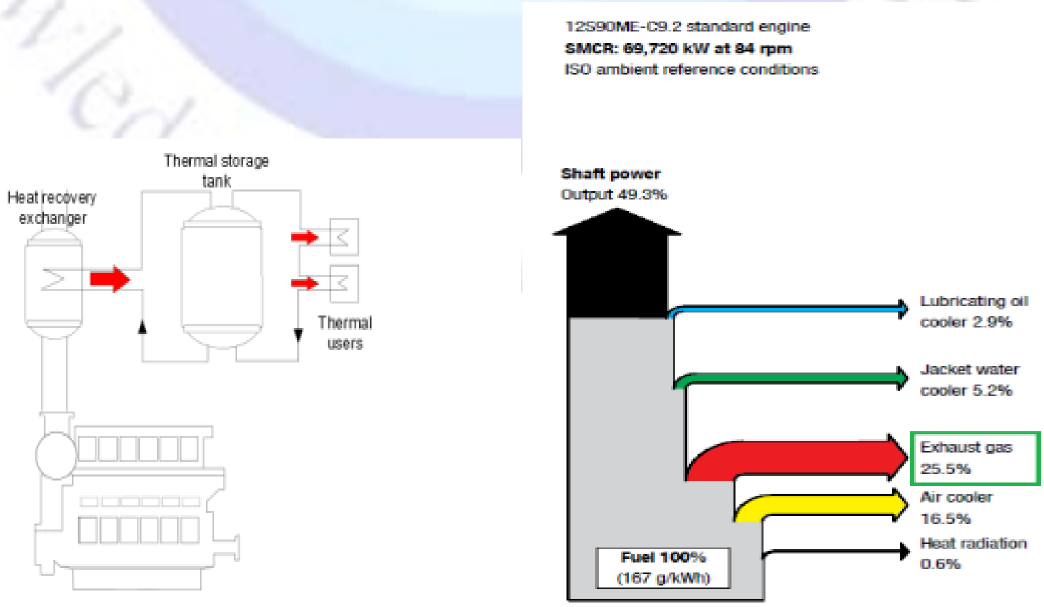


Figure 2 - Source (MAN Diesel & Turbo, 2014).

3.2 Chemical energy-to-heat

The fuels are available onboard that can be efficiently managed or can be utilized by installing ESS. The fuel includes *Boiloff Gas* on gas carriers and *Volatile Organic Compounds* on tankers. Which are characterized by a very high energy density. Boilers provide ability to use these sources directly and provides ability to store the energy contained in sources directly to the thermal energy storage system.

3.2.1 Boil-off gas

While the tanks on an LNG carrier are designed to stay cool, they cannot provide perfect insulation against warming. Heat slowly affects the tanks, which can cause the LNG inside to evaporate and produces a substance known as boil-off gas. To relieve the pressure in LNG tanks, BOG can be re-liquefied, used as fuel or burned in a gasification unit. But reliquification requires lot of equipment resulting congestion in machinery spaces. Rather than reliquification. During LNG holding, BOG is compressed conventionally and then returned back to fuel system. On the other hand, during the loading process, the combined value of the BOG generation is too large than the required fuel; therefore, it is flared into the surrounding. Both of these situations involve the economic loss and damage the environment as a result of high GHG release. Therefore, it is necessary reduce the BOG formation as it will increase overall LNG production, reduce plant energy consumption, and cause less environmental damage

Another alternative is to manage BOG through combustion. Excess gas can be fed to ships boiler which have suitable fuel pressure to utilize it.

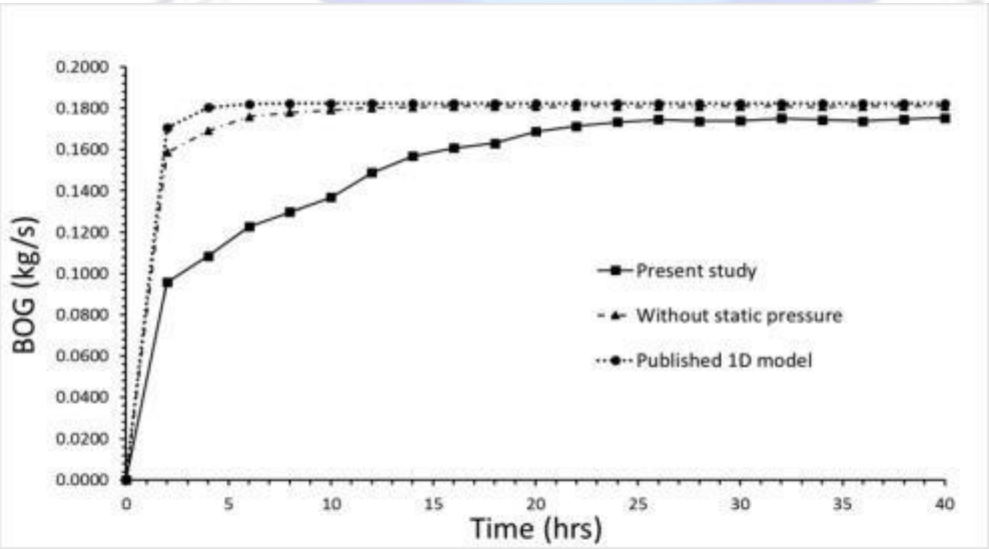


Figure 3 – Boil-off gas production data

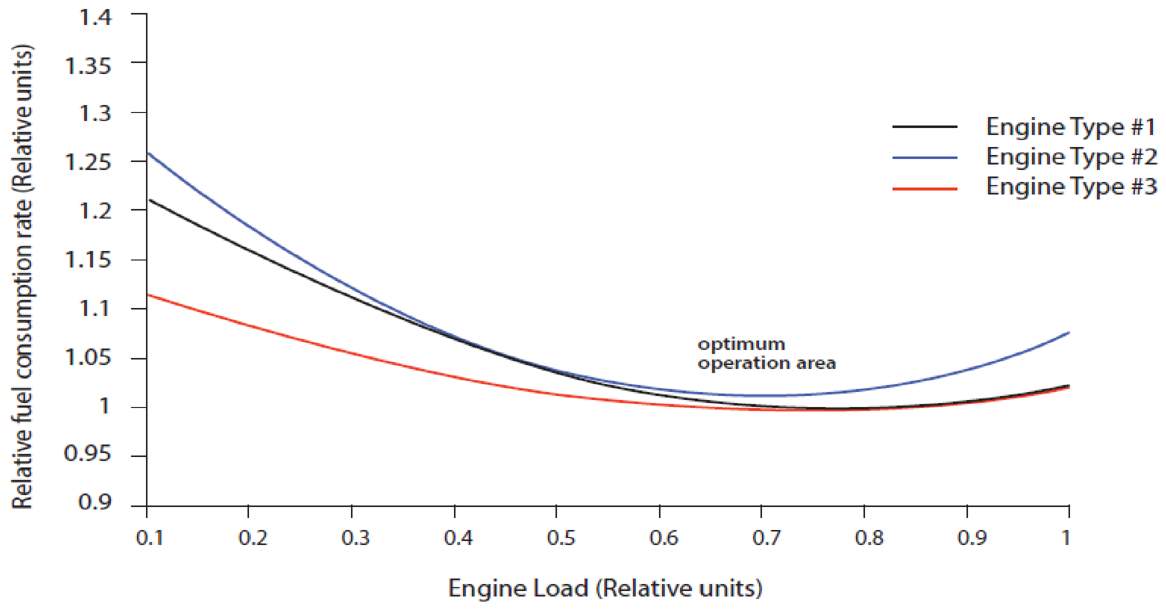
3.2.2 Volatile vapour

During transportation of oil cargo, a large quantity of lighter components evaporates from the oil which are termed as Volatile Organic Compounds (VOC) and are explosive in nature. A great amount of energy is lost in the form of VOC as they are discharged to atmosphere. Similarly, to BOG, these can be used as a source of energy for storage in molten salt thermal energy storage.

3.3 Electricity-to-heat conversion

3.3.1 Excess energy from engine

Marine engines have been designed to continuously operate at optimal engine loads which leads to optimum performance, low emissions, and low specific fuel oil consumption. During operation at low loads engines lead to high fuel consumption, high emissions, and lower efficiency, resulting in structural damage due to unbalanced forces during initial stages. Additionally, it has been reported that continuous low engine load might result in increased carbonization and low temperature corrosion. The typical range varies from 60 to 80 % where engines have lowest SFOC as shown in graph.



Graph 1 - Engine load vs SFOC

Operating Profile				Days
Annual operating time:	6480.00	h	74.0%	270.0
Annual port time:	2280.00	h	26.0%	95.0
	8760.00	h		365.0
Main engine load:	**% time**	**hours**		**Weighted average main engine load above 50%:**
100%	2%	129.60		
90%	6%	388.80		
85%	6%	388.80		59.0%
80%	20%	1296.00		
75%	12%	777.60		
70%	15%	972.00		
60%	10%	648.00		
50%	10%	648.00		
below 50%	19%	1231.20		
	100%	6480.00		

Figure 4 - Source- (Prause, 2020).

3.4 Renewable energy

The wide area available onboard or the vast sources available provides ability to harvest renewable energy. And the vessels are installed with solar panels i.e., NYK line Auriga Leader having 328 solar panels installed harvest around 40 KW energy. Such projects are expanding and requires ESS along with Energy management system due to varying production. Integration of thermal energy system will allow create void for such developments.

Figure 5 - Auriga Leader-world’s first solar powered ship

4. THERMAL ENERGY UTILIZATION

In conjunction with Energy Management System (EMS) onboard ship. The stored energy can be utilized effectively.

4.1 Steam turbine

Turbine generator is the most popular source for generation of clean power in power plants or on ships, outcome of their clean and efficient operation. Steam already has its extensive use onboard ships during operations. The highest use lies on tankers and gas carriers where steam is used during cargo operations. Steam is an easy, environment friendly and cheap from of fuel on ship. Steam is used at high pressure to rotate the turbine where the thermal energy of the steam is converted into rotating movement. The turbine is connected to the alternator's rotor which rotates and is used to generate electrical energy.

4.2 Direct conversion

A thermoelectric generator (TEG), also called a Seebeck generator, converts heat flux directly into the electrical energy. TEG function like heat engines but are less bulky and have no moving parts. However, TEGs are typically more expensive and less efficient.

5. DISCUSSION

Depending on a vessel's purpose, fuel savings are not the only problem. In some area's energy storage represents high operational benefits by cutting risks. Risk reduction is achieved by providing instant spinning reserve, available in milliseconds from ESS, which brings flexibility and value. In such configuration, an ESS can rapidly provide massive amounts of energy, delivering backup power to provide operators with redundancy and a time buffer when traditional equipment fails.

The TES system provides reliability onboard gas carriers and tanker vessels as steam plays an important role during cargo operations. The steam produced through TES can be directly fed to the pumps during cargo operations. ESS provides surety for safe and secure completion of critical operations on such vessels. For vessels of short-range operations, The TES can be charged ashore and can be utilized at sea during operations saving time.

The challenge of storage space comes forward with TES. TES have storage capacity comparable to the Li-ion batteries and have minimal environmental risk. The development of latent heat storage having very high capacity per unit volume will lead in future and can be implemented as an upgradation in preinstalled TES system.

6. CONCLUSION

ESS is an essential part of modern, environmentally friendly and energy efficient propulsion systems in maritime industry. By using a variety of vessel operational modes, the energy stability can be greatly improved and thus, fuel consumption and the emission volume can be lowered or in the case of fully electric systems, the emissions can be avoided completely.

The concept of energy storage onboard ships is expanding at very high rate as with increasing digitalization and unmanned operations. Energy storage develops as an essential element with such developments. Thermal energy storage technology can be competitive in terms of long-term cost and overall efficiency against electro-chemical battery storage (Francesco Baldi, 2015).

Implementation of such storage provides surety to deal with existing and upcoming regulations. Furthermore, a WHRS will rather substantially reduce the ship's energy efficiency design index. thereby helping the shipowner meet even tighter EEDI requirements from IMO in the future (Khaled Senary, 2016).

ABBREVIATIONS:

- MSTES - Molten Salt Thermal Energy Storage
- WHRS - Waste Heat Recovery System
- ESS - Energy Storage System
- TES - Thermal Energy Storage
- BOG - Boil-off Gas

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AUTHOR

Gaurav Kumar is a student of BTech in Marine Engineering from Marine Engineering and Research Institute, Mumbai. Working for development of the Maritime Industry with innovative ideas.

EVOLUTION OF PORTS AND LOGISTICS

Capt Kapil Dev Bahl[1], Mr Ennarasu Karunesan[2], Prof Devinder Grewal[3], Capt Suresh Amirapu[4], Dr Vinh Thai[5] & Mr. Abdullah Siddique[6].

Abstract

The article discusses the different challenges concerning the development and administration of major Indian ports in connection to public-private partnership (PPP) and potential for small businesses as well as enterprises looking to grow into the maritime industry. The paper will also discuss port deregulation, as well as methodological approaches for future improvements. The necessity for India's marine industry to become substantially automated and commercialized is becoming more pressing by the day. The grips of central and state governments, as well as its subsequent effects on major ports and their development, will be discussed, with the goal of transforming port operations, ensuring the industry's sustainable development, and adopting a more revolutionary theories and models that will allow the maritime industry to finally reach its greatest potential and maintain pace with market trends by 2030. India, while being the world's IT powerhouse in terms of technological developments and the usage of cutting-edge technology in other sectors, appears to be trailing behind when it comes to port and waterfront operations and administration. The article will explore the answers and future development ideas for "Smart ports" in India, as well as the realities and impact of Model Concession Agreements in Major Ports 2021. The article has been put forth after careful consideration and conversation with some of the industry's most prominent experts, as well as a thorough assessment and review of some of the research progress being made in the subject.

Keywords: Ports, Harbours, Development, Docks, MCA, MCA 2021, Blockchain, Maritime.

1. INTRODUCTION:

India possesses a 7,517-kilometer shoreline that is divided between ten marine states and union

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[1] Former Managing Director of Murray Fenton India, Maritime Arbitrator (LLB) & a fellow of CMMI.
Email: kapildevbahl@gmail.com
[2] Maritime Transport, Ports & Logistics Expert & Founder of CEO of UMK Group.
Email: ennarasu@yahoo.com
[3] Well-renowned Ports & Logistics Specialist.
Email: devindergrewal21@gmail.com
[4] Advisor at PSA India Pvt. Ltd.
Email: sureshamirapu@gmail.com
[5] Associate Professor at RMIT & Founder of Australian Maritime Logistics Research Network.
Email: vinh.thai@rmit.edu.au
[6] Designated as Research Consultant at ISF Group under the Division of IIRE, Inner Search Foundation.
Email: abdullahsiddique07@gmail.com

territory. Article 246 of the constitution grants the government sole legislative authority over the topics mentioned in the union list, which is incorporated in the seventh schedule to the constitution. Entry 27 of the union list specifies ports designated to be significant terminals by or under law passed by parliament or current legislation, including their delimitation and the constitution and powers of the port administrations, which are a duty of the Centre. All additional ports are under the control of state governments, and their individual state constituents have the authority to legislate. India at present has 12 "major ports" and 187 non-major ports, which were managed by the Major Port Trusts Act 1963 and the Indian Ports Act 1908. With the introduction of the Major Port Authorities Act 2021, the Indian port scene will take on new dimensions. Eleven main port trusts will be reconstituted as Port Authorities. One major port, Kamarajar Port (Ennore), will maintain operation as a major port under the Companies Act 2013, while all other commercially significant non-major ports under agreements to the private industry will further operate under the Companies Act (Paul, 2021).

According to trade figures from 2018, all major ports managed over 679 million tons of goods, representing a 4.77 percent boost in cargo throughput versus the previous fiscal year. Minor ports processed a total of 491.95 million tonnes of cargo. The top five main commercial ports in India are as follows:

- *Kandla Port in Gujarat*
- *Paradip Port Trust in Odisha*
- *Jawaharlal Port Trust in Maharashtra*
- *Mumbai Port Trust in Maharashtra*
- *Vishakhapatnam Port Trust in Andhra Pradesh* (Exim, 2019)

With such a vast coastline, India's shipping industry plays a critical role in maintaining development in trade and commerce, with ports processing nearly 95 percent of import and export flow rates. In Fiscal year 2020, India's 12 major ports handled 704.82 million tons of shipment throughput, representing a 2.74 percent CAGR (Compound Annual Growth Rate) from FY16 to FY20. This is constantly on the significant rise as India moves step closer to achieving the government's ambition of becoming an international manufacturing powerhouse, as seen by the latest declaration of a $82 billion investment in port developments by 2035 (Bansal, 2021).

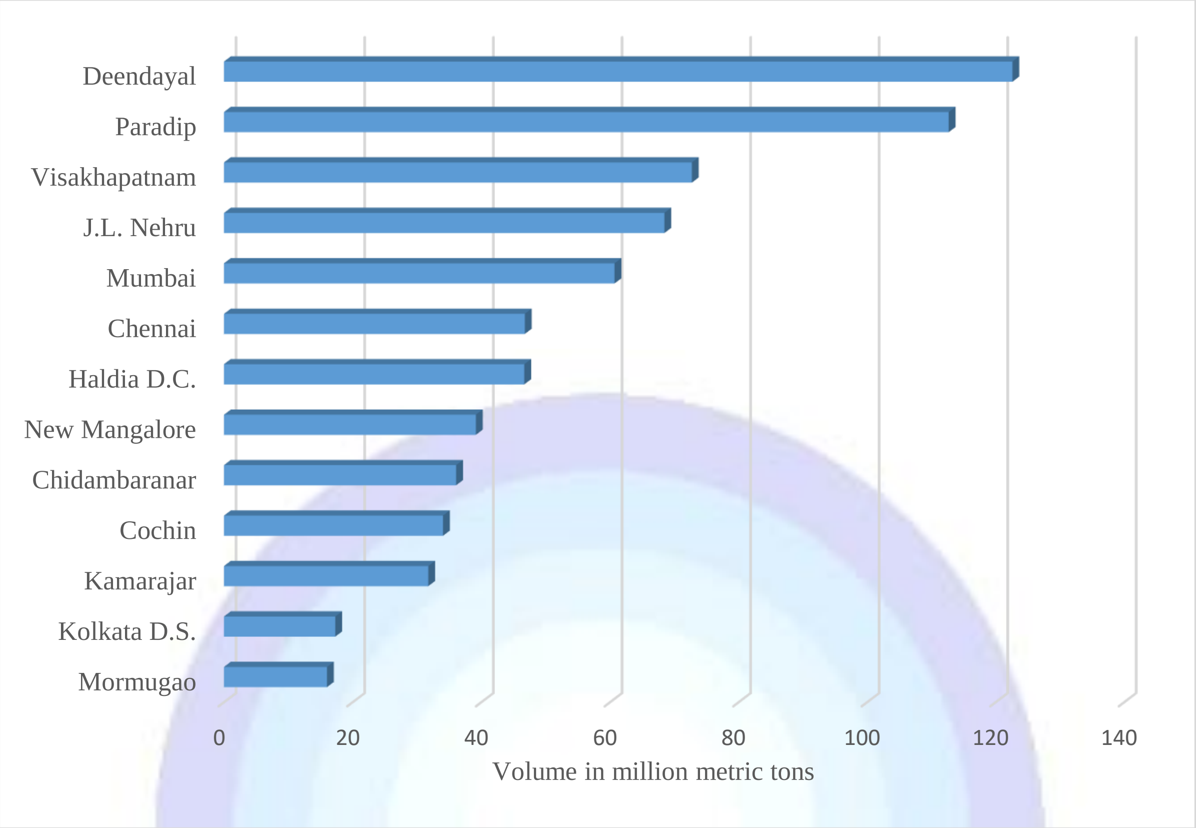

Figure 1 - Volume of total cargo handled across India in financial year 2020, by major port. Source - (Ministry of Ports, 2021).

With the promise of further expansion, there is increased demand on ports to be more productive and commercially viable, as well as to offer higher competitive pricing in order to retain big transport segments. Ports in India and throughout the world confront some significant issues. One of them is a lack of dock capacity due to an increase in the amount of maritime activity and the size of boats. According to Port Technology, improving fleet and terminal operations is the number one objective, and problem for 76 percent of shipping companies. Another issue is a lack of port controllers, which leads to lengthier wait times of up to one and a half day for vessels at the port to be emptied and reloaded. Finally, regulatory authorities are continually urging ports to minimize their greenhouse gas emissions.

These issues are causing port owners to see the underpinning necessity for automation supported by reliable connection. The numerous advantages of digitization to port authorities in terms of enhancing task and workflow, overall performance, expenditures, controlling and supervising, and security are becoming abundantly evident. All of this contributes to increased efficiency, stable and secure operations, and, most importantly, tougher bottom lines. It is also evident that older technologies such as Wi-Fi, Bluetooth, and physical cords are not the solution. There is an urgent need for much better accessibility. The fundamental instrument required to construct a smart port and lay the groundwork for employing IoT in industrial automation is 5G cellular technology. The network infrastructure of a smart port must be capable of handling the huge quantities of information material created by cranes, automobiles, machinery, and personnel. Implementing state-of-the-art technologies to reshape ports into smart ports would also help turn India's aim of being an international manufacturing powerhouse further into reality.

2. BREAKING THE CHAINS OF CENTRALISED ADMINISTRATION:

In the United States, there is no demarcation between large, non-major, and minor ports. The United States has a shoreline of 19,924 km and 361 ports, all of which are under state or local authority and governance. As for Canada, there are four types of ports: corporate ports, the ports of Canada federal system, commission ports with a high degree of independence, and a significant number of public ports regulated by the department of transportation.

Shipping terminals are a governmental responsibility in Australia. Seaport administrative systems differ from one region to the other, and the federal government plays only a minor role in waterfront management. In Japan, shipping ports are classified according to their importance as major ports, minor ports, local ports, and ports of refuge.

Docks in France are classified as autonomous, non-autonomous, or local, based on their prominence and involvement in the country's economic development. The United Kingdom has a shoreline of 12,429 kilometres, with around 300 ports, just 44 of which are economically prominent. In the United Kingdom, there is no classification of ports, and port ownership patterns range from municipal, private, joint sector to public trust ports.

This is critical for recognizing the regulatory control and authority that regulates ports across the world. With its centralized authoritarian control over major ports, India stifles the development and progress that these ports require in order to contend with other nations' ever-increasing technical developments, capacity to accommodate large modern vessels, while enhancing efficiency and productivity.

2.1 Opportunities in Model Concession Agreement, 2021 & Public-Private-Partnership

Ports are key gateway facilities that connect a whole area and its interior transportation network (i.e., highways, railroads, interior waterways) to the worldwide market, with the large percentage of worldwide trade handled by sea. As a result, establishing robust, well-functioning coastal transportation system is a critical component of socioeconomic prosperity for many developing and emerging countries. Public-private partnerships ("PPPs") at docks are becoming a way of improving port operations and developing new port infrastructure, both of which were formerly solely government tasks.

Commercial prosperity and trade growth in past few years have increased the maritime sector's importance as a crucial component in the Indian economy's internationalization. Considering the Government of India's policy measures to encourage Public Private Partnerships (PPP) on a Design, Build, Finance, Operate, and Transfer (DBFOT) basis, this industry has been receiving tremendous attention from both domestic and foreign investors. A detailed legislative and administrative structure is described in this Model Concession Agreement (MCA) for the construction and operation of a terminal on a DBFOT basis.

This structure highlights the problems that are typically important for limited recourse financing of infrastructure projects, such as risk prevention and consolidation; risk- return provision; homogeneity of undertakings between the principal parties; accuracy and controllability of expenses and obligations; transaction expense minimization; force majeure; and termination. It also tackles other critical issues such as client protection, objective monitoring, conflict settlement, and government's monetary aid.

The MCA also establishes a paradigm for commercializing docks in a scheduled and systematic way, on one hand via optimum application of available resources and, on the other, by the incorporation of greatest global practices. The goal is to deliver efficient and cost-effective services to customers while guaranteeing merit for government funds. Owing to the capacity complexities that major ports are now experiencing, there is sufficient opportunity for state governments to give concessions for future ports that would not only offer extra capacity but also improve competitiveness and efficiency. Over time, port-level investments would lead to improvements in efficiency across rival ports, although this may not achieve its full potential until adequate capacity is created at the individual ports.

Given the current lack of competitiveness among ports, the administration would continue to set the rate, but it would be capped in accordance with the tariffs in the sector. A foreordained tariff system would also increase the dependability of Concessionaires' revenue streams, in addition to incentivizing productivity and cost minimization. Tariffs should determine their own levels through competition in the longer run, but this can only transpire if appropriate capacity is produced. Unlike the normal practice of focussing on construction specifications, the technical parameters proposed in the MCA are based mainly on output specifications, as these have a direct bearing on the level of service for users. Only the core requirements of design, construction, operation and maintenance of the port are to be specified, and enough room would be left for the Concessionaire to innovate and add value. Nevertheless, the modified and improved MCA does not come without its drawbacks and cha llenges. Unlike conventional practise, that primarily focuses on construction requirements, the specialised criteria recommended in the MCA are primarily focused on output standards, as the latter seems to have a direct impact on the level of service provided to customers. Only the essential needs of terminal design, building, operation, and maintenance have to be defined, leaving enough freedom for the Concessionaire to improvise and generate value. In brief overview, the structure relies on the 'what' opposed to the overall 'how' of the Concessionaire's service delivery. Which could very well provide Concessionaire the necessary flexibility in creating and implementing cost-effective systems and procedures without jeopardizing customer service quality. Efficiency gains would arise as a result of the change to output-based requirements, which would allow the financial enterprise to reinvent and refine designs and processes in ways that were previously inaccessible to it under standard input-based procurement criteria.

2.2 Kamarajar (Ennore) Port – Possibility of a remarkable future for major ports

In March 1999, the Government of India designated Kamarajar Port as the 12th Major Port. On October 11, 1999, it was formed as Kamarajar Port Limited (KPL) under the Indian Companies Act of 1956. KPL operates the Port as a landlord port, with its functions limited to overarching innovation planning, port conservancy, quality control, sustainability management, dredging of berth spaces, port basin and approach channel, configuration of vessel traffic aids/fire-fighting facilities, and transportation and communication connectivity.

Private enterprises are in charge of the development and operation of specific container terminals.

Kamarajar Port in Ennore was well ahead of the nine main ports in India that had positive development from April to December of 2018. Kamarajar Port was grown by 18.38 percent, well outpacing its closest competitor, Cochin Port, which had grown by 8.92 percent. Kolkata (including Haldia), Paradip, Visakhapatnam, Chennai, New Mangalore, JNPT, and Deendayal are among the other ports (Kandla). "Kamarajar Port measured 30 metric tonnes in the previous year and is now aiming for 35MTS," said Raveendran.

This comes as major ports in India increased by 3.77 percent, handling 518.6 million tonnes of cargo from April to December 2018, compared to 499.7 million tonnes handled during the same period the previous year. From April to December 2018, Deendayal (Kandla) Port handled the most traffic, with 84.91 million tonnes (16.37 percent), followed by Paradip with 80.43 million tonnes (15.51pc share).

The company's track record over the previous 22 years has been so excellent that it has surfaced as a showcase major port. In 2020, Kamarajar Port handled 31.7 million tonnes with just 102 employees, a 27% operating ratio, and even a surplus margin of 249 crores.

In the near coming years, all 11 main ports would obtain an appropriate governing establishment as port authorities, but they will serve as landlord ports, leaving all cargo handling operations to private terminal operators, like in US and European ports. The next institutional shift seems to be from port operators to publicly traded firms, allowing them to function effectively as market enterprises.

As commercial organisations, prospective ports would have convenient access to capital resources, will be able to make management choices quickly and efficiently, and will be more committed and flexible in undertaking development initiatives. Further along Indian shoreline, a series of major, non-major, and small ports operating within the provisions of Companies Act would build a powerful competitive maritime services market. Such docks on India's east and west coasts would contend fiercely in the port services market on the basis of pricing, reliability, and productivity. This would result in cheaper port costs, which will assist to encourage Indian exports while also lowering the landed cost of imports at Indian ports.

3. SMART PORTS – MODERN PROBLEMS REQUIRE MODERN SOLUTIONS:

Seaport stakeholders are continuously seeking for innovative solutions to assist the expansion of corporate operations in ports and the shipping sector while mitigating negative consequences. These industries are hopeful about the possibility of emerging innovations and digital transformation to help them achieve enhanced transparency, security and productivity, ease of monitoring, and reduced risk associated with port operations.

In broad sense, ports provide as a connection among ground and water through offloading and reloading activities. Port operations are now an essential element of global logistics operations that provide value-added services and manage cargo flow in effective and efficient manner. The present revolution stresses the use of digital capabilities to regulate, monitor, and favourably measure port operations.

In recent years, the demand for technological revolution across the corporate world has grown in a variety of industries. Because of the promise of sustainable development, overall performance, cost savings, and security needs, the integration of the digital revolution is critical to maintaining competitiveness in the logistics business. To establish smart ports, federal agencies should gradually deploy information technology solutions to promote improved administration and planning across and within port facilities.

Smart ports make use of a wide variety of devices. The systems employed are determined by the characteristics of the port and the product handled. This, in turn, may be determined by the level of automation necessary. The system employed ranges from load detection to antisway, remote surveillance and operation, and blockchain technology computation. Specific examples include the employment of unmanned aerial systems in surveillance and security operations, while others employ video monitoring with advanced OCR and other recognition technology.

The accuracy of data, its analysis, and the conveyance of results back to people in need of advice are critical to the business growth of Smart Ports (on route, location and status of their cargo). The online world is the primary facilitator of collecting information and distribution, as well as the human interface to the information and the knowledge produced from all of this.

The Internet of Things (IoT) is the most recent advancement of the online platform, employing machine-to-machine (M2M) connections. IoT would be only plausible if there is stable and safe network integration (LAN, Wi-Fi, etc.), sensor arrays to capture/generate data (GPS, RFID, etc.), and continuing to support algorithmic prowess; this facilitates Internet-connected objects to interact, share data, make decisions, and then impose course of action to increase performance and effectiveness. Various advantages of Smart Ports are as follows:

- Enhanced maritime operations: planning and steady improvement utilising IoT sensors on shore and sea to provide real-time intelligence to the maritime crew
- Energy Management: enhancing business performance, presidency, and management of all energy-consuming seaport assets and supplies across the dock and terminals.
- Equipment operations: Real-time communication to all terminal machinery for breakdown predictions, anticipatory servicing, OEE, and operational task selection. Pipeline screening and forewarn reducing vulnerability to hazards by real - time tracking of gas and fuel pipelines using IoT sensing devices and camera systems to identify leaks, detect accidents, and send alerts with advice on the needed reaction.
- Port communication: a multi-channel communication interface that connects all port decision makers to a single unified system regardless of transmission medium.
- Personnel tracking: the tracking and monitoring of patrolling personnel in order to maintain worker efficiency and compliance.
- Improved security: Regulating port accessibility and enabling intruder identification and early warning by cultivating a safe and secure physical and cyber setting
- Operational Efficiency: digitalization of critical infrastructure combined with data analytics for improved judgement call, efficiency, and cost reductions.

3.1 Case studies

3.1.1. Port of Antwerp

Antwerp's technological development system aims to enhance architecture, logistical handling, and port traffic flows. This links all of the port's parts via a network for data and information sharing. It is critical to determine the status of the items or the trajectory they will take in order to function promptly and accurately.

3.1.2. Port of Rotterdam

To enhance efficiency and functional change, Rotterdam is deploying IoT technology integrated with AI via cloud apps. Sensors have been installed on quay walls, dolphins, and other objects across the port area. These sensors are continually collecting and transmitting information to the network. They will gather hydrographic and meteorological statistics on topics such as water levels, salinity, wind conditions, visibility, and current flow and combine it in the freshly created interface. The gathered information will be evaluated and translated into real-time data that vessels and port managers may use to enhance pilotage and berthing while also monitoring and responding to pollution events.

3.1.3. Port of Valencia

The seaport of Valencia reportedly put a network of 'black boxes' on 200 cranes, straddle carriers, vehicles, and forklifts to capture data including position and power use. These assist terminal employees in reducing idle time. Furthermore, they have deployed smart lighting systems, which produces light only when cars are around, a step that is believed to have decreased electricity use by 80%; this also means that light pollution has been considerably reduced.

3.1.4. Long Beach Container terminal, California

Long Beach's primary terminal has now become totally automated. The machinery is also zer
o-emission. All diesel machinery has been substituted by electricity
powered equipment. A central management centre oversees the complete procedure. The ter
minal's brain understands which cargos are travelling and where they are heading. This allow
s for several processes to be performed at the same time, maximising throughput, and saving
hundreds of truck journeys.

3.1.5. TradeLens, a blockchain-enabled digital shipping platform, will welcome major ocean carriers

A.P. Moller-Maersk and IBM unveiled the development of TradeLens, a blockchain-enabled maritime system meant to encourage more seamless and secure global commerce by connecting together multiple partners to enhance information exchange and transparency, as well as drive industry-wide innovation. CMA CGM and MSC Mediterranean Shipping Company (MSC) have both indicated their intention to join TradeLens. With CMA CGM, MSC, Maersk, as well as other companies on board, TradeLens will have access to the information for over 50% of the world's ocean container shipping. This will significantly contribute to TradeLens' objective of more confidence, transparency, and collaborative effort throughout supply chains to encourage global commerce.

3.1.6. The First Bill of Lading Challenges Using Blockchain Technology

The first blockchain-based bill of lading was produced in the Port of Koper, Slovenia (EU). The Bill of Lading for such a shipment was issued wirelessly and transmitted in minutes rather than days, thanks to an ultra-secure and dependable public blockchain channel called "CargoX Smart Bill of LadingTM," and the possibilities of damage, theft, or harm to the Bill of Lading have been significantly lowered to near-zero.

3.2 Blockchain technology will aid in the digital revolution of Maritime industry

Blockchain is among the innovations that may assist organizations with digital transformation in a multitude of ways. This technological innovation may provide organisations and enterprises with a decentralised, transparent, and trustworthy framework. Blockchain has been shown in studies to be capable of being incorporated into operations such as commercial and documentation workflow. Moreover, researchers may further examine the use of blockchain in the ports and shipping industry to drive technological change.

Blockchain technology offers a good prospect for a variety of industries, including property investment, Internet of Things (IoT) technology, Supply Chain Management (SCM), healthcare, banking sectors, and many others. Essentially, blockchain technology may be thought of as a series of blocks that include a comprehensive list of the operation and tamper-resistant digital ledger that is executed in a dispersed manner (i.e., without a single repository) and typically with little or no centralized control (i.e., a bank, a company, or a government).

Blockchain technology gives the ability to the client to record their financial activities in a shared ledger together within a community, so that once a transaction is authored, it cannot be altered, and any adjustments introduced to the transactions are visible to everyone in the network, including who made them and whether or not that individual is authorised to make these adjustments. With the development of the Bitcoin cryptocurrency blockchain in 2008, this concept became well known. Blockchain technology has gained a lot of interest and academics' interest since the very first blockchain application (i.e., Bitcoin) was established.

The usage of cryptocurrencies in the business world, however, is only one functionality field for blockchain technology. Furthermore, blockchain technology may be promoted as a system that can revolutionise corporate cultures, SC management, and other sectors. In principle, blockchain technology enables the safe exchange, storage, and transfer of information between multiple users in a distributed and decentralised digital ledger without the involvement of an intermediary. Furthermore, it has an impact on transaction costs and improves efficiency and information exchange.

Because of broad block reliance and dispersion, there is a minimal chance of falsification. Because a new block is constantly dependant on the hash of a prior block, the primary feature of blockchain technology is its editability and openness of all operations. Decentralization eliminates the need for a middleman to authorize and validate transactions and store all information; instead, the technology creates a direct connection between the parties, allowing for post-factum activities and communications.

Rapid advancements in data and networking technology have resulted in the transformation of service systems into smart systems. The fundamental cause of the rise of smart services is the remarkable technical progress made in last several years. Smart technologies have served a large and important role in strengthening the market benefits for ports and shipping operations in recent times. Smart technologies are utilised in maritime transport to boost productivity, safety procedures, vision, and effectiveness in port operations and shipping. Smart port and maritime technologies provide better operational productivity, increased transparency, traceability of supply chains, and improved ports and marine operations.

Innovative systems in docks are used to assist all activities at the dock such as warehousing, shipping terminal operations, logistics services, and transportation by utilising a specific wireless network. Smart technologies in port activities have recently been the subject of studies and research on numerous computer systems. Smart technologies are those that are new and rely on AI technology. With a growth in the volume of commodities exported via ports worldwide, cargo-handling activities at docks must be carried out effectively and employing cutting-edge machine learning and AI technology. The information system research examined data and networking technology applications utilised in ports and discovered a variety of these innovations that have lately become common in ports. These innovations are divided into the following sections (Alamadi, 2022):

3.2.1. Satellite navigation systems (GNSS)

GNSS, often known as satellite navigation or satnav, uses satellites to deliver precise time and position services. It has evolved into a pillar of modern society, as seen by the deployment of GNSS satellites to offer this service formerly produced by the United States Global Positioning

System (GPS), Russia's Glonass, China's Beidou, and Europe's Galileo system. This innovation has been embraced by the marine sector and ports, with an estimated 87 percent of merchant ships now utilising location and navigation technologies. This is due to the fact that 90% of global trade is conducted by waterways. As a result, there is growing attention in the possibilities of GNSS for rescue and search missions, coastal navigation, inland canal navigation, and luxury vessel users.

3.2.2. Electronic data interchange (EDI)

Contemporary modes of communication are critical in today's worldwide transportation and freighting businesses. Complex SCs provide a dynamic and quick responsiveness to customer requests and require a precise information exchange for command, coordination, and monitoring. Many containerizations and freighting industrial sectors recognised EDI from the start as the appropriate way for conveying important data. EDI automated the gathering, distributing, obtaining, and creation of exchange documents; increases organizational precision; improves customer service; decreases costs through process optimization; and shortens responses times. The shipping sector has been able to cut stopover and freight longer holding periods, enhance and standardise administrative operations, reduce mistakes through automation, increase traceability, tracking, and visibility, and improve warehousing efficiency. It has also facilitated the unification of all intermodal activities.

3.2.3. Radio frequency identification (RFID) (RFID)

RFID (radio frequency identification) is an information collecting and identifying system that is used in passports, access cards, and toll tags. A trackable item is labelled with a label or transponder, which independently emits its unique ID number in response to an RFID reader's instruction. The reader then sends the identification information to formatted middleware, which collects and organizes the information for interpretation. Active (battery-powered) and passive (no-battery) RFIDs are the most commonly utilised RFID technologies. It is primarily used to detect and classify inventory, assets, and personnel without requiring a direct line of sight, and it can be read at varied ranges and encoded with significant amounts of data. This is distinct from other forms of automated identification and data collecting.

3.2.4. OCR (optical character recognition) technology

The OCR technology is an information collecting and classification method that is automated. It includes anything from home scanners and printers to toll acquisition and port safety and control systems. OCR is used by shipping companies to digitise machinery identification, similar to how information extraction and data scanning are used in offices. During the image capture or imaging procedure, a distinctive pattern of separate components or a series of digits on an item is recorded digitally using this technique. This necessitates that the target be observable to an imaging instrument. The image's bits and bytes are then processed by specialised software to extract and locate the specified patterns. The detected patterns are then combined and utilised to distinctively classify the item. The technology could be utilized to record the state of the equipment while also making it easier to identify its marks, such as text on licence plates or number stencils. It aids in the identification of an object without the need of a gadget or tags methodologies.

3.2.5. Wireless Sensor Networks (WSNs)

WSN is a self-configured digital networking system that does not require any architecture to monitor environmental or physical factors such as pressure, sound, pollution, temperature, or motion. The data is then sent via the network to a central sink or location for analysis and observation. The sink serves as a conduit between the system and its clients, allowing users to obtain data by requesting and retrieving outcomes from the sink. This method necessitates the use of sensor devices that interact through wireless signals. WSNs have been employed by shipping businesses to track their items during transportation, and they are also utilised to regulate light. Port light source uses a significant quantity of electricity and expenditures since it operates continuously, necessitating correct control and intensity.

3.3 Sagarmala Programmes: India's Initiative towards Port Digitization

The Prime Minister, Narendra Modi's administration's Sagarmala scheme is bolstering India's maritime commerce such as never previously. Apart from constructing innovative ports, it is also renovating the country's ancient ports through a significant infrastructure revamp. According to official information, the Sagarmala initiative includes 802 projects costing Rs 5.53 lakh billion. So far, 172 initiatives have been finished, with another 235 projects in the works. A new port worth Rs 6,554 crore is being developed.

The digitalization of numerous processes under one unified framework through the Sagarmala programme has enhanced performance and production. The implementation of smart ports in India, openness, and clarity of work, improved the communication process via a web-based network, and a paperless policy are some of the primary projects and advantages of digitalization. As per the authorities, connectivity platforms are being strengthened through multiple reforms and advantages such as the implementation of the Port Community System, a single digital framework for all communications, reduced transaction period and expenses, continuous information exchange, no more superfluous redundancy of documents, and biometric devices that make data easily accessible.

Cargo throughput has grown by 42% since 2014 because to the Sagarmala scheme. Furthermore, efficiency initiatives resulted in a capacity increase of more than 80 million metric tonnes annually. Additionally, port connection has been improved. The Modi administration believes that the Sagarmala scheme will save roughly Rs 40,000 crore each year. There will be a 2% increase in GDP. According to the government, the infrastructure transformation would provide jobs for more than one crore individuals (Nag, 2021).

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AUTHORS

Capt Kapil Dev Bahl is former Managing Direct of Murray Fenton India, Maritime Arbitrator (LLB) & a fellow of CMMI. He is also the President of the Nautical Institute West.

Ennarasu Karunesan is a Maritime Transport, Ports & Logistics Expert & Founder & CEO of UMK Group.

Prof Devinder Grewal is a well-renowned Ports & Transport Logistics Specialist.

Capt Suresh Amirapu is an Advisor at PSA India Pvt. Ltd.

Dr Vinh Thai is Associate Professor at RMIT & Founder of Australian Maritime Logistics Research Network.

Abdullah Siddique is designated as Research Consultant at ISF Group under the Division of IIRE, Inner Search Foundation.

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