MARINE INNOVATION

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CONTENTS

SMARTIFICATION SEEMS TO BE CRUCIAL IN TODAY'S SUCCESSFUL BUSINESS

By: Fatemeh Moonesan
Editor-in-Chief

Smart Technology is rapidly expanding its domains. New achievements are wide-spreading in urban and rural life every single day.

Smart technologies have gone so far that many people in this world have abandoned traditional life and opted for digital life.

Nowadays, the two main parts of the maritime transport industry including ports, shipping and related industries are constantly upgrading and becoming smart. Infrastructures of the mentioned industries (such as ports and shipping) are equipped with innovative smart technologies; accordingly, the skills of the staff in their respective occupations are being continually enhanced through the required training. The productivity of every industry, including the maritime industry, is undoubtedly influenced by three key factors: quality of service, speed of service, and final cost. These factors make a major contribution to competitiveness. Therefore, smartification seems to be crucial in today's successful business in a competitive market.

Smart technologies have effectively transformed the maritime transport industry. In recent years, technologies such as camera, radar, sonar, GPS and a lot of sensors have facilitated the ship navigation for seafarers. It is expected that in the near future, even the task of navigation and steering of the ship will be fully delegated to smart systems. According to researchers' prediction, we will witness the first unmanned ship in local seas in the current year, also the first semi-autonomous ocean-going cargo ship by 2025.

Smart ship manufacturers claim to provide high security level, eliminate human error and reduce labor costs, training, salaries as well as health care. Moreover, operating and controlling of these vessels will be more precise which will increase the efficiency in costly areas such as fuel consumption.

Although some experts believe that smartification is not a threat for human resource, the reality is that skills will be shifted.

Port Smartification by utilizing GS1 standards and variety of technologies including information technology has widely enhanced the speed, security and precision of operations. As an example, digitalizing many of ship reports facilitates information input and maximizing data output while increasing accuracy and durability. At the same time, it has led to staff reductions in their respective departments.

The establishment of satellite networks for the ship's crew to use the Internet, satellite television and communicate with their families has increased seafarers' motivation as well as their productivity resulting in improving their living standards. Automatic digital transition of the maritime navigation to ships, while reducing costs, has also resulted in reducing ship crew's work besides enhancing the security of vessel navigation. The cost control of components, supplies, oils, fuel, etc. is carefully monitored and optimized using advanced software.

IMO SECRETARY-GENERAL;

"WE SHOULD SUPPORT INCREASED DIGITIZATION ACROSS THE WORLD"

The Assembly of the International Maritime Organization (IMO) has approved the renewal of Kitack Lim's appointment as Secretary-General of IMO. He has been reelected for a second four-year period beginning January 1, 2020 to 31 December 2023. Marine Innovation magazine has conduct an exclusive interview with him. in the following section, the answers are represented in the following section.

1.You have been reelected for a four-year until the end of 2023, what are your main priorities?

Looking ahead, I can see five clear areas of focus that stand out from all the others. These will be achieved by continuing the collaborative and cooperative work that is the hallmark of IMO, providing a forum for its Member States, along with other stakeholders, to discuss the policy issues at hand. These will also be achieved through the long-running program of technical cooperation, bringing capacity building and training to developing countries.

The first key area of focus is addressing the biggest single challenge we all face, and this is climate change. We need to address GHG emissions from ships. The Initial IMO Strategy on reducing GHG emissions from international shipping has tangible ambitions which, in real terms, represent a reduction of emissions of over 80% for ships currently trading. The focus now has turned to the detailed work needed to achieve these ambitions, which will continue in 2020 and beyond. This Strategy is helping to drive shipping's transformation towards a sustainable, decarbonized future.

To deliver the Strategy, significant numbers of zero-carbon ships, or ships that can be easily adapted to use low or zero carbon fuels, will have to enter the fleet as early as the 2030s. New technologies and new fuels will be vital if our targets are to be met. I am certain

that these ambitious regulatory targets will act as the catalyst for technology, triggering research, development and innovation. While research into developing zero-carbon marine fuels is under way - with hydrogen, ammonia or biofuels considered viable options - more action is needed to speed-up this process. To achieve this, IMO is stepping up its efforts to act as the global forum and promoter of R&D in zero-carbon marine fuels, bringing together interested stakeholders from around the world. To achieve our goals, there is a need for collaboration of governments, shipping industry, the financial sector as well as all other relevant stakeholders.

Second: the 0.5% limit on sulphur in ships' fuel oil, which is now in place. It is vital that this measure is smoothly and universally implemented so that the full benefits can be felt. Our focus now is on the successful implementation and enforcement of the prohibition of the carriage of non-compliant fuel oil for combustion purposes for propulsion or operation on board a ship - unless the ship has an exhaust gas cleaning system ("scrubber") fitted, that entered into force 1 March 2020. In this regard, IMO will be monitoring the developments closely and will continue to work with Member States and the industry to support implementation of these regulations.

Third: digitalization. Digitalization, big data, and new technologies such as artificial intelligence and robotics have the potential to take shipping and the maritime community into a bright new future. We need to integrate new and advancing technologies in the regulatory framework - balancing the benefits derived from these technologies against safety and security concerns, the impact on the environment and on international trade facilitation, the potential costs to the industry, and their impact on personnel, both on board and ashore.

Fourth: efficiency of shipping. We are looking at strengthening our work to make shipping a more integrated and more efficient part of the global supply chain. IMO is working to ensure the adoption of technologies that increase the connectivity and efficiency of working practices in maritime transport and ship management; be it in marine communications or the exchange of information in the ship-to-ship as well as the ship-to-shore interfaces. Cooperation and communication between shipping, ports and logistics will be vital to enhance the efficiency and sustainability of shipping and therefore facilitate trade and foster economic growth and prosperity.

The well being of over 1.6 million seafarers working on board seagoing ships every day to deliver goods to the populations around the world is, and will remain, a high priority throughout my second term as Secretary-General.

Fifth: seafarers. The well being of over 1.6 million seafarers working on board seagoing ships every day to deliver goods to the populations around the world is, and will remain, a high priority throughout my second term as Secretary-General. Their health, education, safety and legal protection are vital issues for us - and, I can assure you, for the shipping industry, as well. I have pledged to ensure that maritime personnel are always one of the first considerations in any measures that are debated and adopted at IMO.

I would also like to take this opportunity to say a few words about this year's World Maritime theme, which is "Sustainable shipping for a sustainable planet". The theme is intended to raise awareness of the United Nations' Sustainable Development Goals, the SDGs, and showcase the work that IMO is undertaking to achieve the targets set by the SDGs.

The year 2020 will mark the beginning of a decade of action and delivery for the SDGs, not only for shipping but for the global community as a whole.

The shipping industry, supported by IMO's regulatory framework, has already started the transition towards a sustainable future through the adoption and continuous development of measures to address very important issues, such as the reduction of greenhouse gas emissions, the lower sulphur content of ships' fuel oil, the protection of the polar regions, the safety of fishing vessels and the wider participation of women in the maritime community.

2.IMO has taken big steps under your leadership. With regards to digitalization, approving an initial set of guidelines for the conduct of autonomous ship trials is one of them. What will be the next measures - what else is being addressed in terms of digitalization?

Certainly, as mentioned already, the digital revolution is hugely important and is going to have a big impact on shipping. Indeed, I would say that digital disruption has already arrived in the shipping world. Advancements in technologies such as artificial intelligence, robotics, automation, e-navigation and big data will usher in structural changes and will impact on communications as well as navigation among ships. This will lead to new generations of ships that bring step

change improvements in all the areas that IMO regulates. E-navigation and related concern regarding cyber security are already on IMO's agenda.

Fully autonomous ports and semi-autonomous ships are already close to becoming a reality in some countries and we have seen trials of fully autonomous ships. However, they have mainly been very small ships or very short voyages.

It is important to take these developments on board and consider their implications. IMO is undertaking a comprehensive regulatory scoping exercise into maritime autonomous surface ships, also known by the acronym MASS. This scoping exercise considers all current regulations in specific conventions and aims to look into how we integrate these new and advancing technologies into IMO instruments.

In 2019, IMO issued approved Interim guidelines for MASS trials. Risks associated with the trials should be appropriately identified and measures to reduce them should be put in place. This includes taking steps to ensure sufficient cyber risk management of the systems and infrastructure used when conducting MASS trials.

Meanwhile, digitalisation can have great benefits for the logistics and supply chain. In April 2019, an important new requirement entered into force under the Facilitations Convention, making it mandatory for national governments to introduce electronic information exchange between ships and ports. The Facilitation Convention encourages the use of a "single window" for data, to

It is important to take these developments on board and consider their implications. IMO is undertaking a comprehensive regulatory scoping exercise into maritime autonomous surface ships, also known by the acronym MASS.

enable all the information required by public authorities in connection with the arrival, stay and departure of ships, persons and cargo to be submitted via a single portal, without duplication.

This is a key measure for ports to implement and we are ready to support any country which needs assistance to fully implement the requirements and which may wish to develop a single window system, for example, using source code developed under an IMO-Norway project in Antigua and Barbuda.

I am keen to strengthen our work to make shipping a more integrated and more efficient part of the global supply chain. I do believe that we should support increased digitization across the world, and not just in those advanced ports which already are highly automated. We are also supporting work to develop and harmonize international standards for operational data in ports, including for berth to berth navigation, the ship-port interface and the end-to-end supply chain.

Of course, we have to remain vigilant about all security risks and there is no doubt that the increased automation and digitalization of shipping means that cyber risk management is more important than ever. Cyber risk management has to be part of safety management plans. IMO has issued guidance on this and we will continue to keep this on our agenda.

3.Following you proposal, the Council endorsed the theme "Empowering Women in the Maritime Community" as the World Maritime Day theme for 2019. Why did you propose this theme?

First let me say that the 2019 IMO World Maritime Theme "Empowering Women in the Maritime Community" really helped raise awareness of the importance of gender equality. It highlighted the important - yet under-utilized - contribution of women within the maritime sector. Many maritime stakeholders enthusiastically took up the theme at numerous seminars, conferences and panel discussions.

Throughout the year, IMO worked with various maritime stakeholders to help create an environment in which women are identified and selected for career development opportunities in maritime administrations, ports and maritime training institutes and to encourage more conversation for gender equality in the maritime space.

IMO's Women in Maritime programme pushed forward with numerous activities, including premiering a new film, launching online profiles of women in the maritime sector and providing support to the Women in Maritime Associations (WIMAs) launched through the programme.

At the end of 2019, the IMO Assembly adopted a resolution urging further firm action in coming years to advance gender equality throughout the maritime sector and to reach a barrier-free environment. A number of actions can help progress towards gender equality, and these are highlighted in the resolution.

I am pleased to say that IMO and the Women's International Shipping & Trading Association (WISTA International) have initiated a study to establish numbers of women employed across several maritime sectors.

They include addressing any barriers and obstacles that still exist and fostering a safe environment for women in the maritime sector. We need more sharing of best practices in achieving gender equality. And we need more data. We need to collect, consolidate and analyse data relating to the participation of women in the maritime sector, to establish baselines, identify gaps and inform policies aimed at removing barriers and increasing female participation in the sector. I am pleased to say that IMO and the Women's International Shipping & Trading Association (WISTA International) have initiated a study to establish numbers of women employed across several maritime sectors.

We also need to continue to encourage open dialogue and wider engagement between the IMO Member States and observer delegations.

I am positive that we can continue the momentum of 2019 and keep pushing forward to create a barrier-free environment for women - and help facilitate the achievement of the global Sustainable Development Goal (SDG) 5 on gender equality.

AI TECHNOLOGY TO SAVE FUEL ON VESSELS

Artificial Intelligence (AI) is an enabling technology which significantly contributes to the management of environmental impacts and climate change. Stena Line as one of the world's largest ferry operators is expanding the use of Artificial Intelligence (AI) technology to predict the most fuel-efficient way to operate a vessel. After a successful pilot study regarding the reduced fuel consumption by two to three percent, the Stena Line decided to install Stena Fuel Pilot software on five more vessels. In order to discuss this issue, Marine Innovation magazine has conducted an interview with Mr. Erik Lewenhaupt, the Head of tainability, Brand & Communication at Stena Line.

Erik Lewenhaupt, the Head of tainability, Brand & Communication at Stena Line

Could you please brief us on the application of Stena Fuel Pilot software?

Stena Fuel pilot is a project where the use of Artificial intelligence meets the navigational knowledge and experience of our Senior Masters. Since many years Stena Line has had an ambitious program to reduce fuel consumption and emissions. Mainly focusing on technical innovation and upgrades through our 6 person "Energy Savings & Performance team" we have implemented several projects every year – big and small – including frequency-controlled fans, new propellers, bulbs, LED lights and so on. Optimizing speed and schedule has also been an important task for the crew and on-shore personnel. However, following a push into digitalization and transformation in 2015 projects were also initiated to improve efficiency for liner shipping through better use of data. In 2017 the project which is today the Stena Fuel Pilot was launched with Hitachi. Today the system is implemented on four ships and more will be rolled out during 2020. Basically, the system analyses five years of historical data from sensors and flow meters on a ship and specific route. This data is then combined with fresh daily data of weather, currents, depth, schedule, load and trim to suggest and optimal routing and operation to the Master. It is then his/her decision to accept the suggestion or not. The Fuel Pilot suggest route, speed etc. to maximize efficiency on every voyage and the system learns as it generates more experience. Independent tests have shown the system to be able to reduce fuel consumption with approximately 2-3% depending on ship and route. It is likely the system will be commercialized at a later stage.

Your ambitious targets are to reduce your carbon dioxide emissions by 17.5 percent in 2020 and by 100 percent in 2050 compared to 2010, what measures have you taken to achieve the goals? What are the main challenges ahead of you?

Clime change is real, so we must be committed and dedicated to finding new ways. Our main target is to reduce consumption and/or emission with 2.5% per unit carried every year. That's an ambitious target which we admittedly have a hard time reaching only by efficiency measures. However also looking at changes in fleet and future fuels options we are optimistic. To date we have tried expanding the use of shore side electricity (today 15 ships can connect to shore) and are very interested in battery hybrids. Today one ship has been converted to a hybrid with a 1MWh battery installation replacing 1-2 auxiliary engines, but intention is to increase battery size for the next installation to be able to replace one main engine and sail a ship through the archipelago into open waters before switching on the main engine. We hope to have a fully electric ship by 2030. We are also evaluating methanol as an alternative fuel. Methanol has similar characteristics as LNG but is liquid and can be produced from a variety of feedstocks. If going forward it can be renewable produced that is a very interesting alternative. Time, cost and technology are always challenging in projects like this, but we take one step at a time and try to do our part.

Stena line is supposed to become world's first ferry company powered by cognitive computing by 2021. What plans do you have in mind to achieve this goal?

The Stena Fuel Pilot is one example where the system provides a solution, but the human makes the decision.

As we move ahead more systems will be launched where more decision making is also taken by the systems to automate processes and speed up our operation. Currently the transformation team consists of about 100 colleagues working in five workstreams. The types of talent we recruit now are new to shipping and that we are more competing to technology companies about the right competencies. Ultimately, we need to ensure we optimize our business in port and at sea best possible and take decisions based on data and not guesswork, we believe this will also benefit our customers and make sure we offer a reliable service and great experience.

4) How did you cooperate to develop autonomous smart ships?

We don't develop autonomous ships but much more prefer to focus on smarter vessels. We believe a ship of the future will be one where the maintenance of engines and ship will be a lot less labor intense and therefore the crew can be reduced. However, we currently see a limited upside with ship with no crew at all and that is not what we are striving for. With the existing technology on-board our ships can navigate by themselves if we wanted them to but there are many other areas of ship operation that can not be automated at present and our passengers want a human interaction.

The types of talent we recruit now are new to shipping and that we are more competing to technology companies about the right competencies.

DATA EXPLOSION AGE

Smart technologies are having a tremendous impact day-to-day, momentarily and instantaneously on human life around the world. Today, with fast-growing technologies and the ever-expanding virtual network that connects people around the globe, it is as if Marshal McLuhan's hypotheses in the 1960s, the philosopher of communications science who had predicted the next 50 years of human beings in the pursuit of a "global village" has come true.

Nowadays, according to experts, smart technologies are moving from the age of information explosion to the age of data explosion. In this regard, it is worth mentioning that according to a professional review by IT theorists, in this year alone, 50 billion PCs and smart devices will be connected to internet. As a result, in the current situation, we can predict what changes will these devices make. So we can safely say that the first and last word in the future life of human beings is smart technology.

In this regard, the introduction of start-ups into the business, different types of applications that revolutionize human life, smart phones, Auto-driven cars, digital media, big online shops, smart ports and ships, using Internet video conferencing technology, social networking, tele-medical surgery, etc. are proofs that exist in the technology world and is growing in number every day.

With this introduction, the 40th roundtable of Marine Innovation Magazine entitled "Smart Technology with a View to Maritime Transport in Iran and the World" was held with the participation of CEOs and experts in the field of transport and IT.

Attendees at this roundtable pointed out that Intelligent Technology cannot be achieved only by possessing the equipment because Smartization requires a specific culture, convergence and synergy, human resource training, thinking and collaboration across sectors.

On the other hand, by improving the maritime commerce, it can be said that maritime transport and smart ports are a necessity and an opportunity, otherwise transportation will not survive.

Members of this roundtable include: Dr. Mohammad Qaem Tajgardoon, General Managing Director of Information and Communication Technology of the Ports and Maritime Organization (PMO), Dr. Zeinab Barzegar, Advisor of the Managing Director of Ports and Maritime Organization in Information Technology, Mohammad Reza Damavandi, Managing Director of Marine Information Technology

Development Company, Abdolreza Mohebbi, Director of Research and Technical Development Office of the Vice President of Shipping Development of Islamic Republic of Iran shipping line , Dr. Hassan Shadman Advisor of the Vice President of Shipping Development of the Islamic Republic of Iran shipping line , Alireza Mehrgoo, CEO of Sepna Design and Development Company, Seyyed Reza Navab Kashani, CEO of Vaghe' Afzoongaran-e Raya Sepehr Company.

When we talk about IoT, it means we are able to get to the point where machines talk to us and we talk to machines, but in a language other than natural language, because everything requires planning and controlling.

It may not be necessary to look briefly at the evolution of intelligent technology in the world, because today its footprint is evident in various parts of life, and is integrated into society, but it would not be a bad idea if we start our discussion with smart ports first and ask about the stage that Iranian ports currently are in regard with achieving the intelligent technology.

Mohammad Qaem Tajgardoon: I am glad to have the opportunity to discuss intelligent technology. Hopefully it will be useful. For many years, the issue of smart ports has been negotiated by modeling the world's advanced ports. Considering the technology improvement, we can see the outcome of it, but mind does not focus on the efforts behind this outcome. Technology can be found in tools and equipment, but before it got there, human being had been thinking about it for years, brainstorming ideas and working on them and finally represented itself in the feature of a set of equipment. when we have ports in the world that work completely without using human resources, it means that operation planning, logistic planning, control and monitoring the proper execution of programs are done in collaboration with the supply chain and without direct human intervention. For instance, one of the terminals of the Port of Rotterdam is quite intelligent and there is a human resource monitoring behind this smart stream. However, inside the terminal, there is no human. Therefore, Smartization does not mean eliminating human; it means transferring human intelligence to the machine and this will not be achieved unless the human resource is intelligent. Therefore, there are different layers to discuss, but the different aspects of Smartization should not be overlooked. The question about making the country's ports smart is: why do not we have smart ports like the world's advanced ports. And this question has caught the minds of the stakeholders in this area. We also need to have what has already been thought about and worked on for three or four decades in different countries, but let's not forget that we will not necessarily reach intelligence by having the technology per se. It has been more than a year now that the issue of making smart ports has been raised and a plan has been provided and approved by the Board of Directors of the Ports and Maritime Organization. This plan defines Smartization as planning and utilizing all available resources, facilitating the required resources to be effective in all activities in different layers, from policy to execution. So, we have defined five dimensions. In the technological framework, we are looking to Smartization and to create communication networks. Therefore, there are two areas in this layer: 1-Networking discussions 2- IoT discussions (Internet of Things). When we talk about IoT, it means we are able to get to the point where machines talk to us and we talk to machines, but in a language other than natural language, because everything requires planning and controlling. The program given to the machine is our talk with the machine, and the machine is the result of the task accomplishment that helps us with controlling.

Zeinab Barzegar: Ports and Maritime Organization has made a big step towards Smartization which is considered an innovation for the

organizations of the country. In this regard, we have taken three steps towards Smartization. The first step is to create smart thinking, the second step is smart culture development and the third step is smart planning. We cannot use these technologies intelligently, unless we go through these three steps. We believe that Smartization can never be used without thinking, culture and planning. If we aim to see changes in the Ports and Maritime Organization, we need to move from mechanization and automation to information stream management and data management. In this process, we face different challenges. One of them is gathering relevant data from relevant sections. Related sections are a part of information systems. The other part is the experts and professionals in the organization who are doing a series of specific tasks that we cannot mechanize but are in the plan. One example is berthing the ships. How to berth the ships and in which jetty and where to discharge or to store cargoes? We have not been able to systematize this kind of planning yet, but we're working on it. Another challenge in the organization is the "big data". A lot of data is received and then streamed, but we have to refine which data should remain in the organization's data stream, which should be moved or deleted, how much correction should be done on the data. The next step that we will reach in the beginning of 1404 is the use of Artificial Intelligence (AI) services in managing the ports of Iran, which is currently used in a few leading ports. Hopefully, with proper planning, in 1404, we will reach a point where we can use AI services in planning for ship arrivals, ship berthing, offloading, container handling and storage. After 1404 we will focus on hinterlands which are called "Smart City". In some cities such as Tehran, Mashhad and Isfahan some work has been done aimed to transform the cities beside the port, which are not a few, to Smart Cities in order to manage the business well.

Mohammad Reza Damavandi: I have been working in shipping for 26 years and started my career from the sea. I have almost observed the technological process in the shipping and marine industry. In 1997, ship system was changed to GMDSS. Before that ships had Morse system and marine system in the world was 10 years behind the technology which of course this was not only about Iran. The maritime industry began using computer systems and information technology 10 to 15 years later than the non-maritime industries. The main reason was the relations of vessels and the lands. In my opinion, the best event in this industry was the connected ships which made a big change in this industry and made the ships utilize the new technology and use different software.

Of course, digital transformation has a number of obstacles and a number of drivers. Its drivers include increased organizational agility, customer satisfaction, cost savings and barriers, understanding the concept of digital, digital leadership, digital culture, skills and talents.

Today, the top four technologies are applied in the global maritime industry such as IoT, Blockchain, Big Data and AI. IoT has the highest technology at this time. According to a research by Inmarsat 75% of vessels will use IoT equipment in the next 18 months. The research was recorded in early 2020 and each company will spend approximately $ 3 million on IoT. But as I mentioned, today's top technology is IoT which is used to measure ship engine and ship equipment parameters online to reduce fuel costs. Another technology is the technology of emission measurement of the ship, which can be applied to both environmental issues and to optimize the performance of the main engine of the ship. The next technology is to use the vibration measurement of the hull of the ship to increase the performance of the main engine and its equipment maintenance, and is the technology of measuring the temperature, humidity, light and position of the cargo.

Containers, today, are not empty boxes; they are smart boxes that monitor how their cargo is handled to check how the cargo is kept on board, especially refrigerated containers have this capability. Nowadays, Maersk and Ericsson companies use this technology to monitor cargoes. The latest technology is health tracking, which is in the form of wearable gadgets which the ship crew wear them and can be informed of their health status. Today, big data is used in a variety of areas, especially in energy consumption reduction, safe operations, fleet management, service planning and even chartering. The issue of artificial intelligence is discussed in the decision-making of vessels and fuel consumption management.

Block chain has been running at Maersk for two years. In Blockchain, documents are shared in the distributed space used by different stakeholders, and the space is very secure.

This is happening at a very fast pace in the world. Of course, digital transformation has a number of obstacles and a number of drivers. Its drivers include increased organizational agility, customer satisfaction, cost savings and barriers, understanding the concept of digital, digital leadership, digital culture, skills and talents.

But there are a number of obstacles that are being discussed around the world. Unfortunately, we have not been able to use Blockchain technology very much in the country. There are a number of other obstacles in the country that are political. In this regard, Iran 's Vice Presidency for Science and Technology must support knowledge-based companies to produce this equipment so that we can apply it through localization and develop the digital culture in our country.

Now we have to see what are the needs of the national fleet regarding smart technology and what steps have been taken so far.

Abdolreza Mohebbi: Using technology is undoubtedly inevitable and should not be overlooked because in today's world of competition, utilizing all available capabilities makes the organization productive and capable of competing. Maritime transport is one of the largest industries that has been formed in human society since ancient times. Certainly, this vast and expansive network would not be competitively efficient and viable without competing smart systems.

The Smartization and the factors that make it all possible have been integrated in the details of the industry and are among the requirements and thus the prerequisites for continuing to work in this field. Shipping is an interconnected global industry that encompasses a wide range of causes and factors. Therefore, according to the needs of the industry, in order to draw the right conclusions, its causes and factors, and its chains as a whole must get smart in a parallel way. It is not possible for the system to function seamlessly when a part of this chain is broken. Definitely, a part of Smartization requires tools. Certainly, in terms of Smartization, even though the definitions are clear, and everyone knows what they are talking about, confusion sometimes happens. Therefore, although the Smartization and digitalizing are interrelated but are not the same concept. The concept of Smartization is more comprehensive. Digitalizing and other tools are means to Smartization. Perhaps one of the smartest achievements in the maritime domain is to reduce human error and then speed up the work. Most of the damages occurred in the sea is caused by human error. Human being is a part of the Smartization chain. They produce smart systems and in the following, humans are trained to be more intelligent. We will not be able to keep doing our job if we do not tend to reduce the human errors and be competitive, and also do not speed up to be a part of the chain. Part of the shipping industry relates to the port industry, where the present members provided comprehensive explanations. One of the major infrastructures in this area is port operations. Yet another of these industries is the shipbuilding industry and human resource and those smart equipment and tools needed by the industry. Some effective steps should now be taken in several areas to improve maritime transport and shipping activities. 1- Providing background and training for individuals and creating thinking models for onshore and offshore personnel. 2- Available technologies must be installed on the ships.

Hassan Shadman: More than 90 percent of the world's trade is being done through the seas. When the ship enters the network of the country, it will be dominated by a multidimensional system which starts from the ports and is delivered to the customer in a door to door way. Now, we are having a huge evolution for the issue of Smartization and digitalizing which is affected by the world's transport system. The significance of this movement can even be searched in the internet. Based on the current world information and anticipations by UNCTAD and research by accredited universities in collaboration with rating agencies, world trade will be tripled by 2050 in the next 30 years. Some of financial institutes predict it to be doubled at least which based on that, the ports need to be expanded. As a result, our view will be changed in the future.

I was reading an article saying that 80 percent of the world's accredited shipping organizations and approximately 50 percent of the world's biggest port organizations are moving towards Smartization. Otherwise, there will not be any sustainable development. Most importantly, the world's shipping organizations will disappear one after another. Even though the first impact of Smartization is the human resource reduction, we ought to know in which areas we should move forward.

Practically, maritime transportation Smartization should be in line with the current day-to-day shipping policies in order to integrate and develop the managing information systems and produce intelligent software and digitalize fleet activities. In this age of Smartization challenges, we should not underestimate the current capacities such as start-ups.

I personally see the Smartization in line with digitalizing the fleets and maritime industries because it is the matter of integration aligned with the world's smart system. In my opinion, some steps have been taken in this regard but they have not been effective and we should invest highly on this issue.

Cyber security is an important issue in fleet Smartization. In the field of Smartization, the number of people that work on vessels and in ports, or in connection with the integrated rail system or the available trucks dedicated to the DOOR TO DOOR system will be reduced. This will also happen in shipping. Another significant

issue that needs to be taken care of is energy management like the sudden 20-30 percent of increase in the fuel price. Another issue is about electronic charts, which are very important investment items, and the other one is the use of robots and smart vessels that can move intelligently.

Digital process, AI platforms and start-ups are other important issues. In this case, all the activities will be done online. A friend once told me about a person from Kazakhstan who wanted to transport the cargo from Kazakhstan to Astaneh and then to another country. He asked for the price list and we replied in two days and gave the containers' price. That person could find out the route and the price in 1 minute using the start-ups. This is the sustainable development.

Digitalizing is also an important issue so you can predict the future. The next issue is IoT which is very important. Monitoring machines is also significant, not only in the ship but also in the transportation. Today, the temperature of the refrigerated containers in the ships can be controlled on the spot from the center. There are systems that makes us capable of planning to repair and maintain the ships before they have a problem. Another issue is the cargo transportation on the ships most importantly in the ports. You need to know how to handle a cargo transportation in order to be Door to Door and how to clarify this route.

Blockchain which is an important discussion and Maersk company has started their collaboration with IBM and have had a great development. Online marine insurance is also important. In order to make changes we need to consider the world's progress so we can develop it inside the country. Otherwise, we will not survive in the business.

Today, knowledge-based and start-up companies play an influential role in the business which have been maintained with the creation of technology parks and facilities dedicated by the Vice Presidency for Science and Technology. The question is that under what conditions can these companies tend to the seas?

Alireza Mehrgoo: Firstly, we need to know what needs Smartization can meet in each sectors of marine, road and railroad transportation. Nowadays, there is some data in every organization which we have neglected. This data could have prevented some risks and accidents. Therefore, we have some lost data in each fleet which is left unrefined.

Smartization can analyze the data through the information and also human assistance who are in relation with fleets. The major role of human being is to assist with decision-making in critical situations. Collecting and monitoring the data is used in Smartization. As a result, we monitor the Smartization in the areas related to machines which need high security and use it for making better decisions. In marine and railroad fields, the time of repairing and maintaining different devices can be predicted so we can prevent the waste of energy and increase our efficiency.

The field that we are working on in Pardis technology park is transportation. Through this, the lost data which is important for the organization can be monitored.

Seyyed Navvab Kashani: I appreciate the invitation by Marine Innovation Magazine and all the useful discussion made by present colleagues on technology of Smartization in marine industry. We can categorize the technologies discussed in marine industry field in 2 general fields;

First, technologies related to construction, such as technology of designing vessels and buildings.

Second, technologies related to trade, security, fleets and steering.

The building technology is usually related to science of materials and Polymer industries and it deals with the production and use of materials such as self-healing, corrosion-resistant materials, Nano-components, carbon-fiber composites, coatings, welding and reinforcing joints. Operational technologies talk about building and upgrading tools such as hybrid engines or fuels, sensors and data collection, IoT, digital technologies, electronic boards and chipsets, data systems, artificial intelligence, machine learning and communication.

However, today, considering the position of the maritime industry, the notion that a particular technology can make a huge difference to the maritime industry seems far-fetched. If we are seeking the development of the maritime industry, we must find a solution to the use of several technologies at the same time. Today, for instance, there are discussions about the systems of auto-driven systems called Digital Captain in the maritime industry, and there are huge projects defined in this regard. Big companies like Microsoft are working on these ideas. This product comprises communication technologies, IoT, virtual reality, augmented reality, cameras, sensors, online data and dozens of other technologies to gain the results.

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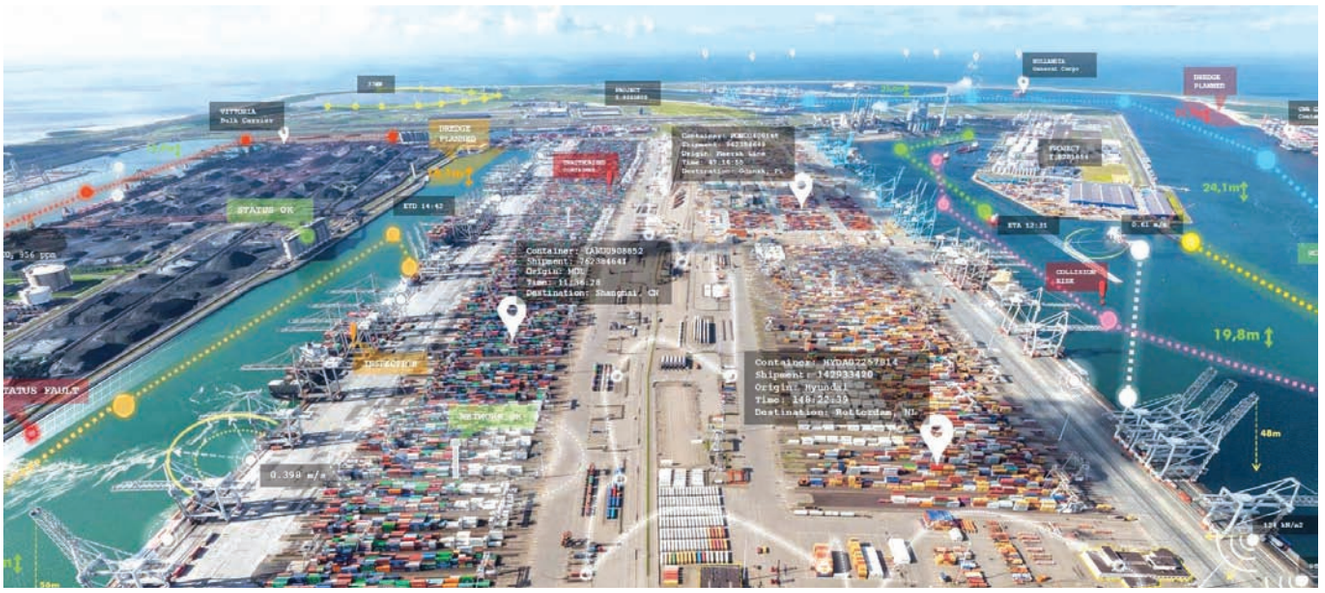
- Providing container shipping by Door-to-Door and Full LINER
- Shipping of 20-40′ dry containers through C.O.C and S.O.C by the owned fleet
- Providing cargo transit from ports of Far East to the Persian Gulf and CIS Countries and vice versa
- Shipment of cargo and oil products within the Caspian Sea
- Providing trans-regional cargo and oil products shipping as well as swap ship agency services



FUTURE PORTS: INTELLIGENT OR SMART?

By: Mehdi Rastegary
Ports & Maritime Expert

In the advent of 2020s and by the surging rise of Fourth Industrial Revolution in it, it seems that maritime transport still has a lot to do to keep pace with other industries in the transport sector (i.e. aviation, rail transport, automotive industries, and the emerging Hyperloop mode). The merchant shipping, troubled by the high winds of new environmental requirements and other market issues, is gearing up to smartify its businesses in order to enter into the new era: many novel concepts are emerging, including (and not restricted to) the smart ship, the autonomous ship, the green ship, the Just-In-Time (JIT) shipping, and the revolutionizing technological trends in digitalization, industrial automation, Big Data analytics, Artificial Intelligence, Robotics, 3-D printing, etc. On the other hand, the ports are also involved in a similar process of smartification and many of them are investing heavily to emerge as a smart port in near future. Yet, in spite of billions of dollars of investment and tons of promotional material on this subject, it seems that 'smart port' is more used as a buzzword in the industry level. Therefore, it is necessary to outline a clear understanding of 'smart port' concept in the port development discourse.

First and foremost, I think that we shall discern the difference between the 'Intelligent port ' and the 'Smart port' concepts: although these two concepts are very close together and one may find many overlapping areas between them, there are outstanding differences in their purposes and approaches. Let's have a brief overview on them.

Intelligent port

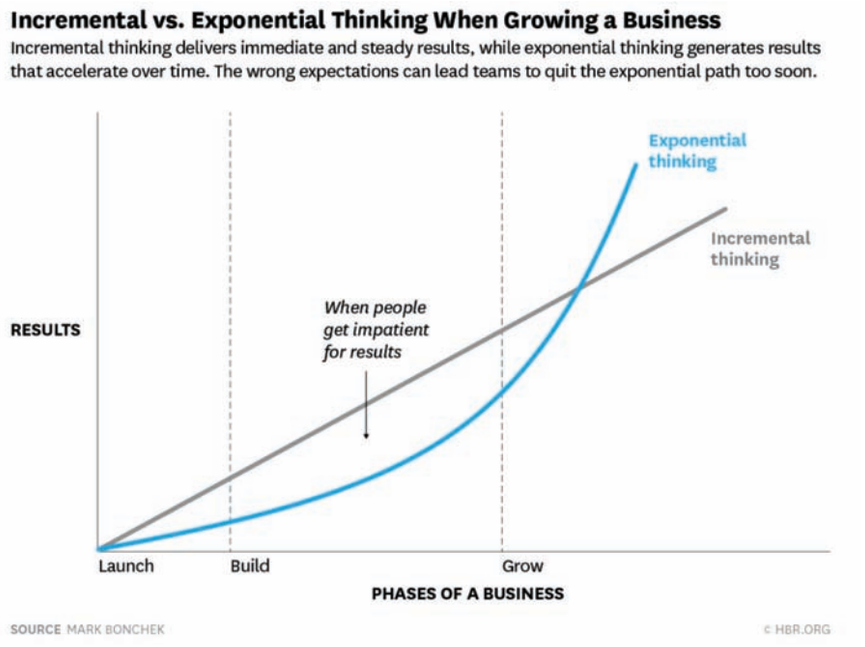
An intelligent port is a port that is focused on elevating its level of intelligence on the events and the occurring in the port businesses and their context, and developing the highest level of understanding and/ or control on them. The stream of intelligent port development has been pursued for more than three decades, by increasing the reliance of ports on informatics, digitization, instrumentation and automation. ICT developments have had a great impact on this concept, and among the most vastly used ICT-based solutions in the past thirty years, we can point to :

- Internet and World Wide Web
- E-commerce (and introduction of EDI)
- Port Community Systems
- Terminal Operations Systems
- Traffic Control Systems
- Security & Surveillance systems
- Industrial Automation Systems
- Simulation Software and Systems
- Various Transaction Processing Systems

From 2015, by stepping into the 4th Industrial Revolution era, a number of novel ICT developments have been signified to be highly influential in raising the intelligence of the ports. It is believed that these new developments can boost exponential growth in ports that will use them, and provide them with outstanding competitive advantage in the existing port markets. Among numerous emerging ICT developments, the following ones are the greatest contributors towards a higher level of intelligence in ports:

Connectivity

Connectivity is like oxygen to intelligent port ecosystems. It provides the development of data and information



flows between all members and parts of the port, its customers and clients and other stakeholders. These data flows foster the synergetic interaction of these entities with each other and contain tons of explorable information on the maritime supply chains, the port operations systems and different components in them, and the required information by regulatory bodies in the port and its hinterlands. Moreover, connectivity is the main facilitator of the interrelated functioning of a great number of systems and services in the port, and its foreland and hinterland. Among the great number of such systems and services we can point to Electronic Data Interchange, Vessel Traffic Management System (VTS), Terminal Operations System (TOS), Port Community System (PCS), Terminal Equipment fleets, etc. The communication infrastructure in ports is revolutionized by use of optical fibers which according to researchers have recorded the capacity of internet speeds of over 100 petabit×kilometer per second. Moreover, the ports are heavily investing on wireless communication infrastructure to augment the internet of things application. Table 1 compares the most used wireless technologies in ports.

Big data

As logistic centers, the main mission of ports is to facilitate the flow of commercial goods, money, and the big data related to them in supply chains. Moreover ports and terminals also generate a huge amount of data in terms of their operations in sea and land, observing the state of port facilities and equipment, monitoring of efficiency and quality of port services, the security of port premises, etc., which are generated and stored in the port infostructure. In this sense, the port is naturally a venue to develop big data on international trade and its supply chains, the industrial and logistical clusters, and the port's facilities and services. The information and data included are closely related to each other: for instance the port throughput is closely related the cargo flow through the port and the value added services demand in the logistical and industrial clusters in it, and the planning of port operations is mainly based on such big data. Similarly, the transport flows and the logistical and industrial activities in the port

Table 1 -Wireless communication technologies comparison

Wireless Technologies	ZigBee	Wi-Fi	RF	4G&5G
Popularity	+	+++	++	+
Speed	250 kbps	300 Mbps	9.6 kbps	100 Mbps/1 Gbps
Relative Cost	$	$$	$$	$$
Frequency	784 MHz	2.4 GHz/5GHz	433 MHz	1700-2100 MHz, 2500-2700 MHz
Range (outdoor)	100 m	100 m	20 km	-
Public Access	-	+	+	++
Compatibility	IEEE 802.15.4	IEEE 802.11 ac/n	802.11 ac	LTE

Yang,Y.,et al. (2018)

The most prominent feature of fourth industrial revolution is the exponential growth in Artificial Intelligence (AI) related concepts and widespread use of cyber-machines in all industries throughout the world.

are impacted by the productivity and quality of port services and facilities.
Like many other industries, ports and terminals have been concentrated on processing high-information-density data by use of applied mathematics and descriptive statistics to develop Business Intelligence. In the fourth industrial revolution era, the ports and terminals are expected to further their focus on mathematical analysis, optimization, inductive statistics and concepts from nonlinear system identification to infer laws (regressions, nonlinear relationships, and causal effects) from large sets of data with low information density to reveal relationships and dependencies, or to perform predictions of outcomes and behavior. In this sense the big data and its analysis will impact nearly everything in ports and terminals: from technology development to port operations, from customer relations to financial analysis, from energy consumption to environmental protection, and many more. Although most of port systems have generated and stored colossal data sets on their activities and transactions, these data sets are mostly stored in data silos and not referred to as a valuable economic resource. By use of the new technologies, not only the size of these data sets will proliferate, but also important steps will be taken in order to enhance the storage, analysis, sharing, and utilization of them throughout the port value chains.

Internet of Things

Internet of Things is another surging ICT development in ports and terminals within the coming years. It is defined as a system of interrelated computing devices, mechanical and digital machines
that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In the fourth industrial revolution era, IoT is seen as the infrastructure of the information society. According to IHS Markit reports within the coming decade, the number of connected devices in the world will rise by a 12 percent average rate and will increase to 125 billion in 2030. The emergence of IoT will embed and enhance intelligence in every aspect of human life. This will lead to an estimated increase of global data transmissions from 20 to 50 percent per year, on average, in the next decade.
IoT is finding vast application in the transport systems as it can facilitate the integration of communication, control, and information processing in different parts of them. It can develop a dynamic integration between different components of transport systems and enable inter/intra-vehicular communication, enhanced vehicle control, intelligent fleet management, better preventive maintenance, higher safety and security, etc. In the fourth Industrial revolution era, the IoT will converge with the big data and the machine learning developments to augment higher levels of Artificial Intelligence in the transport systems. Among the transport systems, ports and terminals are among the most capable sectors for application of IoT: the industry is moving towards developing the port system as an Ocean of (connected) Things1 that can communicate, and interact from each other, and learn from one another in a highly dynamic operational environment.

Port Automation

The most prominent feature of fourth industrial revolution is the exponential growth in Artificial Intelligence (AI) related concepts and widespread use of cyber-machines in all industries throughout the world. In ports and terminals, this is most reflected in the increasing development of port automation. Within the past two decades, the industry has experienced an ascending appeal to telematics and industrial automation of port systems and their operations. Digitalization and telematics have been two great initial drivers to automation, as they enabled the ports and terminals to automate many activities and transactions (e.g. tally writing, physical checks of cargoes and vehicles, documentation, etc.). Also great investments have been made on automation of mechanical handling operations: this originated from full automation of the horizontal transport system, and gradually led into developments in automation of yard handling systems (e.g. autostrads, RTGs, and RMGs) and automation of Ship To Shore Handling systems (Quay cranes). The industrial automation is spreading in the industry throughout the world, and contrary to the initial perceptions of capital-intensiveness of port automation technologies, even ports with low labor costs (e.g. ports in China, UAE, and Saudi Arabia) have joined the port automation league. The automation process cuts the labor costs, reduces the energy costs and environmental impacts of port operations, and enables prevention of break downs and down time. Moreover, it provides a more predictable, consistent and stable operational performance. According to J.P.Rodrigue until mid-2018, 47 container terminals around the world were either fully or partially automated,

which represents 8.8% of all terminals, and 10.3% of the total global footprint in terms of hectares. It seems that the development of port automation will lead to thorough transformation of the dominant designs of ports and terminals in the two decades ahead.

Dynamism in port management

The intelligent port concept is a total departure from the static approach to port management and a breakthrough movement towards accepting the natural dynamism in it. Instead of being passively affected by the events and occurring in the markets and business environment and developing colossal reserve capacity that is considered to be necessary for coping with the streams of change in their business, the intelligent port is able to react (and even proact) effectively and \ in adapting itself with the current and future circumstances. One good interpretation of this breakthrough 1)loan word from DARPA movement has been suggested by Dr.T.Vitsounis. He suggests that by rising the intelligence, the economic firm can spin out of the customary PDCA cycle that is underpinned on a lengthy decision making cycle over static data; instead it will engage in a more efficient dynamic info-centric continuous improvement cycle as shown in the figure below. In other words, intelligence is a key achievement that will let the ports to transform into proactive economic firms that can do more with fewer resources, and find (and reach out for) unexplored sources of economic value generation. Yet, the author believes that an intelligent port needs a number of other qualifications to be recognized as a smart port.

Smart port

The smart port concept has a more strategic essence and tends to transform the port into an 'agile' economic firm. Agility is defined as ' the ability of an organization to thrive in a continuously changing, unpredictable business environment.' (Dove,R.-2000).This is a critical characteristic for ports that are facing several disruptive trends in every day of their economic life. Disruptions are coming from different sources, including conditions of global and regional economy and trade, environmental impacts and requirements, technological developments, competitive regional markets, upper hand and lower hand industries, etc. Within the coming decade, the fourth industrial revolution is taking the disruption trends to a very higher level, and under the VUCA conditions it is like entering ports and terminals into the belly of the whale. That is while the terminals industry is considered as a semi-manufacturing industry, with high capital intensiveness, least mobility of assets and resources and strict constraints in extension of their capacity; therefore, development of agility in them is intrinsically a very hard task.

The Smart Port concept is the result of a new systematic and all-encompassing view of port missions and functions that pursues achieving higher levels of agility in the face of the tsunami of disruptive trends and events. It is essential to understand that Smart Port is the new way of thinking and conception, rather than a collection of costly new technologies for vanity shows in a port. Among several presented models for smart ports, the Smart-Port Project in MED Maritime Integrated Program seems to maintain such a systemic, bird-eye view on this concept. The project is run under a consortium between IAT (Andalusian Institute of Technology), ICCS (Institute of Communication and Computer Systems), TICASS (Innovative Technologies for Environmental Control and Sustainable Development), PROMETNI (Prometni Institute Ljubljana/ Institute of Traffic and Transport Ljubljana) and UCA (University of Cádiz), and it aims contributing towards sustainable growth by establishing the appropriate conditions for the adoption of new management energy models based on low environmental impact and triggering innovation of both technologies and processes in European

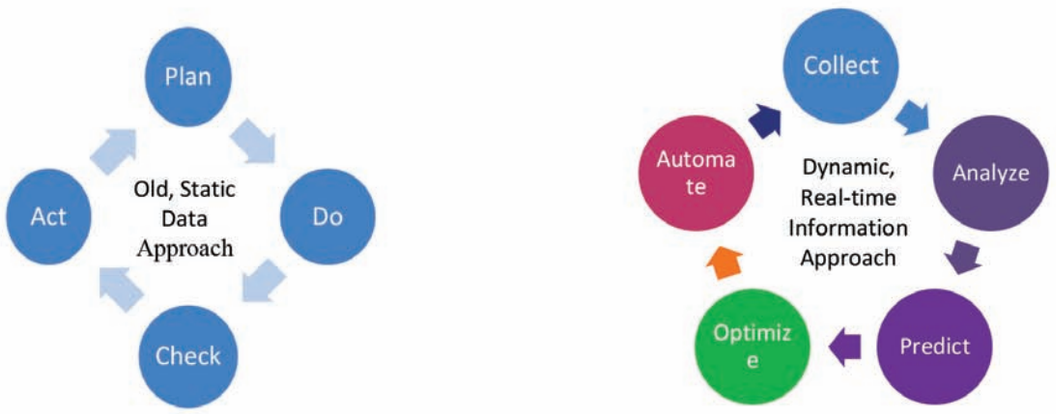


Figure 2- Old and new approach to continuous improvements in economic firms (Vistonis,2014)

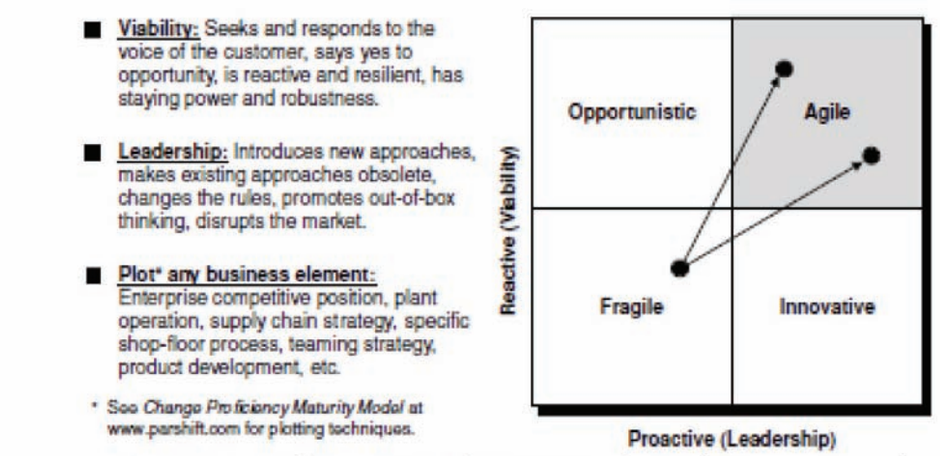


Figure 3 -Agility Space of economic firms (Dove,R.- 2000)

ports of the Mediterranean Sea. The project conceptualizes the smart port with three key areas in its scope: operations, energy consumption, and environmental management. In this sense, a smart port is a green, intelligent, and integrated ecosystem that is oriented towards excellence in its operational performance, efficiency, innovation, safety and security, energy consumption, and management of its environmental impacts.

The concept incorporates 23 criteria with 68 Key Performance Indicators (KPIs) to elaborate the three key areas of smartness in ports. A brief overview on the main criteria of the concept can indicate that ICT developments and intelligence do not establish the entirety of a smart port. In fact a smart port is also characterized by its capacity, market penetration, safety and security, sustainability, environment-friendliness, etc.

There is also a discourse on preliminary works and modifications that should be made to the smart port conception. The development of smart port should be harmonized with smartification of other industries and stakeholders. We are also witnessing the evolution of smart shipping, smart cities, smart Cargo Transport Units (CTUs), smart road and rail transport, and many more. There is a current debate on international standardization of information and data in ports and terminals: a number of professional entities including ITPCO, IPCDMC, IPCSA, and BIMCO are working to harmonize the definitions of port call and port efficiency in the global level. The tides of change in shipping require a proper response in ports and terminals; among the most significant issues one can point to development of services to the emerging ship concepts (e.g. automated and unmanned ships, and modular ships), regulating on implementation of the new IMO environmental regulations (including the sulfur cap regulations, the Ballast Water Management convention, the CO2 and NOx footprint control scheme, etc.), revising the security and cyber-security protocols, digitalization , preparation for Just-In-Time shipping, and so on.

There are also discussions around some basic presumptions of the smart

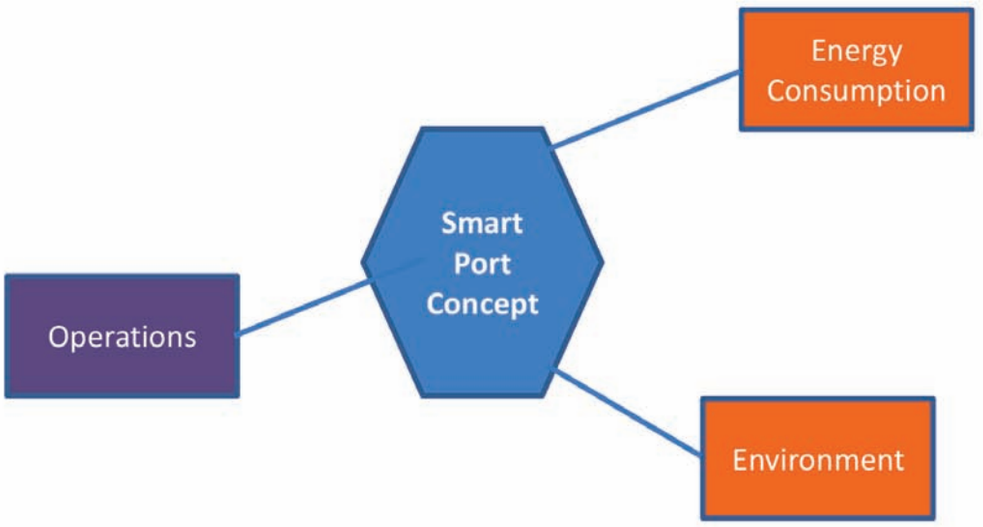
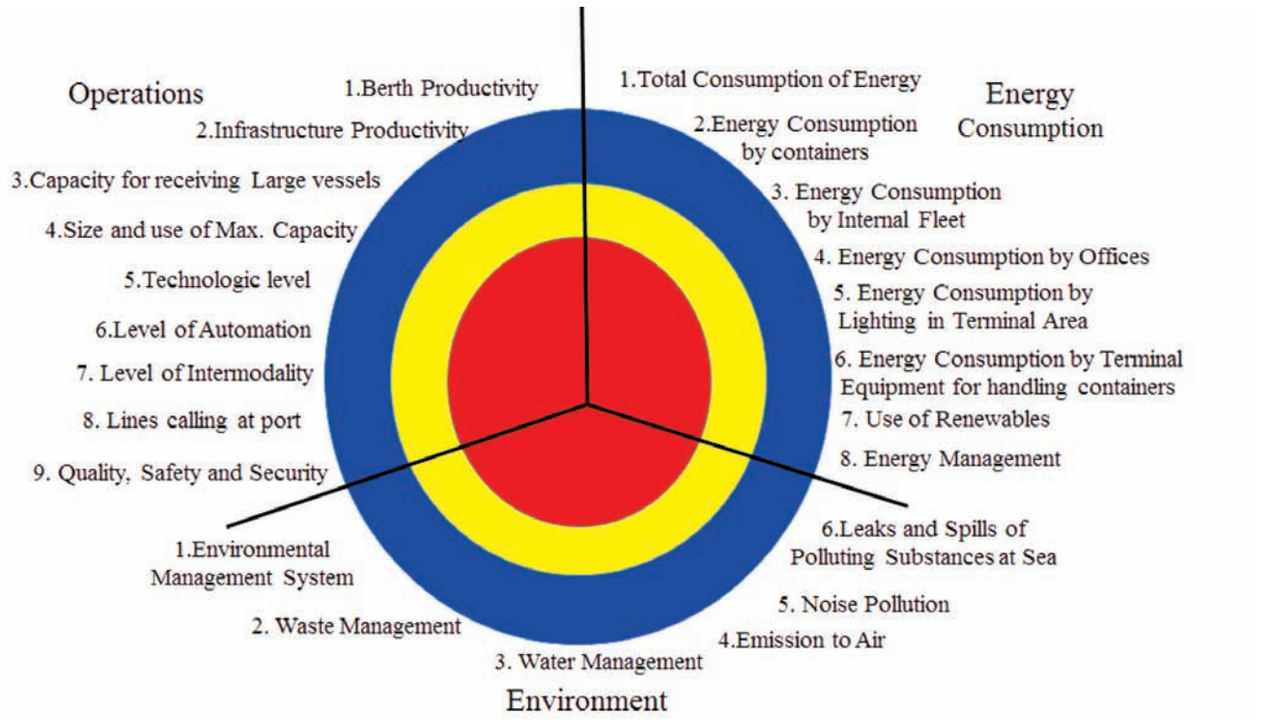


Figure 4- Three Key Areas in Smart-Port Project in MED Maritime Integrated Program (2014)



Smart Port Concept Areas and Criteria. MED Maritime Integrated Project (2014)

port concept. In one of the most significant arguments, it is discussed that regionalization of international trade will transform the geography of transport, and it will bring a new focus on the gateway ports for handling smaller call sizes in smaller ships. Even the Belt and Road Initiative (BRI) (which is acknowledged as the greatest measure to maintain and drive the globalization ahead in the 21st century) is concentrated on investments in gateway ports. Although the emphasis on improving the port productivity is still essential in this kind of ports, the configuration of operations and the priorities in them is quite different with transshipment hubs. There are significant differences in the quay side operations, and moreover there are critical differences in the weight of intermodal transport and the connection of port to its hinterlands. Yet, the smart port concept is mainly constructed to serve the mega-ports with major focus on transshipment and it shall be revised and modified to be practically usable for port development in the coming years.

In a nutshell, it is obvious that ports need to grow smart to sustain the tsunami of change and disruption in the coming decade. Although smart ports utilize ICT and many other technologies to grow their intelligence, but getting smart is much more than that. A smart port is a port that can effectively outline its strategic outlook, and develop and leverage the needed intelligence to realize it with the highest possible efficiency. Ports and terminals need to become more agile to step into the unknown future, and that is the greatest motivation for an accelerated rush for smartification in the industry level.

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SHIPPING INDUSTRY; FAR FROM THE REALITY OF 4TH INDUSTRIAL REVOLUTION

Mr. PIA MELING Vice President, Sales & Marketing Massterly, Mr. Inge André Sandvik Chief Digital Officer and Mr. Jon Helge Ulstein Vessel manager of Wilhelmsen Ship Management (WSM) had answered the questions of Marine Innovation magazine. The discussed questions included the topics concerning the world's first autonomous shipping firm, Massterly, 4th industrial revolution, cooperation with TTI and Semtech on IoT network as well as advance-analytics, Machine-Learning/Artificial Intelligence technologies.

PIA MELING
Vice President, Sales & Marketing, Massterly

1. What measures has your company taken to develop autonomous ships? What is the purpose of launching the world's first autonomous shipping firm, Massterly?

Wilhelmsen came together with Kongsberg in 2018 to create Massterly, a joint venture company that will allow the two firms to create a complete value chain for autonomous maritime logistics; covering design and development of vessels and shore systems, project management, control systems, approvals from relevant authorities, insurance, logistics services and safe and efficient vessel operations. The main purpose of Massterly is to develop environmentally friendly, safe and cost-efficient logistics, enabling a shift in transportation from congested roads to the sea. For short-sea shipping, the major cost drivers are crew and manual port handling. These costs can be significantly reduced by introducing autonomy technology and a new competition area for maritime players is created.

A "Remote Control Centre" is under construction at the Massterly (c/o Wilhelmsen Ship Management) office in Norway. When the needed customer base is established, Massterly will provide 24/7 manned monitoring and control from shore for short-sea vessels with reduced crew, or no crew, onboard. Massterly will also serve conventional (both deep-sea and short-sea) vessels with performance monitoring and land-based assistance to reduce the OPEX for the ship owners and operators; not only on the crewing side but also on fuel and maintenance cost, as well as ensuring higher operational safety and better environmental, contractual and regulatory compliance. Such services include periodically unmanned bridge, condition-based and predictive maintenance, operational support to minimize delays and risks, automated mandatory reporting and crew training.

Inge André Sandvik
Chief Digital Officer, Wilhelmsen

2. How do you evaluate the impact of 4th industrial revolution on shipping industry?

The license to operate for the shipping industry is rapidly changing. New demand from regulators, customers and financial institutions are forcing shipping companies to re-shape their operational model and customer journey.

Access to data in real-time and deployment of modern software has never been more important, but we are still faced with the paradox that the connectivity and technology infrastructure onboard ships are archaic and desperately lack standardization.

If we look at the reality in the maritime industry is the 4th industrial revolution in scale still yet far away from a near time reality. The technology infrastructure onboard the majority of ships is still mainly a client-server architecture with silo oriented on-prem software and systems. Real-time access to data and systems onboard vessels that can be used to improve our processes, systems and customer journey is still very difficult and are holding us back. The paradox we are faced with is that open and scalable access to OT data (data from the operational systems) is difficult due to high fragmentation, proprietary systems and lack of standardization.

The timing and readiness to start leveraging cloud-based data platforms have never been better. The market is mature and attractive from an ROI perspective. The data platform players are extremely developer-friendly and we see exponential growth in new capabilities around analytics, ML, AI and low-code frameworks. This gives us amazing opportunities to leverage data

to innovate and our customer journey and automate inefficient processes.

The big question we are faced with today is how we are going to enable to run modern software in a containerized environment on the Edge as we do on the Cloud today. We need a new Edge infrastructure onboard the vessels that can collect, compute and analyze data closer to where the data it is created. For this new infrastructure to be successful is it required to be open and not force customers to put all their data in one cloud data platform, but support a hybrid data platform strategy.

The success of cloud and data platforms has been dependant on a well functioning open-source eco-system. The same need to happen if the Edge infrastructure and eco-system is going to flourish. What made cloud disrupt on-prem data centres was not the technology alone, but the business model and openness to the developer community. It offered small development teams to build enterprise-grade solutions that could compete with larger teams and global companies without huge Capex investments.

My prediction is that we will look back at 2020 was an important milestone when shipping companies started to utilize cloud data platforms in scale and that an Edge infrastructure became an enabler for this transformation.

Jon Helge Ulstein Vessel manager, Wilhelmsen Ship Management

3. Would you please explain about your cooperation with TTI and Semtech on IoT network?

Wilhelmsen aim to bridge land and sea by building end-to-end secured LoRaWAN 2,4GHz.

Instrumental in the set-up of this new IoT system, is developing the digital infrastructure for the future of autonomous shipping. Enabling us to better monitor and optimize operations and deliver genuine environmental benefits to the industry.

Evaluating existing wireless solutions, nothing can match the openness, robustness and low-cost the LoRaWAN delivers. The LoRa ecosystem combines theneedsoflandandseaintoonetrusted, global and customizable IoT service"

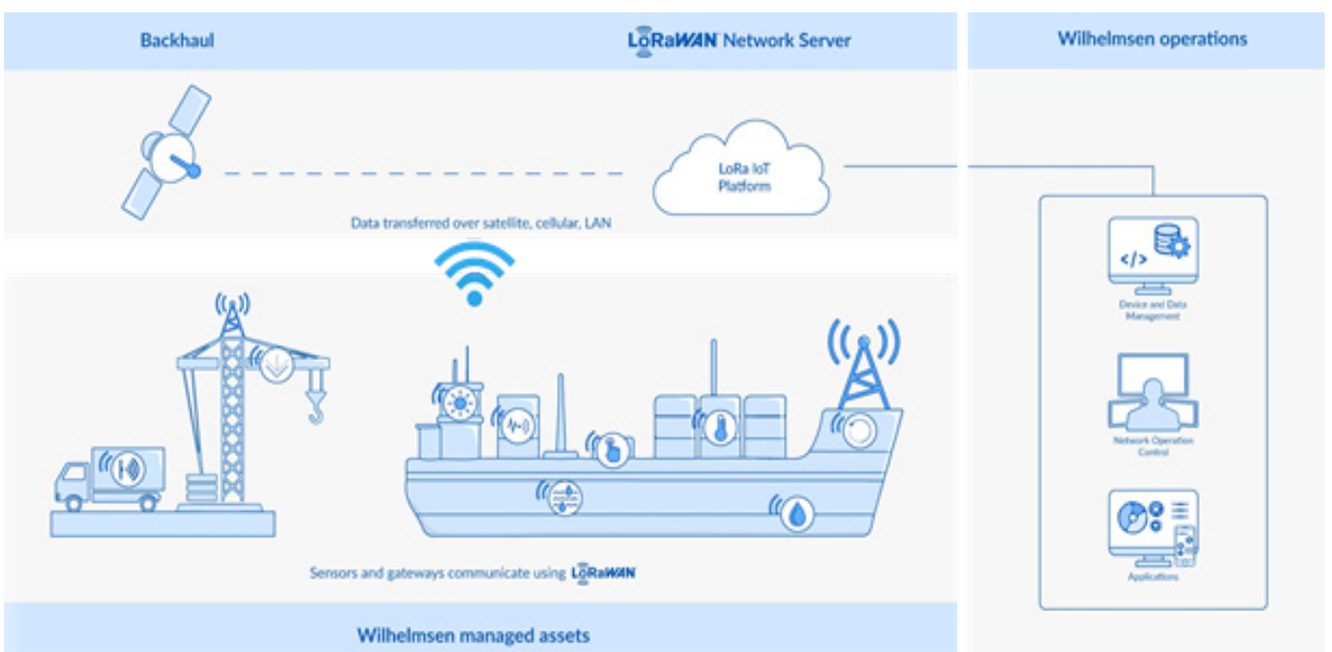
Traditionally, sensor data is carried through wired systems, or managed via periodic manual readings. However, with LoRa now established as the leading IoT network technology, it is possible to complement these systems with numerous easy to install, connected low-cost sensor solutions.

Wilhelmsen has selected Semtech's popular LoRa (long range) open source, wireless radio platform as the foundation for its new maritime IoT network. Part of the Wilhelmsen's ongoing portfolio-wide digitalization strategy, the company, in partnership with technology provider The Things Industries (TTI), will utilize LoRa to deliver a cost-effective, robus**t and proven IoT solution, available to its diverse customer base worldwide.**

4. What is the role of advance-analytics, Machine-Learning/Artificial Intelligence on the future of shipping industry?

The maritime industry has a huge potential of utilizing ML/AI to get rid of unnecessary waste and inefficiency. My prediction is that we do not see use cases were ML/AI will significantly change operation models until we have solved standardization, compatibility and digital infrastructure that can run ML models on the Edge. Condition-based maintenance will probably be the first type of use cases where we will see ML provide value and efficiency gains.

Inge André Sandvik



A ROADMAP TOWARD AUTONOMOUS SHIPPING

ONE SEA is a high-profile ecosystem with a primary aim to lead the way towards an operating autonomous maritime ecosystem by 2025. Marine innovation magazine has carried out an interview with Jukka Merenluoto, co-leader of One Sea – Autonomous Maritime Ecosystem. In the following section, you can see the answers.

Jukka Merenluoto, co-leader of One Sea – Autonomous Maritime Ecosystem

1. Creating an environment suitable for autonomous ships by 2025 is regarded as the main goal of the One Sea Ecosystem. How will this primary goal be realized?

One Sea seeks to harmonise the regulations and standards, interfaces and testing regime necessary to deliver a safe and commercially viable highly automated logistics system. A system comprising both physical infrastructure (ships, ports, freight and communication infrastructure), data infrastructure (cloud services, data interfaces and platforms), as well as services enabling the interoperable travel and transport chains. The ecosystem's activities are centred around these functions. Figure 1 shows the ecosystem activities.

The One Sea core activities include creation and steering the 2025 vision of the ecosystem and establishing the strategy to pursue the achievement of the vision. Another important core activity has been the creation of roadmaps towards 2025. The roadmap (Figure 2) published in the spring 2017 highlights the perceived technology development, milestones and themes on the way towards commercial autonomous shipping.

Top part of the roadmap envisions that the initial focus will be initially on remote operations, which will gradually move towards more autonomous operations. The need for testing and validation is emphasized on the green background. It is acknowledged that testing is needed both to prove the technology, processes and procedures as well as to assure the regulators and class societies that the solutions are mature and safe. It will also assist in building the social acceptance for maritime autonomy. The path of regulation is on the red background. It is understood that the current regulation needs to be reworked to accommodate autonomous ships. The regulatory work takes time, hence the red background. The light blue area in the roadmap describes the perceived overall development also around the maritime domain.

The bottom part of the roadmap lists identified key themes that are carried out over the course of the development. These include concern on the ethical issues (human factor, AI, et cetera), emphasis on the cyber security, development projects and IPR created in the companies (One Sea does not accumulate IPR) and ensuring the education is tailored to accommodate designing and operating with autonomous ships. The legislative work done nationally and internationally is **also seen as an ongoing activity.**

2. What technological challenges are ahead of One Sea Ecosystem? How do you cooperate with your team members?

Increasing the level of autonomy in maritime is not only about technology. One Sea has identified six main themes, which are the areas of focus for the ecosystem (Figure 3). The main topics

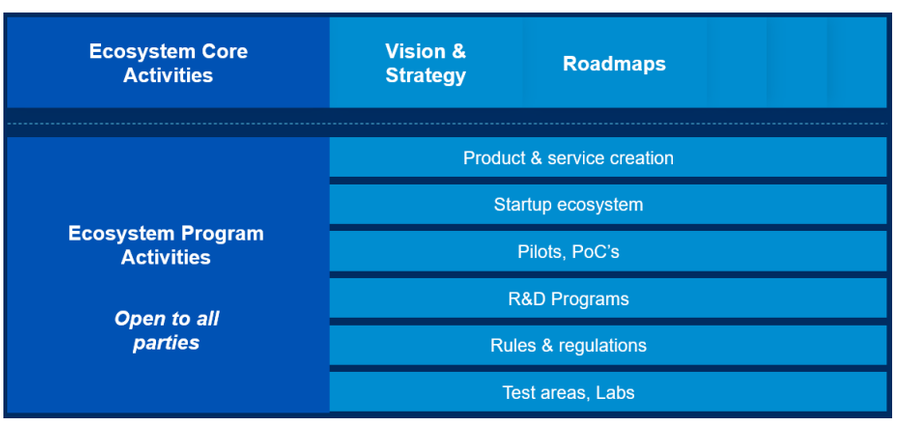


Figure 1: One Sea Ecosystem activities

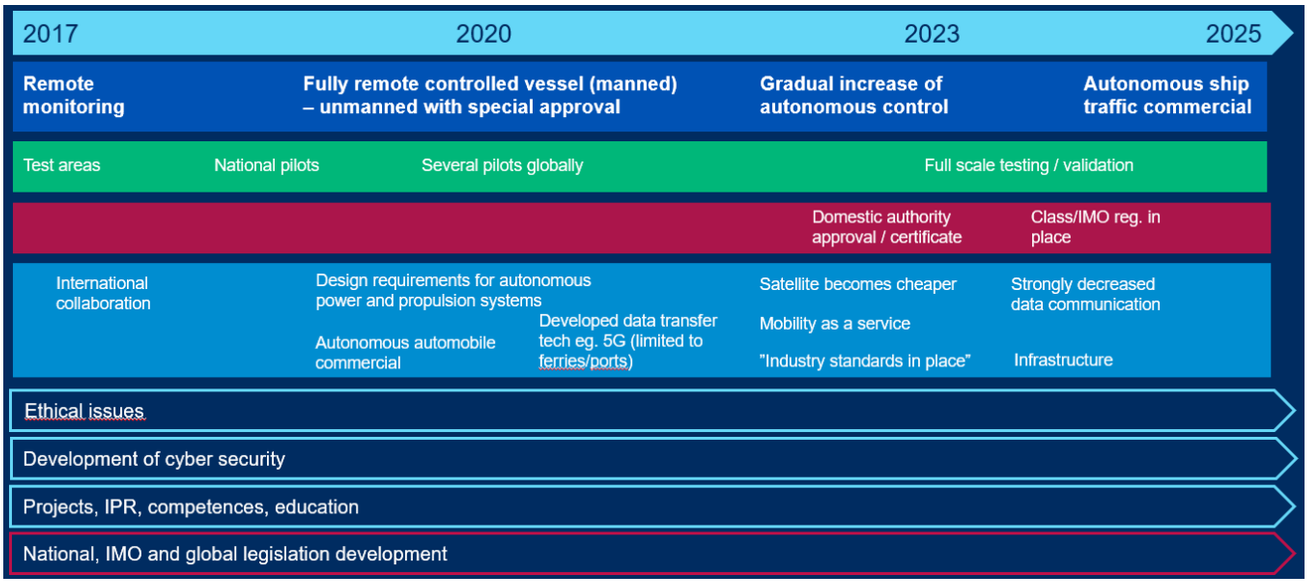


Figure 2: Roadmap towards 2025

are: technology, security (including safety), regulation, traffic control, ethics and operations. The themes are all partially overlapping. One Sea has also established working groups to progress the topics. Their purpose is to support fulfilling the 2025 vision of autonomous maritime ecosystem.

One Sea seeks to create industrial standards to efficiently develop the autonomous marine transport. The standards may cover areas, such as safety, testing, data transfer, cyber security, data and systems architecture, artificial intelligence, et cetera. The objective is to harmonise the operational models within the industry with industry-specific regulations, where the rules and regulations drafted by the authorities may not correspond to the rapid development that the sector is experiencing. One Sea also collaborates globally with players within the field **of autonomous marine transport.**

3. Could you please brief us on using Big Data, smart algorithms, artificial intelligence in the ecosystem?

Many of the solutions relating to autonomous and remote-controlled maritime traffic rely on the abovementioned technologies. These technologies are useful also for traditional ships. For example, situational awareness solutions can easily be used in traditional ships for object detection and classification at sea. Situational awareness systems use many different sensor types (radar, lidar, infrared, camera etc.) and combine this data through sensor fusion, thus giving the seafarers a much better view of what they are seeing out at sea. The system has then been taught to recognize what they encounter to give possible warnings to the humans. Vessel performance and condition can be monitored, planned and enhanced using Big Data and machine learning. Machine learning can also be used for fleet control and optimization.

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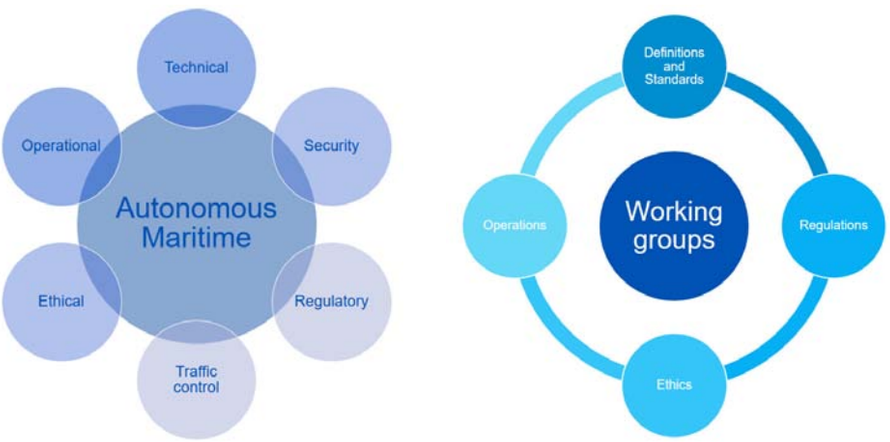


Figure 3: One Sea main themes and working groups

AUTONOMOUS SHIPS; A KEY TO FUEL CONSUMPTION REDUCTION

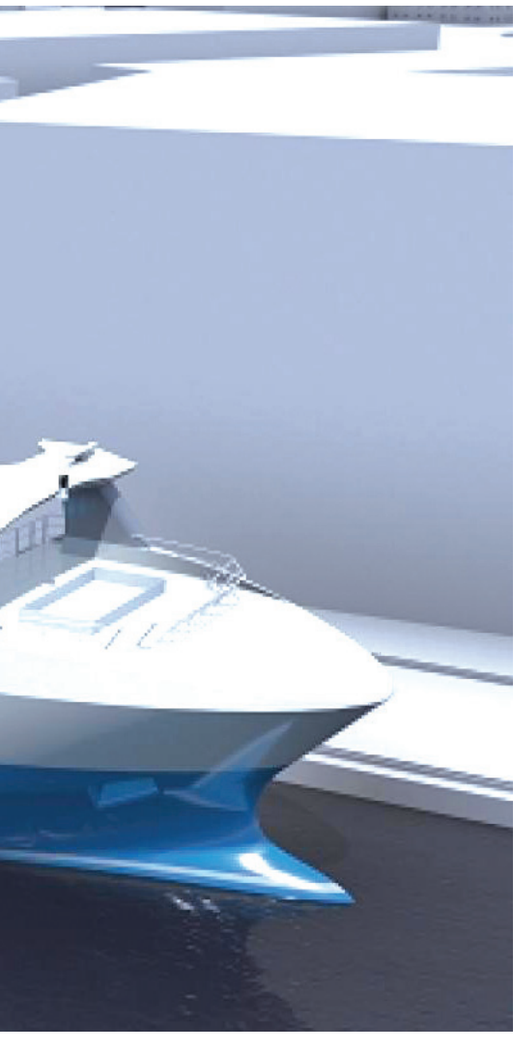
It would be no exaggeration to say that unmanned vehicles have become an inseparable part of human daily life. This capability and technology has made its footprint not only in the aerial but also in the maritime sector. However, when it comes to the sea, what we have seen so far is small platforms near the shore that are usually used for research and inspection purposes. But the industry has not been content enough and tests are being carried out on large automated cargo ships operating in high seas. Automated and autonomous ships are the key elements of smart shipping. A common definition says; Autonomous ship means the next-generation modular control systems and communication technologies that will enable us to wirelessly monitor and control activities onboard and off-board. High-tech systems called Decision Support System (DSS) provide the capability of controlling the ship remotely.

Improvements in sensor technology, improved connectivity at sea, the growth of deployment of analytics and decision support softwares and algorithms development (Artificial Intelligence) applied for navigation and situational awareness has resulted in increasing demand for autonomous and remote ships. Electric propulsion system for solutions related to automation has a lot more advantage over traditional diesel engines.

However, at the same time, it seems compulsory and vital to consider the sustainability aspects of all mechanisms and devices installed on smart ships. Due to the fact that even the simplest impairments such as burning fuse or gasket leak can lead to a serious problem if there is no human on the ship to repair.

Not to be overlooked is the fact that this human has been sending unmanned equipment to space for many years and has guaranteed its long-term operation. So we can trust him again.

Automated ships operate in an ecosystem where decision-making is based on big data, smart algorithms,



and artificial intelligence. One of the main advantages of utilizing automatic technology in ships is the reduction of fuel consumption. When computer algorithms calculate routes using extra data such as real-time weather data, the ship will be able to travel on any given route with an optimal speed. Therefore, fuel savings that benefit the marine environment will come.

According to European Maritime Safety Agency (EMSA), it is expected that automation in shipping industry reduces the emission and pollution in maritime sector which as a result will lead to a huge saving in fuel consumption and also a 20 percent of saving on costs imposed on shipping operators.

Protection and Indemnity (P&I) Club in Britain believes that automated and autonomous, for legal approval and public acceptance, must be at least as secure as traditional ships. Indeed, a successful approach to change will be to develop regulations in line with technological advances while maintaining a focus on the safety of individuals and assets on the sea. But whether such a process can always be followed is a question to be answered by industry players.

As the maritime industry develops more complicated vessels with intelligent capabilities, the International Maritime Organization (IMO) is reviewing the regulations for automatic vessels.

In December 2018, Maritime Security Council (MSC), evaluated some instruments including; the International Convention for the Safety of Life at Sea (SOLAS), laws to prevent accidents at sea, ship loading and stability in regard with applicability in the field of automated and autonomous shipping. Moreover, during 2019, this international organization, continued to analyze how regulations can be addressed in the development of smart operations.

IMO defines Maritime Autonomous Surface ships (MASS) as a ship which, to a varying degree, can operate independent of human intervention. Followings are four degrees of autonomy:

- Degree one: A ship controlled by seafarers on board, some operations are automated.
- Degree two: A ship with seafarers on board, some operations are controlled and operated from another location.
- Degree three: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location.
- Degree four: Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself.

Mayflower, the fully autonomous ship will begin its voyage this year in September across the Atlantic Ocean. The American technology company (IBM) provides the artificial intelligence systems for this ship. If this journey is successfully taken, Mayflower will be the first large ship travelling across the Atlantic Ocean automatically.

Another noteworthy point is Cyber Attacks, ships are heavily dependent on computers and robotic equipment which can exacerbate the consequences of cyber risks. Dr. T. Bye, professor and head of technology at the Norwegian University of NTNU says: “The issue of cyber security is especially important for existing and old ships. Old ships which are connected to internet do not have any preventive measures against cyberattacks. However, it is less risky for new-generation ships since new equipment designed by applying Internet of Things (IoT). On the contrary, in old ships, sensor data is less secure and may require cyber security mechanisms to be retrofitted.

Protection and Indemnity (P&I) Club in Britain believes that automated and autonomous, for legal approval and public acceptance, must be at least as secure as traditional ships.

THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN SMART MARKETING

By: Dr. Arash Afshinfar

At the present time, Artificial intelligence can be considered as the most important means in human life to improve and develop any service. The advanced capabilities of artificial intelligence have brought a lot of advantages in organizations changes such as in sales products and services.
According to researches, more than 64 percent of studies and the developments in organizations carried out through artificial intelligence have been related to the sales and marketing area. Among the artificial intelligence gains for these organizations can be increased marketing range, finding new customers, achieving growth rate and maximize sales capacity based on existing data analysis.
This tool makes a big contribution to accelerate, discover and extract information as well as increase decision-making power in the creation of new approaches and ideas to attract potential customers. In the meantime, there are different views and definitions in the organization that make the marketing maturity in the organization. The only aim of marketing and sales department of the organization is to increase the profitability and flow of money into the organization. While senior executives using data from the organization are thinking of developing new strategies to enter new markets.
In order to reach the artificial intelligence in the organization, three steps need to be taken which are briefly discussed in this article.

1- Identifying practical actions taken in a similar company and examining its aspects as a superior example.
Applying artificial intelligence to companies that solely understand the behavior and desires of customers through data analysis is a very attractive and driving factor for their business development.
Using artificial intelligence can help these companies ranging from simple virtual collaborations to major decision making. For instance, in the Islamic Republic of Iran Shipping Line, it is first necessary to identify companies having business similar to the national fleet business and then to localize and use algorithms simplified for these companies by artificial intelligence after reviewing the inputs, processing, and outputs of the information. These algorithms and solutions can start from refining a simple process and continues to using Application Programming Interface or Building Block, a software which is connected to the main current system. Therefore, it should be noted that ports for input and output information are incorporated.

2- Focus on valuable, Business-related data
One of the significant benefits of artificial intelligence is the recognition of low-value and mass data in the organization from high-processing data. That does not mean that the organization should stop searching on its organized mass data. However, the real value is achieved by analyzing all of the organization's data through artificial intelligence and separating the underutilized, unstructured data from the structured data.
Based on artificial intelligence logic, organization's structured data is separated from databases and excel files and classified into third-party data. Unstructured organization data is also available for use in cases where it is not directly defined in line with the core business in the organization.

3- Considering the advantages of B2B
B2B models represent transactions between two companies. In other words, it refers to the relationships between businesses. According to estimations, it comprises nearly 80 percent of all trades, especially electronic trades.
Many companies utilize artificial intelligence capabilities such as natural language processing, pattern recognition, machine learning, etc. to boost their company revenue and sales. However, an increasing number of companies are using artificial intelligence capabilities to provide better solutions. For instance, these companies provide their customers with smart market insights, market analysis power, shopping patterns, and more. Of course, it should be mentioned that these customers are business partners and suppliers who share their analytical information using artificial intelligence.
The steps mentioned above are each capable of increasing their position in the business day by day and also increasing the productivity of the organization in different aspects. Due to the software structure of artificial intelligence tools, its application will be a prelude to smart marketing, developing geographic territory, time and location independence, and also e-commerce.

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SMARTIFICATION IN MARITIME TRANSPORTATION INDUSTRY

BY: Ali Poormand
Chief Engineer, Master of Ship Structural Engineering

According to international investigations, the emergence of recession and its escalation in the maritime transport industry which has been problematic lately is the result of several factors in the field of container transportation. The first factor can be the emergence of Ultra Large container ships in the shipping industry. This issue is originated from the ingenious action of Maersk shipping company ordering Triple E-class gigantic container ships of more than 18,000 TEU during the global economic crisis.

Two major aims were considered in this plan; First, to maximize the scale saving in size and capacity of the ship and then to save the fuel consumption. This leading action was followed by the world's top container shipping lines such as MSC, GM, CMA and then other world's best container lines also turned to this procedure to maintain their position and competitiveness in the market. As it seems, the three mentioned big companies have planned to unite to centralize the market and taking up more shares of it by observing and forecasting the market's process.

As a result, the second affecting factor in the transportation industry recession was brought another wave of evolution which formed shipping unions. The third factor was along with the failure to meet the expected economic growth in the world. The significant factors in the lack of economic growth include: low economic growth in China, having the world trade overshadowed by the economic conservative flows in developed countries including Britain and the United States which have risen up to accept the challenge of globalization of the economy and regional and global treaties.

Today, the competitive advantages should not be sought through technologies related to improvements in factors such as saving scale in ship capacity or saving fuel consumption. Applying new technologies, Smartification of different shipping operational systems, concentration on smart transportation equipment (e.g. smart containers equipped to smart seal systems, tracking with facilities like GPS, temperature measuring, detecting people entering and leaving containers, change in the business models, attempting to enter the international trading relations, partial or full replacement of current conventional marine fuels with low-priced, renewable pure energy carriers are some of innovative solutions in future.

Significant Axes in Smartization of Maritime Transportation Industry

1. Application of smart maritime systems in following areas:

- Control of the frontier and maritime security (utilizing CCTV and night visions with warning alarm systems)
- Rescue Operations
- Inspection of marine structures and installations (utilizing remote control submarines for underwater inspections and also smart submarines for inspecting inside the pipes and etc.)
- Marine telecommunication
- Marine discovery
- Oceanography
- Environment and Fisheries (e.g. utilizing special software to estimate the route of oil pollution spread or the path of the fish

2. Architecting and designing smart vessels

- Architecting, sorting, and stimulating integrated operations (Fluid integrated analysis of the performance of various components in a vessel and the possibility of investigating their interactional outcomes for instance analysis of the effect of ducts used around the propellers on the ship operation or Smartization of loading the vessels or changing the trim of the vessel in various climates in order to increase the efficiency or reduce the fuel consumption and speeding up)
- Hydrodynamics (Optimal design of the hull considering effective parameters to reach the highest speed and lowest fuel consumption applying smart designing algorithms)
- Structure (Optimal structural design of vessels to reduce the weight and increase strength and durability utilizing smart design algorithms and predicting future structural conditions by analyzing information received from smart sensors)
- Dynamic modeling and situation control (Utilizing advanced software, it is possible to create mathematical models for dynamic analysis of structures and as a

result investigation of equilibrium and control status of structures as mathematical models)
- Propulsion systems and energy sources (Optimal management in the production and distribution of electric power and increased utility from hybrid systems)
- Transmission and telecommunication
- Hardware in smart marine systems

3. smartification in marine systems
- Smart algorithms in steering, controlling, modelling, error tracking and inspecting
- Smart communication network in vessels
- Smart sensors in marine systems
- Obstacle avoidance algorithms
- Processing software
- Views and plan of smart methods in marine systems

4. Smart systems and applicable subsystems in Smartization
- Smart marine vessels
- Marine robotic inspired by nature patterns
- Targeting and sonar systems in smart systems
- Deployment, recovery and rescue in smart systems
- Information transfer and processing in smart systems
- Minimizing in smart systems
- Communication network in smart systems
- Smart system support

• Questions that need to be answered in Smartization process:

- What are potential drawbacks of digital ships? How does cyber threats enter and what solutions will be considered to fight them?
- How will be human resource sorting in vessels with higher level of digitalization? Are they accepting this change and how will it change in regard with education and training?
- Will digitalization be considered in designing new ships? If yes, how is it possible to encourage shipbuilding industry towards this matter?
- Will Smartization in shipping increase security and efficiency?

In the last few years, smartification phenomenon has been accelerated and digital transformation of assets and the information flow can be regarded as the biggest changes in the shipping industry in a way that besides automating existing processes and operations, has also had a positive impact on security and environmental performance. Ships are transforming to increasingly complex sensor hubs and data generators. On the other hand, improvement in satellite communications would ameliorate ship connectivity. This will also result in a significant increase in the amount of transmitted data at a lower cost. Therefore, Smartization in shipping results in more efficiency and security.

Integrated Smart Ship Solution (ISSS)

• One of the innovations in shipping Smartization is Integrated Smart Ship solution (ISSS). This system has been launched by Hyundai heavy industries group in South Korea. Smart Ship Solution (SSS) is a new generation as a service designed to integrate monitoring and control, and to increase the efficiency in operations and ship security management based on the application of Information and Communication Technology (ICT). Its ICT technology is capable of realizing economical and reliable navigation and management of ships. The intended goals in ISSS presented in figure (1) include:

- Economical Operation
- Propulsion system monitoring analysis
- Remote maintenance
- Power system monitoring analysis
- Safe operation
- Asset management service

As an example, ISSS in "Asset management service" section means increasing performance at all levels through efficient risk management, maintenance costs commensurate with the useful life of different equipment, and also providing "asset management" solutions based on the customer needs. ISSS system includes numerous navigational methods that standardizes ways of navigation varying depending on levels of skills and experiences of navigators, collects and analyses real-time information on navigations, and thus will play a role in enhancing efficiency and safety of ships. Thus, it is predicted that this one of its kind solution cuts annual operating cost by 6%. Hyundai heavy industries group in in South Korea extended the smart ship technology for the first time in 2011 and applied the mentioned system for 300 ships.

Supporting INTEGRICT technology which is Hyundai's smart electric energy management system (figure 2), ISSS provides operators with an enormous amount of ship information. This information consists of: optimal navigation routes and navigation speed along with a slope status of the front and back hull of a ship that has a direct impact on the ship resistance and also fuel consumption. The solution allows safer and more efficient management of ships by collecting and analyzing energy data and monitoring status of engines and propellers.

The ICT solution already completed field tests as well by being mounted on a 6500 PCTC and a 250,000 DWT very large ore carrier (VLOC).

According to Clarkson Research in London, 6,500 ships are to be ordered globally for the next five years. Lloyd's Register's Director of Innovation, Strategy, Marine and Offshore Research believe that Hyundai shipbuilding in South Korea takes up a considerable share of shipbuilding market in the world. It is predicted that ISSS is to be installed on approximately 700 ships.

CORONAVIRUS: SHIPPING MARKETS STRUGGLE WITH DISRUPTION

Before the spread of the mysterious respiratory virus in China, The Drewry Research Institute had predicted that the dry bulk and tanker market will continue to move on a positive wave in 2020. Dry bulk trade is projected to increase by 5.58 billion tons that shows 3.7% growth. Recent estimates also show that dry bulk trade has reached 5.39 billion tonnes in 2019, representing a rise of 4.5%.

While some activists in the dry bulk market expect the freight rates jump by 20%, the others are less hopeful. However, dry bulk ship owners will certainly benefit from the soaring demand for high-grade iron ore from Brazil in 2020, opposed to 2019, when the Brazil's iron ore exports was down.

In the dry bulk shipping sector, there are positive and negative outlook for what the new decade will look like in terms of demand and revenue. Some operators hope for higher freight rates, while others believe that the market will continue to remain steady, or experience a downward trend.

Trade barriers and geopolitical tensions reduce industrial activity and have an inevitable impact on the transportation of raw materials, As a Result, the global economy is in a downward slope. Moreover, environmental concerns that may influence coal consumption in the years ahead will affect market trends.

On the one hand, fleet growth is expected to outstrip demand growth which result in reduced average revenue, but on the other hand ,vessels will be taken out of service for scrubber installation until the middle of 2020. This may help reduce tonnage and increase freight rates. In addition, mandatory speed limits for ships using more expensive fuel compatible with lower sulfur fuels, may limit total growth in tonnage supply, which is considered a good sign for freight rates.

The Baltic Dry Index (BDI) represented unusual fluctuation in 2019 and recorded lowest level in three years, but it jumped to its highest level a few months later.

It should be noted that : according to the recent statistics, in early December 2019, the dry bulk fleet stood at 12 thousand and 43 ships with a total capacity of 2 million DWT. Compared to other vessels, the bulk fleet is considered to be a young fleet with an average age of 5 years. Over 2019-2023 period, 2000 ships are expected to be delivered, which will be the same number within the past five years. But in terms of capacity, the deliveries of the new ships will reach 5 million DWT over the next five years, a 4% increase over the last five years.

It is also projected that only 38 million DWT of bulk capacity will be demolished over the next five years, while the demolition of 99 million capacity DWT is registered over the past five years.

Bulk fleet capacity has experienced an annual compound growth rate of 2.9% over 2014 -2018 period, and an average annual growth rate of 4.4% is estimated for the next five years. An upward trend of fleet capacity is predicted due to maximum vessel delivery, especially for larger vessels.

The slow growth of the world tanker fleet capacity, the increase in long-distance trade across the Atlantic, and the positive impact of the IMO's low-sulfur fuel regulation, will lead to an increase in tanker market freight rates in 2020.

The container market is expected

to continue installing scrubbers on container ships throughout the year so that numerically 15 to 18 percent of ships will be fitted with scrubbers by the end of the year. Although at the beginning of 2019 only 0.4% of the fleet capacity had installed scrubbers, towards the end of following year this number increased to about 4.4%. As more container ships were taken out of service, due to installing scrubber, the total inactive fleet capacity increased. By the end of the year it reached 1 million and 200 thousand in TEU suggesting 5.4% growth. What is certain is that the implementation of low-sulfur fuel law will significantly affect the shipping lines' cost. Inactive fleet capacity stood at 1.200 million TEU in January 2020.

The emergence of the mysterious respiratory virus in China and reaching beyond its borders has spooked the global market and sent it into a wealth-destroying tailspin. This new virus has sounded the alarm that it will send other shock waves across the market in the near future. The profits of the trade war ceasefire and geopolitical peace will be destroyed, affecting the global economy which makes the businesses, works and families facing the threat of decline or failure.

The spread of the Corona virus has paralyzed the total global market; shipping industry market is no exception. It is certain that the shutdown of China's markets will cripple marine markets and severely hurt freight rates. It will definitely take some time for the shipping industry to get back on its feet again. As the virus continues to spread, it is difficult to predict the short- and long-term consequences, the dropping demand and falling freight rates are its definitive immediate consequences.

Due to the pessimistic forecast for a decline in demand, leading container shipping lines such as Danish Maersk and French shipper CMA CGM have announced that they have cancelled services and calling at Chinese ports. Cancelling the shipping trade to China was always applied by the shipping lines to manage the capacity during the Chinese New Year Celebrations. The outbreak of the Coronavirus-hit showed a bad the holiday season. As the Corona virus continues to spread, it is expected that the travel plans will continue to be canceled, which may cause the excess capacity to exacerbate.

It should be noted that the dry bulk market has been severely affected by the spread of the Corona virus. Recently the production in virus-affected cities has been shut down, and as the virus spreads, the risk of closing off more cities is increased. Accordingly, the Baltic Index of the dry bulk on January 31st experienced a sharp downward trend which appears to be a continuing trend.

Drewry is not optimistic about shipping freight rates following the spread of the Corona virus and low iron ore exports from Brazil. Moreover, the virus outbreak will hit the China's massive appetite for importing iron ore.

It has been reported that the tanker shipping rate is expected to decline in the next months. The seasonal weakness in refinery activity, low Chinese oil demand, as well as a sudden influx of vessels to the world fleet after the US lifted sanctions on China's COSCO shipping tanker are among the factors that will drive down shipping freight rates in the next two months.

Following the decline in freight rates, ship owners will move back to demolishing their old vessels in the first quarter of this year. Moreover, high bunkering costs resulting from IMO law will lower shipping revenue. Estimates also suggest that LPG prices will go down in the following months, as the Asian LPG market demand has been declined due to the Corona virus spread.

In spite of the decrease in world trade tensions, including the first phase of the US-China trade agreement, event such as the outbreak of the Coronavirus negatively impact optimism on global economic growth.

In 2019, economic growth was only 2.9 percent, which is the lowest level since the global financial crisis. Recent developments have made the global economy forecast to grow at 3.3 percent in 2020. However, a number of factors can cause the global economy growth . One of the most important factors is the outbreak of Coronavirus. The prolonged closure of factories and the reduction of imports could affect the first phase of the US-China trade agreement.

Noting the China's significant presence in world trade, serious disruption to its economy has had bad consequences on the rest of the world. Bulk and tanker trades have been directly affected by the decline in Chinese demand. While the demand for container exports from China depends on other countries, the long-term closure of the country's manufacturing sector limits the ability to meet needs. Therefore, the container shipping sector will be damaged.

During 2020, it is predicted to face a low demand growth in the container shipping sector, while shipping lines are working to raise freight rates to cover the additional costs of implementing 2020 laws of IMO. It should be noted that the growth of the fleet capacity in the current year will be lower than the previous year, but it is very high compared to the demand growth rate.

The cancellation of 105 sailings of passenger and cargo ships on the routes from Asia to the North America and Europe in February 2020 has caused a shortfall in revenue of 1 billion dollars.

The volume of maritime trade has fallen to 20-40 percent between January 20 to February 10 in 2020. This is due to the inactive Chinese ports and limited ship traffic in Asia.

According to the report, the 5% decline in economic activity in China has had a negative impact on global trade and maritime trade.

Drewry has added that cargo owners and shipping lines are desperate for a swift resolution that will see Chinese factories resume production.

While all of the Chinese ports, apart from Wuhan, have remained open, they are not operating at full capacity with staff shortages arising from travel restrictions and quarantine measures.

Drewry experts believe that the most optimistic scenario is when the Chinese government will do everything in its power to bring China back into the world of trade. However, increasing stock market indices requires a lot of time.

Economic slowdown in China will unfortunately increase the number of blank sailings, which could lead to the bankruptcy of some shipping companies.

In this regard, it is imperative that all countries work together to prevent damage to the maritime transport industry, and that the Chinese government will make every effort to return to its original condition.

THE INTRODUCTION OF LNG AS A MARINE FUEL FOR IRANIAN SHIPPING INDUSTRY

TOMBAK PORT AS A CASE STUDY

By: Capt. Arash Shoghnian
Capt. Ahmad Rajabi

Abstract

New environmental regulations require the shipping industry to reduce its Sulfur oxides, Nitrous oxide, Particulate matter, and Carbon dioxide emissions. Currently, the most environmentally friendly alternative for ship-owners to comply with the regulations is the switch to Liquefied Natural Gas (LNG)-fueled vessels. Using LNG as a marine fuel is a new phenomenon in Iran, and the purpose of this study is to identify the challenges of LNG as a marine fuel from the stakeholder's perspective, through qualitative research, with the aims of assessing the stricter IMO emission regulations, estimated investment costs, LNG drivers, Iran Natural Gas and LNG potentials, the current status of LNG projects, uncertainties and barriers behind it and the extent of successful factors in developing LNG projects in Iran. In general the relatively low oil price reduces the economic feasibility to apply LNG fuel as a marine fuel in the short term.The successful development of LNG infrastructure relies on public funding programs, private financiers, government support, positive LNG demand outlook, prior long-term sale and competitive costs. In this regard, the Iranian government's role as a member state of IMO is crucial in order to comply with new emission regulations. One way to comply with new regulations is to make the situation of using green fuel, such as LNG, easier, and to try to pull the LNG demand sector instead of pushing the situation through excessive incentives that further the taxation and subsidies for use of LNG as a ship fuel. The policymakers here need well-elaborated strategies and increased awareness of LNG among stakeholders by pointing out the potential of LNG for complying with stricter emission regulations and economic potential.
The main contribution of this research is to provide information and recommendations in order to support such a strategy for the introduction of LNG as a marine fuel for Iranian shipping and local industry. The study is limited to Iranian southern ports, focusing on the TOMBAK port as a case study.

Introduction

The International Maritime Organization (IMO) has set stricter regulations under MARPOL Annex VI to reduce SOx, NOx and PM emissions from sea-going vessels. LNG here is one of the main alternative fuels for maritime transport. It

complies with current environmental regulations, reduces greenhouse gas effects and can have economic benefits in the long-term. A number of different actors in Iran may have considerable interest in this topic, such as the natural gas supplier, port authority, ship owners, LNG project developer and policymakers. Besides air pollutant emissions, the second problem is Carbon Dioxide (CO2) emission from the shipping industry. The Global Shipping Greenhouse gases emissions amount is high, and, if no measures are taken, will lead to climate changes and the world facing more environmental problems. Another advantage of using LNG as a marine fuel is a considerable reduction in NOx emission, where the IMO requires governments and national authorities of the Member States that are parties to MARPOL for monitoring, compliance and enforcement of the new limits.

The existence of the LNG infrastructure provides a lot of benefits for shipping and local industry. The creation of LNG infrastructure not only ensures its compliance with current and coming regulations, but also improves the shipping, port and trade route environmental performance. In this regard, both ship-owners and gas suppliers have a greater interest in investing in LNG as an alternative fuel. However, its implementation is dependent on various issues; for example, the local and international regulatory authorities need to set clear guidelines for the creation of LNG shipping and bunkering operations, ship-owners shall invest in LNG-fueled ships and to be assured for availability of "LNG Fuel" as well. Additionally, the port can facilitate the creation of bunkering terminals by participating in investments, and can increase public awareness in close communication with other main stakeholders. Indeed, local industry can benefit from LNG availability.

LNG as a ship fuel, its drivers and barriers

By running on LNG for the new LNG-fueled vessel, in addition to reducing NOx, SOx, and PM emissions, it is expected to satisfy phase 3 of the Energy Efficient Design Index (EEDI), defined by the International Maritime Organization (IMO) for ship greenhouse gas (GHG) emission.

In principle, there are several methods where ships can comply with the sulfur CAP requirements, in which three main compliancy strategies are identified:

- Continue using HFO as the main fuel, but prevent sulfur oxide emissions by scrubber (HFO+Scrubber)
- Using diesel bunkering fuel with low sulfur content, such as Marine Diesel Oil (MDO), Marine Gas Oil (MGO) or Low Sulfur Heavy Fuel Oil (LSHFO)
- Switching to alternative fuel, such as LNG.

DNV GL has identified LNG, LPG, methanol, biofuel, hydrogen and other power-to-fuel (PTF) solution as the most promising alternative fuels for shipping. The use of gaseous fossil fuels strongly reduces SOx emissions (up to minus 100%), NOx (minus 85%) and PM (minus 95%) compared to liquid fossil fuels, while CO2 emissions has been reduced to a lesser extent (25~30%). From a cost perspective, natural gas fuels have the great advantage of being much less costly than MGO and even HFO per unit of energy, although the reduced operating cost (of up to -50%) will compensate the much higher (+30%) gas-fueled ships price.

The main driver for the use of LNG is environmental regulation, especially with regards to the sulfur content of the fuel and the price difference between LNG and other fuels. The main barriers are the uncertainty about the availability of LNG in ports, technical issue, safety standards and the second-hand prices of LNG ships. In the LNG supply chain, natural gas is either transported via gas pipeline or via ship in the form of LNG carriers.

The investment in LNG-fueled vessels here is not as high as in vessels fuelled with other fuels due to compliance with air emission regulations (Table.1). So, more investment is required for LNG-fulled vessels.

The major uncertainties which are currently holding back the demand for LNG as a ship fuel are the uncertainty of the fuel price (compared to conventional marine fuels, there is no public information on LNG bunkering price), uncertainty about the availability of LNG in ports, uncertainty about the second-hand price of the LNG ship, lack of experience in the use of LNG as a bunker fuel, maintenance, cargo space, standardization, future price developments and so on. In the coming decade, a number of these uncertainties are likely to

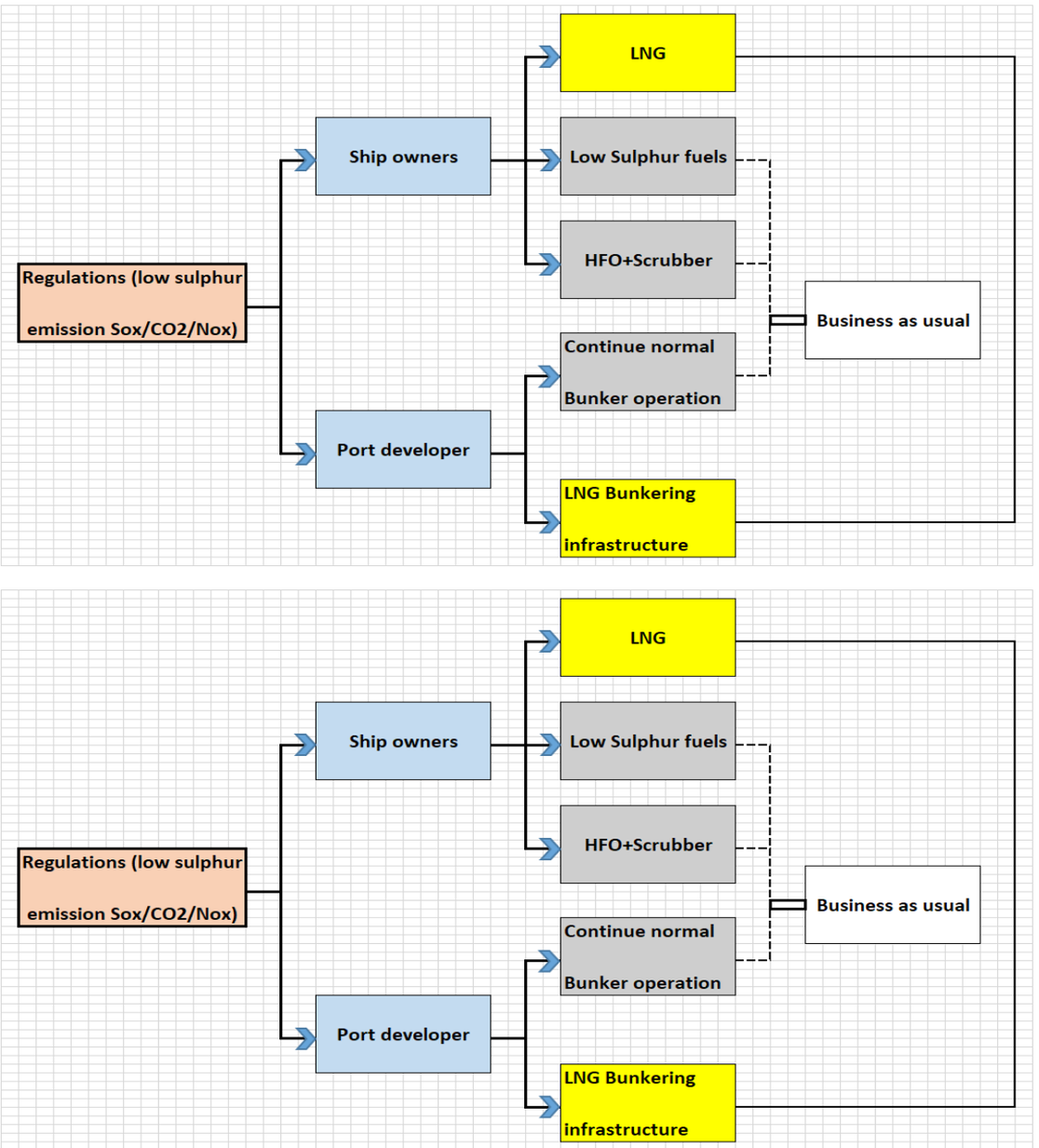


Figure1. Ship-owners and Port Authority challenge

be reduced considerably.

Shipowners and port developer challenges

A ship's fuel has become the largest part of a vessel's operational expenses and, for vessels trading in SECA and NECA areas, the costs will be even greater. With international rules and regulatory restrictions concerning the emission of marine pollutants, the Iranian ship-owners, as main actors in the shipping industry, and the national port authority named the Port & Maritime Organization (PMO) as IMO member state should comply the regulations. In this regard, they have a significant challenge to find a suitable alternative ship fuel. Most ship-owners consider MGO as a short-term solution, while LNG has been found to be the most promising long-term alternative. Many ship owners appear to be unsure how to deal with the emission regulation, having three alternatives to comply with the new emission regulations. These are: to continue using of MGO, to invest in scrubber technology or switch to LNG. A LNG-fueled vessel only makes sense when its supply is available at the ports. The role of stakeholders to support and stimulate the shipowners is important here. Contrarily, the port developer has two options; the first is to continue the oil fossil fuel bunkering operation as a usual business, or to create bunkering infrastructure, which requires high investment and can be materialized with the participation and commitment of port authority and gas suppliers, along with the numerous other stakeholders that

can either impede or facilitate the process.

LNG

When switching usage from HFO to LNG, there is a significant reduction in emission. Sulfur oxides are completely removed, nitrous oxide is significantly reduced and emission particles are fundamentally eliminated which is clearly one of the major benefits enabling shipping to become more green, says Timo Koponen, Vice president of Flow & Gas Solutions, Wartsila Marine Solutions.

By 2020, DNV GL estimates that around 1000 LNG bunker vessels will be operational globally. In addition, industry giants believe that it will definitely be one of the most significant alternative fuels, going forwards.

LNG supply chains

The LNG supply chain starts with the extraction of natural gas from the gas fields, where natural gas is transported, either via gas pipeline or via ship in the form of LNG carriers. The LNG requires the liquefaction of natural gas and then, if it is fed to the domestic gas grid, it needs regasification plants. When the LNG is at the port, it can be used to fuel ships, supply local inland energy demand or be transferred to an LNG carrier, where significant capacities for LNG storage are necessary. The LNG projects will not only supply the shipping industry with LNG, but also significantly supply the local and national energy grid where supply to local inland demand; feeding the energy grids ,supplying local businesses; international & regional demand; fuelling gas fuelled vehicles are among of main share of LNG profitability. The LNG supply infrastructure in port consists of truck-to- ship bunkering; ship-to-ship bunkering; and shore-to-ship bunkering by pipeline.

Benefits of using LNG and Comparing the Alternatives

As mentioned in this study, the main drivers of demand for LNG are environmental regulations and the difference in economic benefits between LNG and its alternative. In order to gain further insight into the benefits of using LNG, an article was written by Committed to the Environment (CE Delft) was chosen. According to its authors, the LNG ships require additional investments in engines, tanks and piping in comparison with petroleum-fuelled vessels, including vessels using heavy fuel oil (HFO) + scrubber and marine diesel oil (MDO). When they are trading in Sulfur-Emission Control Areas, such as the North or the Baltic Sea, or when trading to EU ports post-2020, they do not require additional measures or investments in exhaust-gas cleaning systems. However, the ships using more expensive marine gas oil or marine diesel also do not require this investment for same areas, either. Still, in a similar situation, the LNG ships require a higher investment than conventional ships.

The price of LNG at the terminal is often lower than that of other marine fuels, although this depends on availability and bunkering option. There are normally three ways here to supply a ship with LNG:

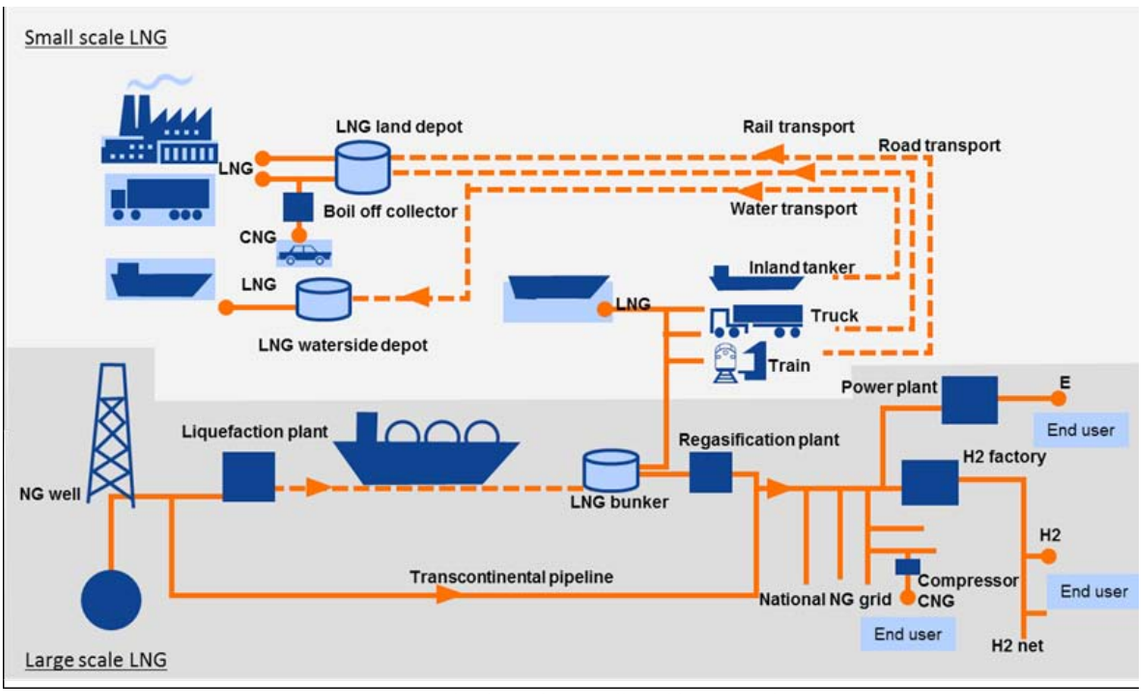
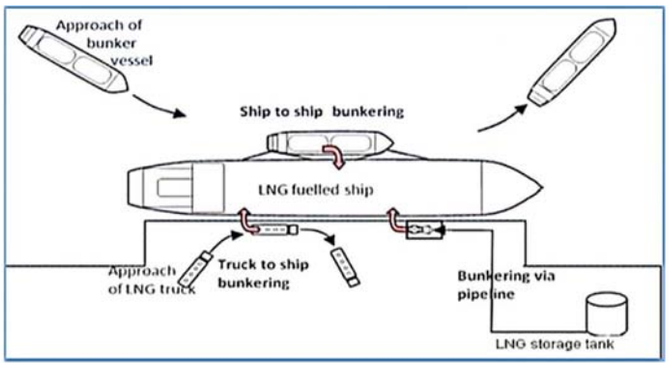


Figure 2. Supply chain for small and large-scale LNG



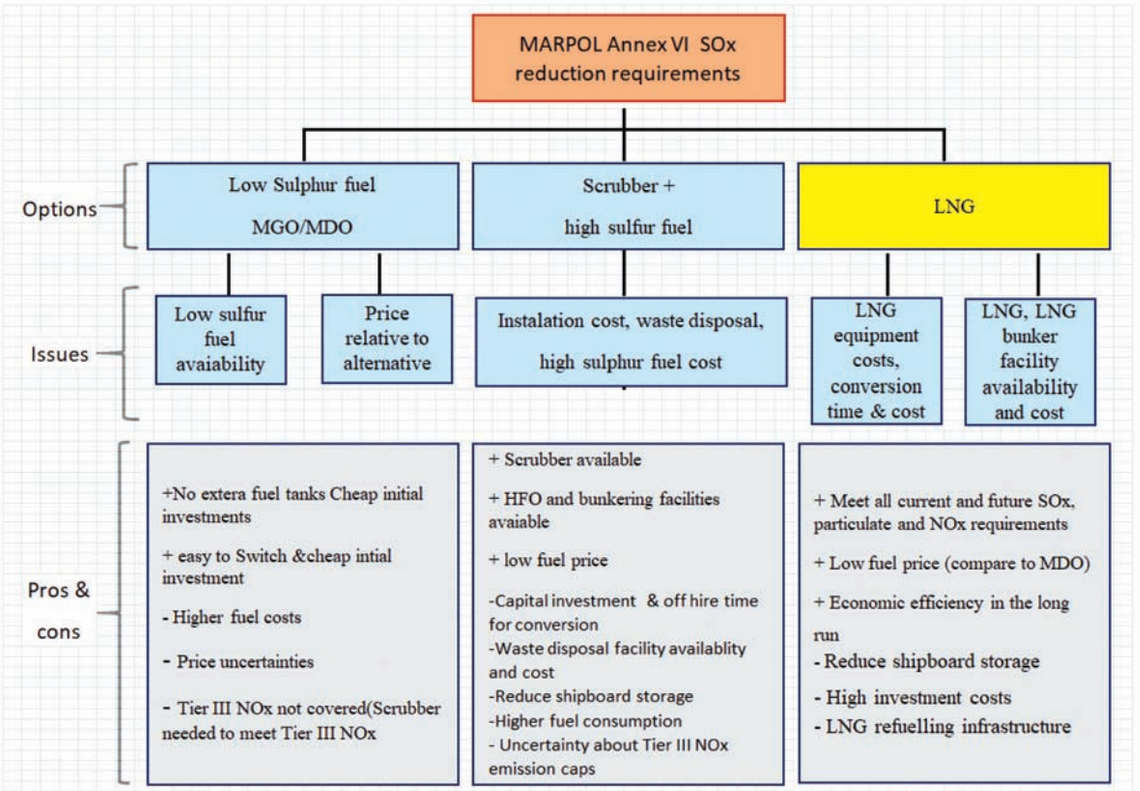
Figures 3. LNG Bunkering scenario

- Tank truck-to-ship, which typically adds 40-45% to the price of LNG at the terminal;
- Pipeline-to-ship, depending on the storage tank, which has a wide range of costs, 6-380%, to the price of LNG at the terminal.
- Ship-to-ship, which depending on the size of the bunkering vessel, adding 6-16% to the price of LNG at the terminal.

According to CE Delft research, analyses show that the LNG delivered by truck is often more expensive than HFO, but cheaper than distillate fuels, whereas LNG delivered by a bunker ship is often less expensive than either HFO or distillates. If the LNG costs are around 20% less than HFO per unit of energy, the total cost of ownership of LNG coastal ships is lower than that of HFO-fuelled ships with a scrubber and, contrarily, LNG ships also are more cost-effective than MGO ships in most cases, when the fuel costs are the same per unit of energy. However, these are raw estimates, and the results depend on the vessel design, cost of capital and type, and the cost of the scrubber if compared to an HFO+scrubber.

Costs and benefits of cases:

In these regards, auditors (CE Delft) point out that the results of the cost-benefit analysis, have shown that LNG coastal ships are more cost-effective than HFO-fuelled ships with a scrubber when fuel suppliers have invested in the best bunkering option (in 9 of the 12 cases analyzed). These results are based on the assumption of an average cost of capital of 10%, LNG import and fuel prices in line with the World Bank long-term forecast, and a consideration of the additional investment in 10 years. If a lower interest rate is used (4%) or if the LNG import price is 25% lower, relative to HFO, all cases will have positive returns. However, if LNG import prices are 25% higher than announced by the World Bank, all cases will have negative returns. In the case where smaller-scale bunkering ships are used, however, the cost



Figures 4. Pros & Cons of Different Alternatives

and benefits remain positive, but the pay-back time increases by about a year. In another case, where LNG were supplied by tank trunks, an LNG ship would not be an attractive option compared with an HFO-fuelled ship with a scrubber. Compared with an MGO-fuelled ship, all costs and benefits have positive net present values with pay-back times ranging from five to eight years, even when fuel is supplied by tank trucks.

Estimated investment costs for vessels with HFO + scrubber

According to the CE Delft study, the costs of vessels with an HFO engine including a scrubber and SCR[1] (Selective Catalytic Reduction) is 560 EUR/kW for retrofit vessels and 2,060 EUR/kW for new vessels. The auditors have mentioned that the investment costs here depend on the type of scrubber, and are not specified per kW specified in the study. Regarding the cost of the scrubbers, the data here is considered from 3 million EUR, and the different types of investments are given in Table 1.

Because of compliance with air emission regulations, the investment in LNG-fueled vessels is not as high as vessels fuelled with other fuels, according to the CE Delft study. However, it is difficult to show the LNG ship's cost-competitiveness without further data and calculations.

Table 1. Comparisons of the total cost of ownership per type of fuel

The existence of the LNG infrastructure provides a lot of benefits for shipping and local industry. Based on the literature review, it is better to mention that the LNG projects may not be feasible just for the shipping industry, and that the marine LNG is part of LNG projects. The creation of LNG infrastructure not only ensures its compliance with current and coming regulations, but also improves the shipping, port and trade route environmental performance. In this regard, both ship-owners and gas suppliers have a greater interest in investing in LNG as an alternative fuel. However, its implementation is dependent on various issues; for example, the local and international regulatory authorities need to set clear guidelines for the creation of LNG shipping and bunkering operations; furthermore, ship-owners need to invest in LNG-fueled ships and security to have LNG available for their fleet, additionally, the port can facilitate the creation of bunkering terminals by participating in investments, and can increase public awareness in close communication with other main stakeholders. Indeed, local industry can benefit from LNG availability.

1 SCR= Selective Catalytic Reduction, a process is used to reduce oxides of nitrogen.

Table 1. Comparisons of the total cost of ownership per type of fuel

	MGO /MDO	HFO + scrubber	LNG (retrofit)	LNG (new)	LNG dual fuel (retrofit)	LNG dual fuel (new)
Capital expenditures engine	180 EUR/ kW main	225-400 EUR/ kW main + 240 EUR/kw aux	320 EUR/ kW main + 150 EUR/kw main + aux	995 EUR/ kW main + 100 EUR/kw main + aux	340-420 EUR/kW + 150 EUR/kw main + aux	950-995 EUR/kW + 100 EUR/kw main + aux
Capital expenditures scrubber		150 EUR/kW main				
Operational expenditure scrubber		2.5/EUR/MWh				
Fuelling	Depends on case study	Depends on case study	Depends on case study	Depends on case study	Depends on case study	Depends on case study
Operational costs	Depends on case vessel	Depends on case vessel	Depends on case vessel	Depends on case vessel	Depends on case vessel	Depends on case vessel

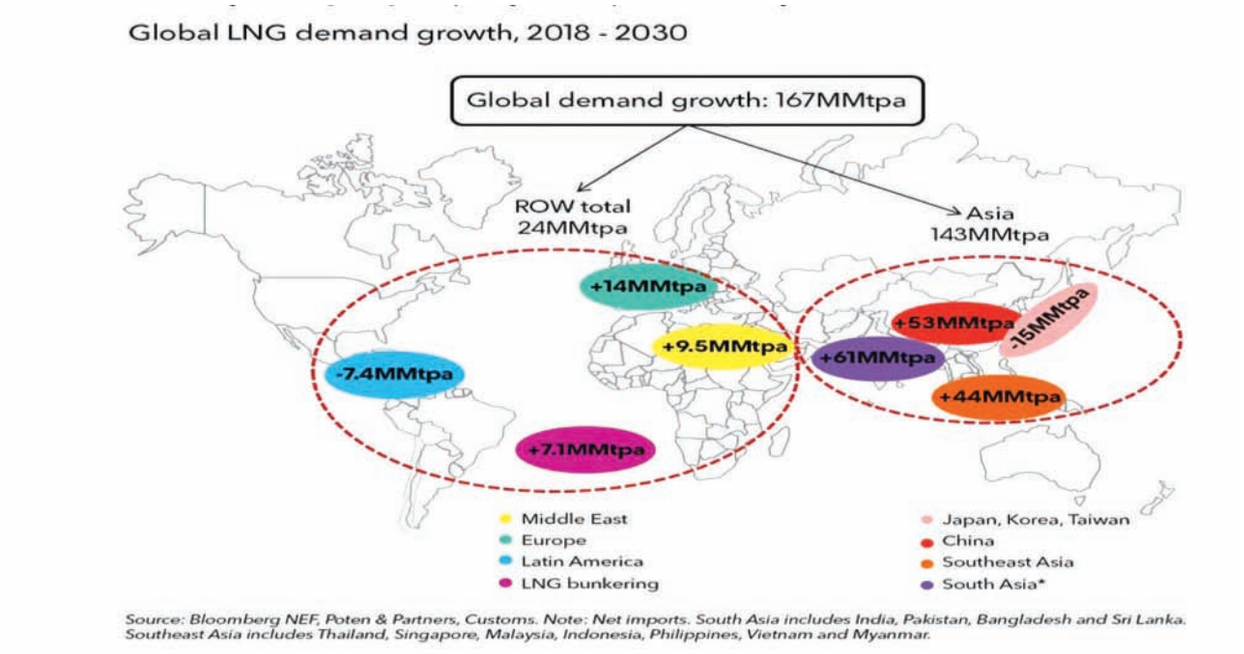


Figure 5. Global LNG demand growth

Keys to successful LNG Project Development

- ***Prior long-term Sales/ tolling commitments that provide assurance of adequate revenue.***

A sufficient advance in LNG sales can ensure an LNG project will be developed, and allow a positive final investment decision. When the contract for sufficient LNG sales has been contracted, the project will be on its track to completion. Incidentally, LNG sales contracts are normally 20-year commitments.

- ***Attractive to 'Premium' Asian Buyers.***

The LNG project must be well planned and economic, such that it meets economic criteria for both liquefication development and for buyer. The project will preferably be attractive to the 'premium' buyers who have extensive long-term gas demands. Indeed, Japan, South Korea and China purchased over 60% of all LNG imported together in 2014 and, historically, the LNG prices in Asia have been twice as high as the price paid by long-term buyers in other regions.

- ***Strong Resource Base.***

The buyers look for a reliable and steady supply of LNG and, are attracted to large gas reserves given for long-term LNG sales and continued purchasing agreements. In the life of the gas field, in which characteristics vary from field to field, some experience steep declines, resulting in the seller's inability to supply agreed quantities. The force majeure and other consequences here may come into play as resources are discharged. Therefore, the quality and quantity of the gas supplied is a consideration when attracting 'premium' buyers, especially for a long-term contract.

- ***The host country has predictable legal, contractual, regulatory foundations and evidence support for the project***

The host government supporting the projects is essential, and the failure to obtain government support will result in delay or cancellation. Without question, the sponsor's relationship with the Government is critical to the success of the project. The sponsor here must have a clear understanding in order to be able to apply the general legal, contractual, regulatory and fiscal framework internally regimes and, in addition, for foregoing LNG projects as well.

- ***Competitive cost of an LNG project***

A mindful approach to the construction delivery system will generate a competitive engineering, procurement and construction contract and has a direct relationship with a project's success. However, there are few qualified contractors who can construct and operate onshore or offshore projects. In this respect, the construction cost have doubled in the last decade and, in some cases, increased

even further.

- ***Financeable project***

The role of the sponsors to attract financial support is fundamental. A project is financeable if there is a predictable and clear legal framework established by Government. A commercial structure ensures a predictable long-term revenue and a construction contract that limits the construction phase risk by contractors with a sound delivery history, will attract investment. Financiers will also be stimulated by an experienced operator and limited scope for increases in operating costs.

- ***Buyer participation in the project***

Involving key buyers in project-participation is a positive approach and has lately been the norm in LNG export projects, where the sense of 'partnership' between the seller and buyer develops a long-term successful relationship, thereby it has a direct impact on project success. premium buyers, however, may insist on taking equity in the export projects.

- ***Few partner conflicts of interest.***

According to the auditors, the 'sponsor' typically comes from a venture of among numerous participants who have gas discoveries in one or more fields. The sponsor's conflicts can arise when different LNG projects and portfolio priorities exist. These conflicts can impact project success, especially when there is a misalignment in the various segments of the LNG chain. However, the joint operating agreement does not prevent development, and partners are able to work together in project development. Disagreement between participants, however, can weaken the relationship with the Government and interest from potential financiers, and cause significant project delays.

- ***Timed with buyers' 'windows' of demand.***

Historically, market demand seems to come in "waves". Buyers come in the form of seeking for additional or replacement LNG supplies. They seek to diversify supply source to reduce the risk and ensure the reliable supply, and to look for large LNG supplies because of energy transition. Therefore, one of the factors for success in the LNG project is to know the market, be able to predict demand waves and be on track in offering services in the forecasted demand timeline.

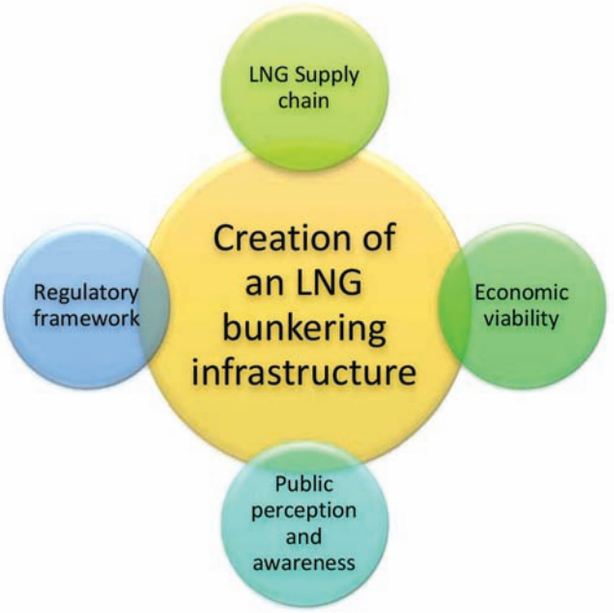


Figure 6. Creation of an LNG infrastructure

Creation of an LNG bunkering infrastructure

Based on the literature review, this study also provides some suggestions and practical guidance for actors on how to create an LNG infrastructure and promote and facilitate the use of LNG as a ship fuel. According to the auditors (Wang & Notteboom, 2015), The most important aspects have been identified and classified into four categories; LNG supply chain, the regulatory framework, economic viability and public perception and awareness. Understanding the feature of each part is necessary in order to take measures of improvement for LNG development.

Natural Gas Reserves

Iran's estimated proven natural gas reserves is 1,191 trillion cubic feet (Tcf), and are second behind Russia, according to Oil & Gas Journal, published on December 2017. Moreover, Iran has 17% of the world's proved natural gas reserves and more than one-third of OPEC's reserves.[2] The South Pars field is Iran's largest natural gas field, which is shared with Qatar's Natural gas field, 'The North Field'.
South pars field holds almost 40% of Iran's total natural gas reserves[3]. Other major natural gas fields are Kish, North Pars, Sardar-e-Jangal, Forouz-B, Aghar, Golshan, and Kangan.

2 Oil & Gas Journal, Worldwide look at reserves and production, (December 2017)
3 Facts Global Energy, Iran's Oil and Gas Annual Report 2017, (December 2017)

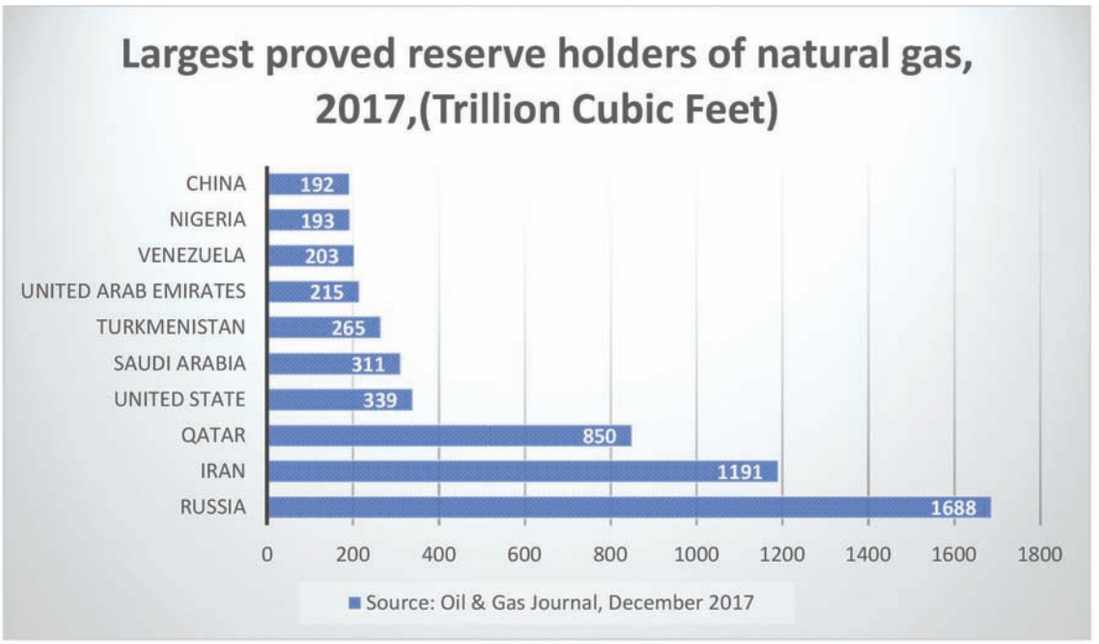


Figure 7.the Largest proven reserve Natural Gas holders in 2017

Stakeholder involvement

Stakeholders play a crucial role in LNG development. The most important stakeholders identified in Iran are the National Port authorities, the gas suppliers, the project developers, ship-owners, cargo owners and local industry. The Gas Supplier known as the main initiator of the project is called 'The National Iranian Oil Company' (NIOC), and possesses the technical knowledge to control oil and natural gas upstream activities through its eleven subsidiaries. There is also 'The National Iranian Gas Company' (NIGC), which controls natural gas downstream activities.

The National port authorities, called 'The Ports & Maritime Organization' (PMO) monitor the port operations and are directly concerned with providing external infrastructure to the project. Shipowners generally have the biggest interest in having LNG fuel available at the port, so make a lot of effort in order for the concerned party to investigate where LNG will be available and pull the supply side in order to initiate project plans. The local land industry is the other main customer of LNG. The Governmental authorities also monitor the directives, strategies, and planning of LNG development. Cargo owner and Offshore project clients, similar to the local industry, are not yet aware of their potential to shift the shipping industry towards LNG.

Iran and LNG

Iran has 3180 kilometers of coastline in the south and north of the country, and its geostrategic location, known as 'the bridge between East and West' benefits from its highly important strategic position (figure 8). Iran has 14 ports, six of which are major commercial seaports; five in the south, on the Persian Gulf and the Gulf of Oman (Bandar-e Imam Khomeini, Bushehr, Bandar-e Abbas, Assaluyeh and Chabahar); and three on the Caspian Sea (Bandar-e Anzali, Amirabad and NoShahr).

From an LNG supply point of view, Iran boasts the world's second-largest natural gas reserves, estimated at some 34 trillion m^3, which means the country has gas to meet its sizeable domestic requirements with volume to spare. Tehran is planning new and expanded pipelines to Oman, Pakistan, Turkey and central Asia, but also sees LNG as a way of ramping up its exports.

Despite the general factors, the Iranian Gas sector strategists and policymakers should take a more serious look at the factors contributing to the shift in LNG, including the following:

- Iranian growth in gas production:
- The positive impact of the lifting of sanctions:
- Asian and Global LNG demand outlook:

Figure 8. Iran's Strategic Location

Port	Status	Comments
TOMBAK	Planned to be in operation; 3x140000 m3 storage capacity; 10.5 Million ton/annual	Small port; the bunkering strategy not considered yet; the main driver is the proximity to the source of Natural gas
Bandar Abbas(Rajaee Port)	No plans	
Imam Khomeini Port	"	
Assaloyeh Port	"	
Bushehr Port	"	
Amirabad Port	"	
Noshahr Port	"	
Chabahar Port	"	
Anzali Port	"	

Table 2. List of port and their status

- Iran-Qatar Common Gas field and geostrategic realities:
- Iran plans to ban on flaring of the Gas:

Current development status of LNG in Iran

The environmental performance, ship-owner demand and proximity to the source of Natural gas were outlined as the main drivers for providing LNG at the port. Only one port has made plans for the LNG project, namely TOMBAK. No other ports have yet powerful decision-makers come to LNG projects.

The 'Iran LNG Co.' was established to build an LNG plant in a special economic zone nearby ASALOYEH port in the south-west of Iran. The National Iranian Gas Export Company (NIGEC), National Iranian Oil Company (NIOC) Pension Funds and Saba NAFT Engineering and Construction company are shareholders, and they have all invested in this project as well. In 2007, the construction of a 200 hectares area was started and the 'Iran LNG company' has been developing an LNG plant comprising of two trains with a capacity of 5.4 MTPA for each; expandable to four trains in the future (ILC, 2017).

At present, Iran does not have an LNG infrastructure. Although its plan to build a liquefaction facility date back to the 1970s (EIA, 2018), the country has been too busy to actually build one, and most of the work has almost entirely stopped. A lack of technology and foreign investment, along with the impact of old international sanctions and a lack of finance to purchase necessary equipment, has caused an inability to construct a large-scale LNG project. It has led to a change in Iranian strategy to work on plans to construct small- and medium-sized LNG plants, including the 'Iran LNG project', which is explained above, and may lead to the chartering of a floating LNG (FLNG) terminal (CIA, 2018). The 'Iran LNG project' consists of three packages of LNG plant, storage tanks and harbor and jetties. The marine facilities have been defined in package III and, at

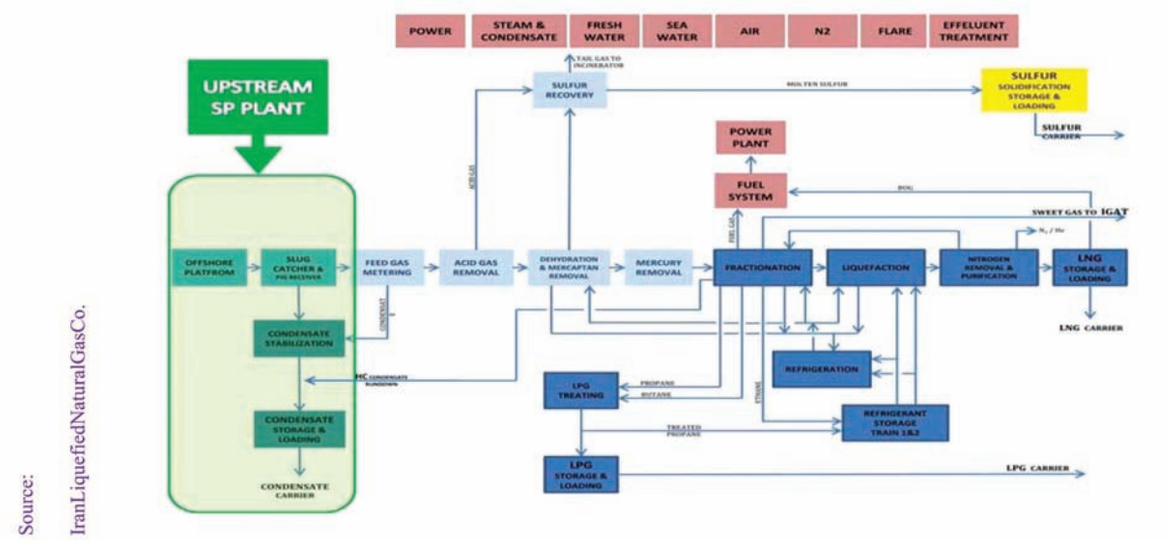


Figure 9.Iran's LNG project overview plan

Figure 10. Map of TOMBAK Port

the moment, there is no bunkering infrastructure at TOMBAK port (ILC, 2017).

There are no clear conflicts between the main stakeholders, most of whom complained the US sanction as a common issue keeping their LNG strategic plans slow-moving. It is felt the government should support the public funding programs in LNG projects, although, the public funding programs will only make sense if it can actually promote the introduction of LNG. The supply of the natural gas is secure, and ensuring sufficient supply for upcoming LNG projects might be the agenda of public funding programs that have an important role in the creation of LNG projects, by financially supporting project developers.

The biggest barrier of all is the low oil prices that have slowed down the interest of stakeholders in investing in LNG. However, the US sanctions are not without effect. The low prices of oil have decreased the economic attractiveness of LNG vessels, especially for shipowners, who are currently hesitant to invest in LNG-fuelled vessels. The main driver for LNG projects is the demand from the local and shipping industries, and this can be achieved through public awareness and the Government's support in pulling the demand sector. Building by own-country-potential is the best option to confront unilateral US sanctions, where all relevant stakeholders have the interest to develop LNG. However, local industry and cargo owners are relatively neglected, but, even if they are not in the picture, cargo owners and offshore project clients can have a direct influence on the interest of shipowners in switching to LNG. local industries can also contribute to LNG projects and their creation, as the main part of the demand for LNG.

CONCLUSION

The IMO emission regulations are in the near vicinity and the shipping industry is undergoing significant changes. As a new phenomenon, LNG is now playing its role as one of the alternatives in the shipping and land industry, for which a great deal of effort has been carried out and a large number of articles have been published in the past years. A new vision can now be made by looking at LNG development from the literature review, where it can be seen that the LNG trend will increase largely in the near future, with the proactive cooperation between stakeholders playing a crucial role in the development of LNG.

The global sulfur cap has reduced from an initial 4.5% to 3.5%, and it will gradually reduce further to 0.5%, effective from 1 January 2020. This phenomenon indicates that the issues associated with adapting to new IMO regulations is not only restricted to ECA nations but will affect all nations around the globe.

There are various suitable alternative fuels with different uses, and each offers specific environmental benefits compared to HFO. DNV GL has identified LNG, LPG, methanol, biofuel, hydrogen and other power-to-fuel (PtF) solution as the most promising alternative fuels for shipping. The use of gaseous fossil fuels strongly reduces SOx emissions (up to minus 100%), NOx (minus 85%) and PM (minus 95%) compared to liquid fossil fuels, while CO2 emissions has been reduced to a lesser extent (25~30%), From a cost perspective, natural gas fuels have the great advantage of being much less costly than MGO and even HFO per unit of energy, although the reduced operating cost (of up to -50%) will compensate the much higher (+30%) gas-fueled ships price.

Low oil price compared to the LNG bunker is also a major factor minimizing the transition of ships to LNG as an alternative to HFO fuel, with these prices making it less attractive for shipowners to proactively invest in LNG-fuelled vessels. The non-availability of LNG fuel is another factor making it difficult for ship owners to decide to invest in an LNG-fuelled vessel. In this regard, the policymaker's role and decisions are important in how this dilemma will be handled. The successful development of LNG projects requires well-established strategies from international to regional levels of legal authorities.

In this respect, public funding programmes are the main tool to support LNG development and their provision should be in line with future LNG strategies and programmes. However, a lack of LNG awareness has to be considered by legal authorities as well, where better public awareness of the new emission regulations and economic potential of LNG could stimulate a better understanding of LNG projects, especially among local industry and policymakers.

This research points out the environmental and economic benefits of LNG as a ship fuel compared to other temporary alternatives, such as MGO and scrubber technology. It has been argued here that awareness of LNG projects and its considerable potential in Iran should be promoted as a public and Governmental value. In this regard, policymakers can acknowledge that LNG could be an energy source as a ship fuel of primary environmental benefits, although its economic efficiency cannot be ignored.

Capital investment for LNG-fuelled vessels is larger than for vessels using HFO with a scrubber or MGO. It can be

concluded that the LNG is, in general, available option if MGO was used instead of LNG, However, this depends on the bunkering method. If HFO and a scrubber were used instead of LNG, the viability of LNG would depends on the type of ship, as well as the bunkering method. The investment in LNG-fueled vessels is not as high as in vessels fuelled with other fuels due to compliance with air emission regulations. As regards the benefits from reduced emissions, however, LNG is relatively more beneficial when compared to MGO than to HFO + scrubber.

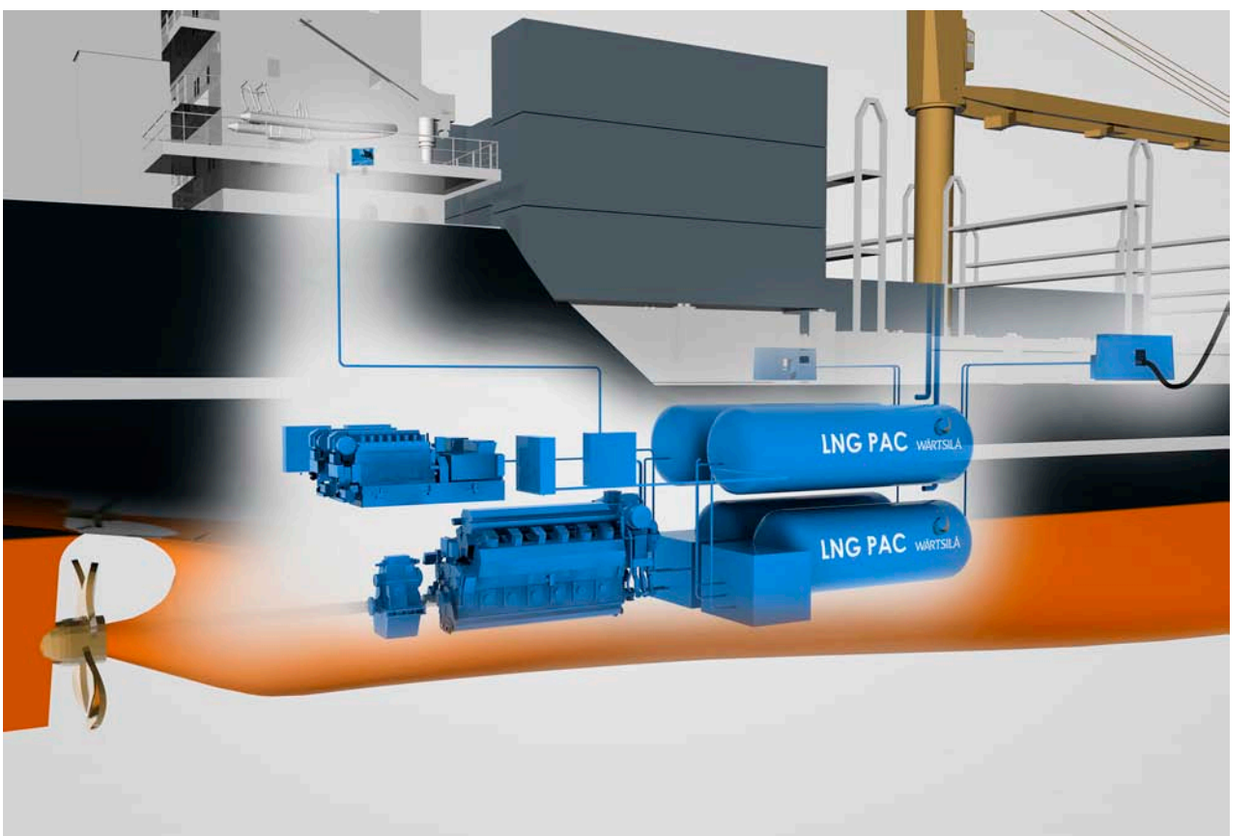
Based on a literature review and history, the success of LNG projects has been influenced by many factors, several of which are under the sponsors' control or influence. Knowledge of key LNG project success factors here can help sponsors to stay focused on critical project variables that can influence a project in order for it to be successful. Contrarily, areas outside the direct control of the sponsors can be managed with a proper level of attention. This, however, depends much on market norms.

Public awareness is one of the key factors in developing the LNG as a ship fuel. The national/local government here can establish public incentives more efficiently than a normal subsidy, funding or taxation regime can; for example, changing the negative public perception of the use of LNG as a ship fuel, where investment in LNG-fueled vessels is not as high as vessels fuelled with other fuels, due to their compliance with air emission regulations.

Iran has the potential to be a significant LNG player in the market, having a number of important factors that will gradually increase its LNG project success; its major gas resource; its geostrategic location as a gate to Europe, Central Asian (the countries around the Caspian Sea), China, the "Silk Road"[4] and the Sea itself; the Asian buyer interest in LNG; Government support; LNG outlook demand due to restrictions in emission regulations; growth in gas production; plans to ban flaring gas; and the positive impact of sanctions being lifted.

The proactive co-operation between stakeholders plays a crucial role in the development process. The national gas supplier has the highest amount of interest in developing LNG projects, because of strategic, political and economic benefits reasons. While shipowners consider how they are affected by the emission regulations, and how looking into the availability of LNG fuel can influence decision-makers and show their interests; nothing will happen without gas suppliers actually investing in and implementing LNG projects, as well as government support. In the form of national port authorities, the port's interest in LNG is also very high, but it has been shown that they are still waiting for the availability of LNG fuel. Their level of influence in is much lower than a national Gas supplier's, although it is greater than that of the shipowners. Cargo owners and local industries could have a considerable influence in the development of LNG;

4 The Silk Road which the main Land path passing through Iran, was an ancient network of trade routes that connected the EAST and WEST.



two actors that have great room for improvement within the process, but whose role is neglected by others.
To sum up, despite the large amount of natural gas and other potential resources in Iran, LNG is a fossil fuel with a more smaller environmental impact than other energy sources. These aspects can be considered by policymakers in the promotion of LNG projects.

Recommendation

Iran has a competitive advantage to gradually become a significant player in the LNG market. It is very positive to see that Iran is taking the right approach in creating medium and small-scale production at the beginning. Even so, there are some challenges that need to be addressed for policy makers before Iran can become a major producer in LNG as a marine fuel.

- ***LNG technology:*** LNG technology is a major part of the LNG project and is potentially one of the sectors most vulnerable to US pressure, where certain key components are only US-made. In this circumstance, the best measures are to continue with EU technology and be careful to avoid a new wave of US pressure on transfers of technology. The project developer is the party responsible to secure the relevant technology. The strategic partners, China and Russia, have the technology that can reduce the risk of US pressure. As mentioned in 4.9.3, in the circumstance that the USA, increases the pressure in the trade conflict with China, the clash over Russia and the trade war with the EU Commission, this could be the best time to secure EU technology or to incorporate Chinese and Russian technology.

- ***The gas market is driven by buyers rather than seller:*** the global gas market is not the same as the international crude oil market, in that the global gas market is driven by buyers. With the additional infrastructure required at the receiving process, including LNG carrier, and so on, Iran must similarly invest in LNG carrier fleets. However, it is important to realize that infrastructure, and commercial and human resource capacities, must be expended by way of development. The policymakers are responsible here to keep different actors focused on the LNG project plan. For example, policymakers can stimulate the NITC (National Iranian Tanker Company) to invest in LNG carriers and other service providers for bunkering facilities at the initial stages.

- ***The comparisons between pipeline gas and LNG export***: Based on some technical interviews, some experts argued that pipelined gas could be a more feasible export. While their economic calculations may be correct, they do not take certain unknown risks into account, such as conflicts in exporting to Europe via Turkey and failure to construct a gas pipeline to India via Pakistan. Terrorism here is a chief example of such unknown risks. In fact, refering to the environmentally friendly, global LNG demand outlook, as well as to buyers from the Asian Far East, the LNG export project and LNG fuel is a logical strategy, in comparison with pipeline gas export.

In current circumstances, and because of the great potential of LNG, policymakers need to make a proper decision in LNG development through measures discussed in this study.

- ***Investment dilemma:*** In past years there has been a classic problem: that of developing an LNG infrastructure for the shipping industry. There has been the investment dilemma of who invests first; the shipowners from the demand side or the project developer from the supply side. In Iran, this problem has already been overcome by investing in national gas suppliers. The investment dilemma here has not been an obstacle for LNG development, but LNG projects are still at an early stage. In these regards, the policymakers have to take proper measures in order to overcome this stalemate situation. For instance, regarding international cooperations or confronting US sanctions, Iran has suffered from international sanctions for a long time now, and has been able to survive, staying strong in different industrial aspects.

- ***Pull the LNG demand sector:*** The actual demand for LNG from the shipowners is very low, and from local industries as well. Based on the literature review and project developer interview, marine LNG is a part of the LNG project that is not profitable if only targeted to LNG as a ship fuel. Public awareness and incentives by the government here play a key role in stimulating the LNG demand sector to stay alive and move ahead. In this respect, policymakers can make certain in implementing government policy, in this regard, and pull the demand sectors smoothly for both shipping and local industries, local industries, including electric power generation companies and national steel producer factories near to TOMBAK.

- ***Shipping companies cooperation:*** shipping companies must now be proactive and participate more actively in the network of actors and find a solution to comply with the new emission rules in

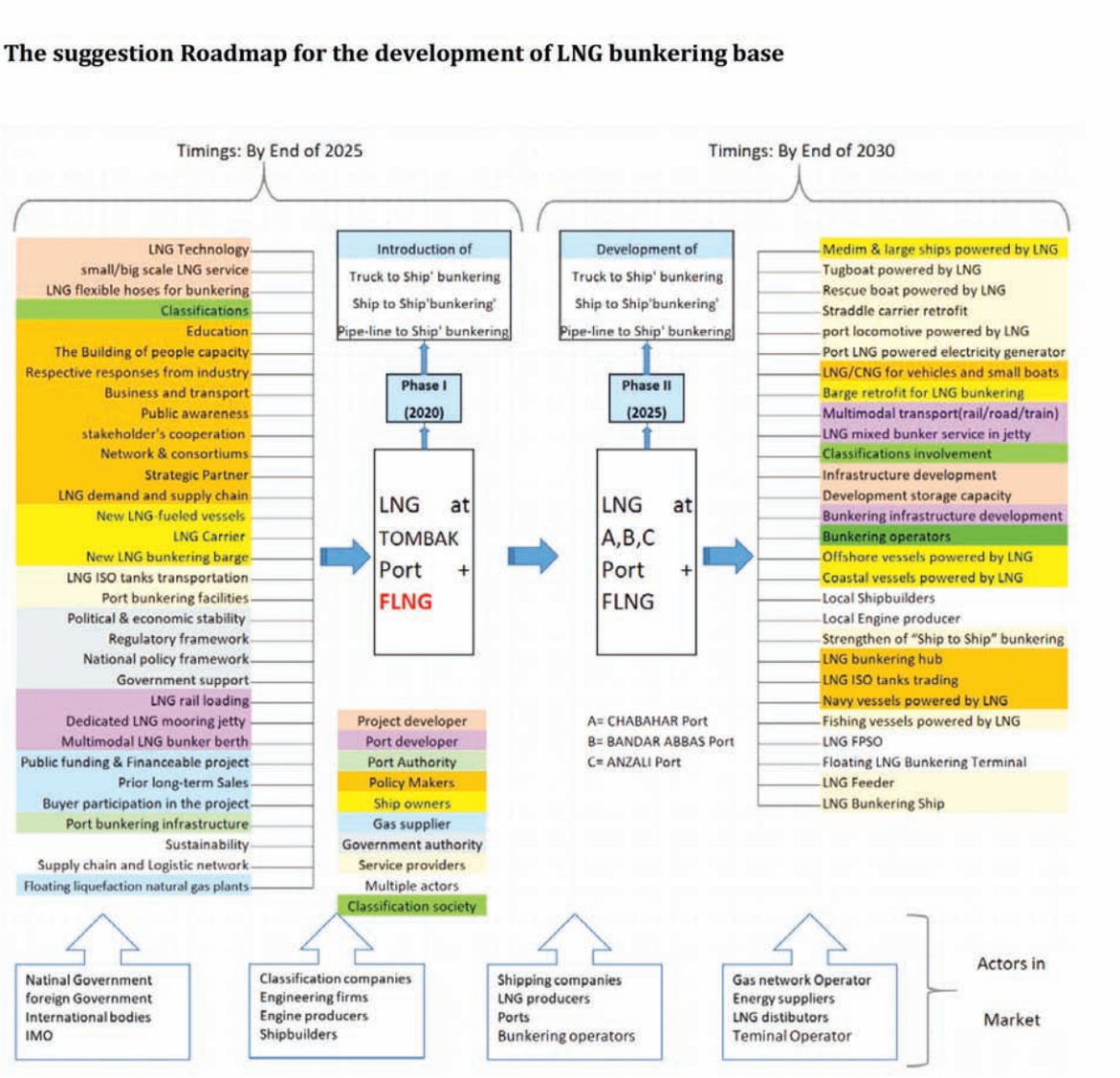


Figure 11. The suggestion Roadmap for the development of LNG bunkering base

2020. By cooperating with each other, investment in LNG-fuelled vessel will accelerate, which can influence policymakers in making better decisions. Policymakers can create LNG networks as a platform for systematic cooperation to bring together LNG actors such as shipowners, port authorities, classification societies, shipyards and research institutes, in order to exchange knowledge and experiences on LNG issues.

- ***LNG supply chain at TOMBAK port:*** the location of the port not only contributes to the economics of the projects, but also enhances the reliability and safety of the LNG supply chain. TOMBAK, located inside the Persian Gulf, along with its actors, should consider a reliable LNG supply chain in order to attract shipowners, including reliable bunkering facilities, a deep water dept, a long jetty and easy access. The port authorities, gas suppliers, port operator, service providers and so on, should well elaborate LNG supply chain skilfully in the early stages for reliable supply chain management.

Iran has the ability to monetize its gas. LNG technology may still very expensive and only available to a limited number of western companies, but Iran is still able to gain access to it. The national shipping companies are the most important actors in developing LNG as a ship fuel, because they have to comply with IMO emission regulations. Moreover, although the ports and bunkering operators will bring LNG to ships, they will face a lot of challenges regarding safety and bunkering procedures. Nevertheless, LNG is highly likely to be the marine fuel of the future, and all stakeholders involved can profit from environmental and economic benefits.

ULTRA- LARGE CONTAINER SHIPS LIMITS AND BENEFITS

By: Reza Darban; Researcher and consulting engineer in marine technology

Abstract

Undoubtedly, in current decade, the biggest change in global containerization system has involved with market balance between trade and fleet supply capacity, due to the innovation of Ultra-Large Container (ULC) ships.
Top shipping lines have tried to take advantage of the economies of scale by operating larger vessels.
This strategy has proved to reduce the costs of sea transport per container and gave ship owners an opportunity to overcome the losses of fuel price rise.
In other hand, presence of mega ships means modification or new choice of trade routes, investment in ports and terminals facilities. Based on this, some questions will be raised, for instance, is there any approaching limits mega ship dimension development?
This study mainly focused on mega container ships dimension, the reasons for the strong development of the ship size and important commercial and technical challenges as its limitations and benefits. At the end the possible solutions to difficulties that might come across on new development with ultra- large vessels will be discussed briefly.

Keywords: Mega container ships, gigantic container ship, ultra-large, panamax, Suez max, Malacca max, boxships.

1-Introduction

Increasing size of container ships is not something unusual. The last decades have seen an almost continuous increase of container ship size, driven by container shipping lines in search for economies of scale. This was to a large extent facilitated by the invention of container shipping that made cargo handling much more efficient and enabled the increase of ship size. Containerization has certainly caused to decreasing maritime transport costs. As such it has facilitated global trade, which has had large benefits worldwide [1]

1-1- Background

What are Container Ships?

1-1-1 Containerization

As the name suggests, a vessel structured specifically to hold huge quantities of cargo compacted in different types of containers is referred to as a container vessel (ship). The process of sending cargo in special containers is known as containerization.
One of the most potent methods of hauling goods is done by Container Ships. These ships have made it feasible to transfer towering quantities of cargo at a time and have changed the global trade efficaciously.
Container ships are the cargo ships which carry most sea-going non-bulk cargoes. In today's world, container vessels carry around 90% of the world's non-bulk cargoes.
One of the main ways of carrying ready goods worldwide is through Container Vessels. These containers are of a standardized size so that they can be easily transferred to various modes of transport. Anything can be carried on a Containership.
Because of the increasing demand in the market, increasing cargo carrying capacity, increasing operating efficiency and improvement in environmental processes and operation of a container vessel in liner service, the container vessels have become bigger and bigger continuously.
The container carrying capacity of container ships today has increased more than 1200% as compared to 1968. They have become more technologically advanced and fuel efficient by the time. [4]

1-1-2 Container ships

The initiation of the container shipping forms one of the most remarkable developments in the maritime cargo industry. Container ships, a type of cargo ship, have revolutionized the manner in which cargo supplies are ferried and transported across the world, by providing assurance of safety and security of the thus transported cargo supplies. Some of the biggest shipping companies today deal mainly with containerized form of cargo.

The very first models of container ships were launched in the early 1950s and were mainly designed to ferry goods trains' freight cars. Using crane systems and ramp systems, these freight cars could be loaded and unloaded from the vessels.
Over the years technological advancement has made it possible for comparatively far more feasible methodologies, though crane systems still play a major role in the loading and unloading operations of the containers to and from the vessels' holds. Specialized lashing and cargo handling systems are used to secure the containers in their places.

Container vessels are typical in that that they are constructed to accommodate massive possible cargo loads. The load holding capacitance of container vessels is measured in terms of Twenty-foot Equivalent Units or TEUs, with the biggest container ships carrying as much as over 23000 TEUs.
Because of such high capacities, some of the largest ships in the world are container ships. [4]

1-1-3 Development Generations

Since the beginning of containerization in the mid-1950s, containerships undertook six general waves of changes, each representing new generations of containerships ,figure 1:

A-The first generation of containerships was composed of modified bulk vessels or tankers that could transport up 1,000 TEUs. These ships were carrying onboard cranes since most port terminals were not equipped to handle containers. They were also relatively slow, with speeds of about 18 to 20 knots and could only carry containers on the converted decks once the container began to be massively adopted at the beginning of the 1970s, the construction of the first fully cellular containerships (FCC; second generation) entirely dedicated to handling containers started.
The first cellular containerships, called the C7 class, were introduced in 1968. All containerships are composed of cells lodging containers in stacks of different height depending on the ship capacity. Cellular containership also offers the advantage of using the whole ship to stack containers, including below deck. Usually, an extra of two containers in width can be carried above deck than below deck. Cranes were removed from the ship design so that more containers could be carried (cranes remain today on some specialized containerships). Cellular containerships were also much faster with speeds of 20-24 knots. [3]

B- During the 1980s economies of scale rapidly pushed for the construction of larger containerships; the larger the number of containers being carried the lower the costs per TEU. The process became a beneficial cycle compounding larger volumes and lower costs, which significantly helped the diffusion of the container. The size limit of the Panama Canal, which came to be known as the Panamax standard, was achieved in 1985 with a capacity of about 4,000 TEUs. Panamax container ship designs were evolving to take maximum advantage of the canal's limitation in beam (Panamax Max).

C - Post Panamax I and II. – 4,500 TEU (initially) – 6,600-TEU (max); Once the Panamax limit was achieved, a decade passed in which the growth in ship sizes stagnated because shipping line's saw going beyond panamax as a risk in terms of the configuration of shipping networks (ships larger than the Panama Canal could handle would be required to sail around Cape Horn in South America). In addition, not many ports could provide the additional handling infrastructure needed by ships carrying more than 4,000-teu, while draft limitations required expensive dredging works.
Top 5: Ways container ships have evolved in size

However, innovation in the shipping industry never slows for long, and by 1988 the first Post Panamax ships, the APL C10 class, were developed, with a capacity of 4,500-TEU (made possible by their beam, which was wider than the Panama Canal's 32.2m limit). Once this reference limit was broken, container carrying capacities once more raised suddenly, the first Post Panamax container ships were launched in 1996 with a capacity of 6,600-TEU. The need for economies of scale become even more important because of the longer voyages required, however, and so by the late 1990s ships carrying 8,000-TEU (Post Panamax II; "Sovereign Class") were the growing giants of global container shipping. Post Panamax containerships initiated an infrastructure challenge for many ports since they require deeper drafts (at least 43 feet) and highly efficient, but costly.
D – New -Panamax, or Neo-Panamax (NPX). Refers to ships designed to fit exactly in the locks of the expanded Panama Canal, which opened in June 2016. These ships have a capacity of about 12,500 TEU, but there are several configurations of Neo-Panamax ships in terms of length (17 to 22 bays) and width (19 or 20 containers across).
E - Very Large Containerships (VLCS) and Ultra Large Containership (ULCV). By 2006, a third generation of post Panamax containerships came online when Maersk shipping line introduced a ship class having a capacity in the range of 11,000 to 14,500 TEUs; the Emma Maersk (E Class).
A further extension of the post Panamax design led to the introduction of Ultra Large Containership class of 18,000 TEUs and above in 2013 (named 'Triple E' by Maersk). This class was further expanded and by 2017 ships above 20,000 TEUs started to be delivered. ULCS is getting close to the technical limits that the Suez Canal can accommodate, beyond which the commercial relevance declines substantially. [3]
There are larger ship designs on the drawing boards, such as the "Malacca Max" class that could carry about 27,000-30,000 TEU, but they are not expected to be constructed until there are sufficient volumes on the limited routes these ships could service.

2 - Types of container ships
Container vessels can be classified in several ways based on:
1.Handling modes: LOLO, RORO
2.Ship sizes: Panamax, Post-Panamax, Suezmax, Post-Suezmax, Post Malacamax
3.Service range: feeder ships, mother ships

- **Handling Modes**

LoLo Container Ships
Lift-on/Load-off vessels are the Geared container vessel, which can load and discharge the cargoes itself using the ship's own crane.
They have the capability to operate without port cranes and can do the cargo operations unassisted.

ROCON Container Ships
ROCONs are ro-ro vessels which also carry containers. The arrangements are such that the containers may be loaded on the deck or there is separate hold specifically for loading containers.

- **Ship Sizes**

Some of the main types of container ships based on size are:
– Cellular container ships
– Panamax
– Post-Panamax
– Suezmax
– Post-Suezmax
– Post-Malaccamax

Cellular container ships
– The first purpose-built fully cellular container

ships were launched in the 1970s.
- It could carry as more than 1,000 twenty foot containers.
- Cellular container ships were the first major breakthrough in container shipping.

Panamax
- Panamax size vessels were first introduced in 1980.
- These vessels were of around 4000-5000 TEUs.
- Their dimension was such that they could pass the Panama Canal. They were limited to the max length of 294.1m, Breadth of 32.3m and max draught of 12m, which was par in comparison to the dimensions of the canal.

Post- Panamax
- A new transportation net was introduced by APL without using the Panama Canal. This created the 'Post-Panamax' type. Introduction of Regina Mersk in 1996 created a new development in the container ship market with an official capacity of 6400 TEU.
- Post-Panamax's development was climactic. In the present world, they occupy nearly 30% of the world's fleet.
- These sizes of vessels were subversive introducing new ideas and methods in the container shipping market.
- Concept of cellular container vessels was introduced. Wherein the cell guides ran from the bottom of the hold to some tiers above the deck. This n reduced the running cost of ship owners as no lashing materials were used to secure the containers but also improved the speed of loading and discharging and reduced container shifting. [4]

Suezmax
- Suezmax max size vessels were introduced in relation to Suez Canal. These vessels have nearly the same size as that of the Suez Canal.
- Suezmax vessels have a carrying capacity of around 12000 TEUs, with Breadth about 50-57 m and draught in between 14.4m-16.4m.

Post-Suezmax
- These are Ultra large container vessels with a carrying capacity of 18000 TEU with a breadth of 60m and 21m max draught.
- These vessels are known as Post Suezmax as their dimensions are too big for the vessel to pass the Suez Canal.

Post – Malacamax
- This size emulates the maximum permissible draught of 21m of Malacca Strait.
- For this size of the vessel to enter the Ports, the port authorities will have to be ready. Presently only two ports in the world is ready to accept this size of vessel i.e., Singapore & Rotterdam.

- Service Range

Feeder Ship
- These ships are used for short routes. Basically, the voyages are not longer than 500nm and they trade in the coastal areas only.
- The Capacity of such vessels does not exceed 1500TEU.

Mother Ship
- These are the vessels which are on international trade.
- The size of these vessels is much bigger than feeders.[4]

From a technical and naval architecture standpoint, there isn't any limit on the size a container ship can be. At this time here are generally three major limitations that a shipping line has to consider when building new vessels: terminal infrastructure limits, draught restrictions and length overall. [5]
Currently there are vessels sailing with a 23,756 TEU capacity and a length of 400 meters, the 61.5-meter-wide ship is on the Asia – Europe service loop of the 2M alliance network (MSC Gulsun, the world's largest containership). This is something that was unimaginable 10 or 15 years ago.
Container ships length can extend, the width can increase, and the vessel draught may also increase beyond the 16-17m limit. Also, with creative ship design consideration in construction they can probably go from loading 10-12 high containers on deck to 20 high.

3-1- Length limitation
Container lines are always hesitates to extend the length of the vessel because then the berthing fees increase into the next "100m bracket." This can be seen by the fact that all mega vessels have not had a length above 399.99m, despite their increases in capacity.
If owners are going to breach the 400m barrier, then it is only logical to move to something like 450m in length. That would allow sufficient additional capacity to offset the increase in berthing fees.
Also by simply increasing the length of the vessel, then the problems of vessel torsion that the classic Panamax vessels were particularly prone to, would be created. They had a width to length ratio of approximately 1:9. Combined with the fact that the bays on these vessels were mostly limited to being split into two compartments, it was very difficult to avoid torsion issues without clever planning and ballast water. [5]
The cluster of ships near 366 m and 400 m does not seem to have direct relation to quay length and turning basin because

most of container terminals have a quay length of more than 400 m and are 1.5- 2.0 times the diameter of LOA(Length overall). [10]
New Panamax ships will have a dimension of 366 m (1,200 ft) in length, 49 m t (160.7 ft) in width and 15.2 m (49.9 ft) in depth. They have been designed strictly in accordance with the dimensions of new locks at the Panama Canal.

3-2- Width limitation

This is where the terminal infrastructure comes into play. The most modern gantry cranes available right now can reach 23/24 rows across the vessel. If you exceed this limit, then you either have to load cargo for another port in the extra rows or you have to turn the vessel around part way through the operation. This is both costly and time consuming so not a practical option if you have to do it in every port.
Due to strain and stresses of crane weights, the gantry cranes cannot just scale up in size. Thus something new is needed. [5]

3-3- Draught limitation

The latest generation of mega vessels can load 11-12 tiers of containers under deck. This can extend but then you start to run into problems of the stack weight limit that the vessel could handle. The limiting factor became the amount of weight that the container at the bottom of the stack could support.
The fact that the vessel is so much deeper will not cause the problems. Now day's crane operations are fully automated. The crane operator is further and further away from the containers they are loading or discharging. This automation should speed up operations dramatically, because it could apply dynamic calculations to determine the distance the next container to be loaded or discharged.
Draught also comes into play when you are looking at both terminals and, perhaps more importantly, the Suez Canal and Malacca Straits. Mega ships design must consider the restriction present due to the depth of major transit passages. The largest ULCC's (Ultra-Large Crude Carrier) have drafts in excess of 20m, cannot transit the Suez Canal and cannot berth in a traditional terminal.
Given the current terminal infrastructure, vessels can only get longer, unless terminals are willing to invest in ever larger cranes.
At present, the limitations on vessels are the outreach of the cranes, the height of the cranes and the draft of the terminal. The above profile would be the equivalent of today's 18,000 to 22,000 TEU vessels. [5]
Currently the permissible limits for suezmax ships are 20.1 m (66 ft) of draught with the beam no wider than 50 m (164.0 ft), or 12.2 m (40 ft) of draught with maximum allowed beam of 77.5 m (254 ft).
New Panamax ships will have a dimension of 366 m (1,200 ft) in length, 49 m t (160.7 ft) in width and 15.2 m (49.9 ft) in depth. They have been designed strictly in accordance with the dimensions of new locks at the Panama Canal.
As per the current permissible limits, a Malaccamax vessel can have a maximum length of 400 m (1,312ft), beam of 59 m (193.5 ft), and draught of 14.5 m (47.5 ft).

3- 4- Gigantic Container Vessels Dimensions Estimation

According to the order book, the biggest vessel is 23,756 TEU ships, and its dimensions are 400 m lengthwise with a breadth of 62 m, 15.2m average draught, height of 33m and speed 14.6/25.1Kn. If this trend is consistent, 25,000 to 30,000 TEU ships will appear in the shipping market in the near future.

The estimation of megaships' dimensions is conducted via regression analysis method, and the data selection and the choice of the best fitting model are key factors to increase the reliability of the results (Researched by Department of International Logistics, Tongmyong University and Institute of Port & Logistics Industry, Busan, Korea).
The analysis is conducted using the dimensions of 300 vessels that consist of 8000 or more TEU ships and the following is the regression equation between ship capacity and ship length:

$$\text{LOA} = 25.08 \times \text{Ship Capacity (TEU)}^{0.28}$$

Estimation of Ship Breadth: The regression analysis shows a linear model as a practical model. The following is the regression equation between ship capacity and ship breadth.

$$\text{Breadth} = 0.0013 \times \text{Ship Capacity(TEU)} + 32.42$$

Estimation of Draught: The following is the regression equation between ship capacity and draft:

Case	Ship Capacity (TEU)	Ship Length (m)	Ship Breadth (m)	Summer Draft (m)
1	20,000	404	59	16.4
2	21,000	410	60	16.5
3	22,000	415	62	16.6
4	23,000	421	63	16.7
5	24,000	426	64	16.8
6	25,000	431	66	16.9
7	26,000	435	67	17.0
8	27,000	440	68	17.0
9	28,000	444	70	17.1
10	29,000	449	71	17.2
11	30,000	453	72	17.3

Table 1- Prediction of Vessel Dimension using Ship Capacity (TEU), [6]

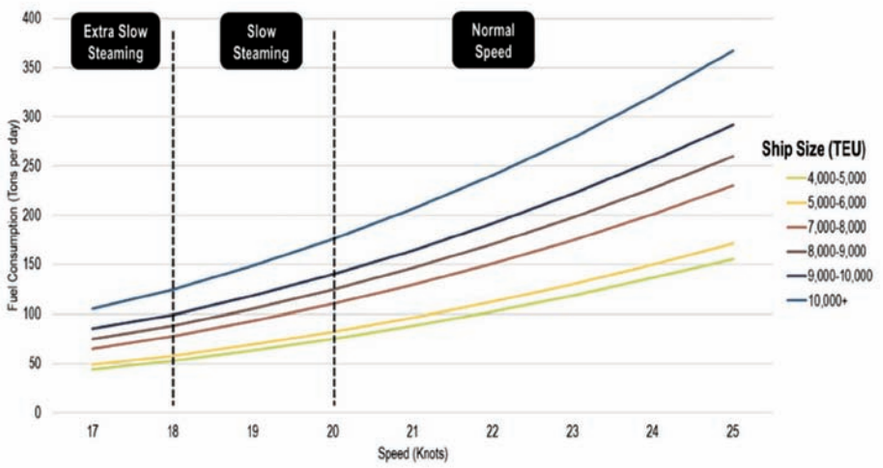


Fig 2 - Fuel Consumption by Containership Size and Speed, [8]

The main ship speed classes are:

$$\text{Draft} = 4.81 \times \text{Ship Capacity(TEU)}^{0.12}$$

With S-curve (also known as the logistic curve) regression modeling, the dimensions of a 25,000 TEU ship is predicted to measure 431 m lengthwise with a breadth of 62.6 m and a summer draft of 16.9 m, while the dimension of a 30,000 TEU ship is expected to be 453 m in length, 67.0 m of breadth, and 17.3 m of summer draft as shown in Table 1. [6]

4- Containership Speed and fuel consumption

Fuel consumption by a containership is mostly a function of ship size and cruising speed, which follows an exponential function above 14 knots. For instance, while a containership of around 8,000 TEU would consume about 225 tons of bunker fuel per day at 24 knots. At 21 knots this consumption drops to about 150 tons per day, a 33% decline. While shipping lines would prefer consuming the least amount of fuel by adopting lower speeds, this advantage must be mitigated with longer shipping times as well as assigning more ships on a pendulum service to maintain the same port call frequency.

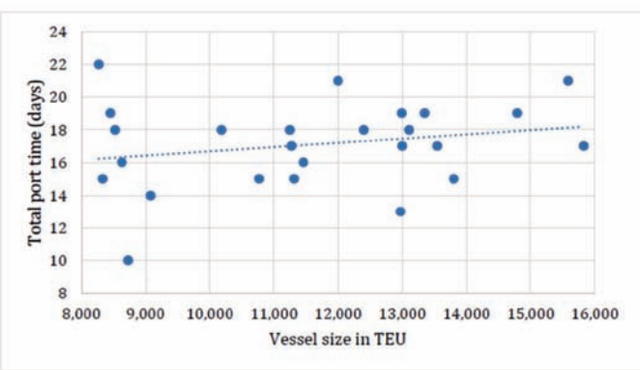


Fig 3- Total Port Time (Days) vs. Vessel Size, [2]

The main ship speed classes are:

- **Normal** (25-20 knots; 37.0 – 46.3 km/hr). Most containerships are designed to travel at speeds around 24 knots.
- **Slow steaming** (20-18 knots; 33.3 – 37.0 km/hr). Running ship engines below capacity to save fuel consumption but at the expense an additional travel time, particularly over long distances (compounding effect).
- **Extra slow steaming** (18-15 knots; 27.8 – 33.3 km/hr). Also known as super slow steaming or economical speed. A substantial decline in speed for the purpose of achieving a minimal level of fuel consumption while still maintaining a commercial service. It can be applied on specific short-distance routes.
- **Minimal cost** (15-12 knots; 22.2 – 27.8 km/hr). The lowest speed technically possible, since lower speeds do not lead to any significant additional fuel economy. The level of service is however commercially unacceptable, so it is unlikely that maritime shipping companies would adopt such speeds.

Slow steaming involves adapting engines that were designed for a specific optimal speed of around 22-25 knots, implying that for that speed they run at around 80% of full power capacity. Adopting slow steaming requires the "de-rating" of the main engine to the new speed and new power level (around 70%), which involves the timing of fuel injection, adjusting exhaust valves, and exchanging other mechanical components in the engine. [8]

Fuel consumption is related to the cube of speed. If a vessel travels twice as fast it will consume eight times as much fuel. This is known as the "cube-rule", making it far more economically viable for a container ship to travel slowly if it can afford to do so from a timing perspective. The "cube-rule" has important implications for the economics of the shipping industry and the design of the new generation of vessels.

$$F = F^* \left(\frac{S}{S^*}\right)^3$$

Where:
F = Actual Consumption (Metric Tons per Day)
S = Actual Speed (23 knots)
$F*$ = Design Fuel Consumption
S* = Design Speed
Note - t the exponent is dependent upon the type of engine concerned. For diesel engines, it is approximately 3: thus the "cube rule". [7]

5- Mega Ships, Cost Saving and Freight Rates

Mega ships came about on the back of a need by the shipping lines to achieve maximum economies of scale and achieve cost savings to offset the depressed freight markets.
Cost savings is required to achieve price competition which is one of the main drivers of the container shipping industry.
The current wave of mega ships is also due to the top shipping lines' playing "catch up" and not be left behind in this race to supposedly reap the benefits of the purported economies of scale through the deployment of mega-ships. While, doubling the maximum container ship size over the last decade has reduced total vessel costs per transported container by roughly a third, these cost savings are, however, decreasing as noted by the ITF (International transport forum).

5-1- Container ship size and total port: The trend of the total port time increases with vessel size as shown in Figure 3. This increase is explained by increase in beam size, port difficulties and inefficiencies in accommodating large containerships. [2]

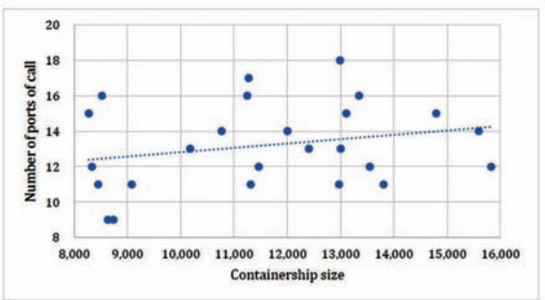


Fig 4 - Number of Ports call vs. Containership Size, [2]

5-2- Container ship size and Number of ports calls: The number of ports of call in a loop has gradually increased with the increase of containership size, Figure 4. The bigger ship needs to stop at more ports. A big ship cannot discharge and load all its containers in one port. These results are meaningful in indicating the overall negative impact of large vessels on port time. [2]

It also seems as the ship size moves over 15000 TEU the number of port calls reduces mainly due to draught limitation and quay crane outreach.

5-3- Fuel cost per container: It is apparent that, on average, larger ships are slightly more efficient than smaller ones. This means that larger ships fuel costs per TEU are lower than those on smaller vessels. In other words, an economy of scale exists in fuel costs as well, figure 5.

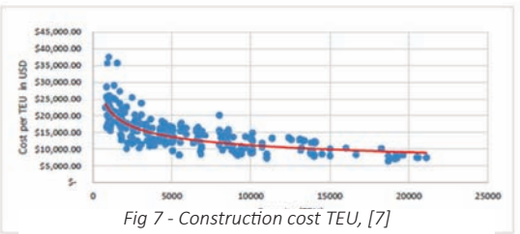


Fig 7 - Construction cost TEU, [7]

5-4- Daily operating cost: The graph (figure. below) shows the operating costs per TEU for the years 2001, 2008, and 2015. It is not surprising that operating costs have increased over the past 15 years, as these values are not inflation adjusted. What is notable, however, is the impact that vessel size has on cost, figure 6.

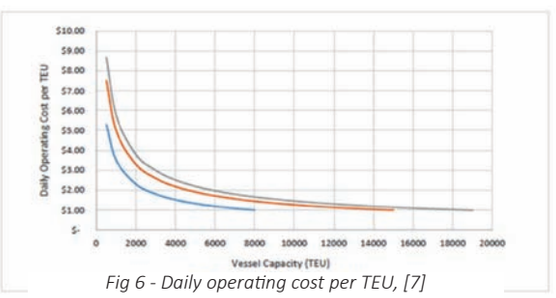


Fig 6 - Daily operating cost per TEU, [7]

It is apparent that larger ships have considerably lower per TEU costs than smaller ones; again, the economy of scale persists. [7]

5-5- Capital cost: It is not surprising that larger ships cost more

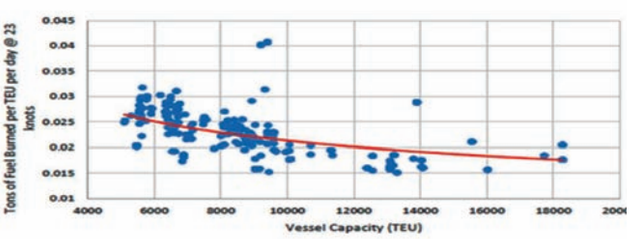


Fig 5 - Tons of fuel per TEU at speed of 23 Knots, [7]

than smaller ones. After all, there is more steel, and more labor required assembling it. A detailed look at the cost per TEU further confirms the presence of an economy of scale: as vessel capacity increases, the cost per TEU clearly decreases figure7.
Smaller ships cost more to build per TEU; a ship of 6000 TEU costs, on average $13,912 per TEU while a ship over 13300 TEU has a per TEU cost of just $9,299.[7]

6- Ports Infrastructure

6-1- Water Depth of Container Terminals: The depth of sea channel should be adequate to safely accommodate ships with the deepest draft. Reviewing tidal effects in a sea channel and turning space, container terminals for handling mega ships should consider its impact. Considering the ship draught, tide height, wave-induced motion, a margin depending on type of bottom, and water density, the channel depth/draft ratio should be applied to be 1.1 to 1.3. When the 25,000 TEUs ship calls at a terminal, the depth should be 18.6 m to 22.0 m.

The Required Water Depth = Full Draft × 1.3

.

As Rotterdam port has a channel depth of 20 m, which is mean lower low waters (MLLW), the mega ship with full draught has to call during the time window of high tide. High tide, which is mean higher high waters (MHHW) at Rotterdam port, is estimated to be 1.58 m for one week. This terminal can handle a megaship of 25,000 TEU with a draught of 21.58 m. The time windows of high tide at Rotterdam port are around 07:30 am and 20:00 pm based on Coordinated Universal Time (UTC) +2. [6]

6-2- Ship Waiting Time: The second challenge a port operator faces is an increase of ship waiting time. The length of a 25,000 TEU ship and a 30,000 TEU ship are predicted to be 431 m and 453 m, respectively, figure 8. As the gap between ships is given to be 10% of the length of the ships, a vessel occupies 478 to 498 m of a quay wall. That is, if the arrangement of quay walls is in a straight line, mega vessels need more waiting time to secure enough space along a quay wall than smaller ones do. [6]

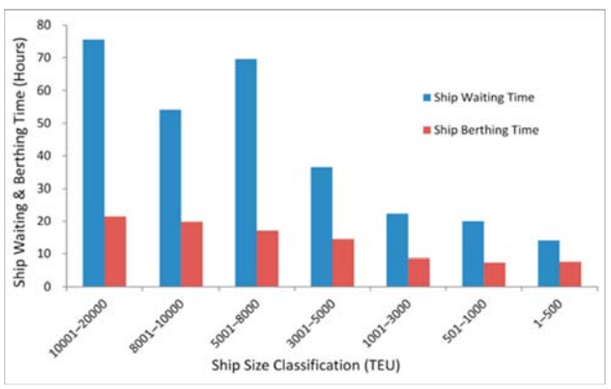


Fig. 8 – Average waiting time, berthing time, and port time based on ship size classification.[6]

6-3- Handling Cargo by Quay Cranes (QC): The third difficulty arises when the existing quay cranes limit the loading and unloading work of mega vessels. Through checking the outreach of a QC and the height of the crane, the limitation can generally be confirmed, Table 2.

Case	Ship Capacity (TEU)	Ship Breadth (m)	Ship Rows	Outreach (m)
1	20,000	59	23.0	67.7
2	21,000	60	24.0	69.0
3	22,000	62	24.0	70.4
4	23,000	63	25.0	71.7
5	24,000	64	25.0	73.0
6	25,000	66	26.0	74.3
7	26,000	67	26.0	75.7
8	27,000	68	27.0	77.0
9	28,000	70	27.0	78.3
10	29,000	71	28.0	79.7
11	30,000	72	28.0	81.0

Table 2 - Prediction of quey crane outreach by ship capacity, [6]

6-4-Yard Capacity and Yard Equipment: As megaships are calling at the port, the available stacking area and the number of handling equipment can be limited too. If a mega container ship of 22,500 TEU and 27,500 TEU calls at a terminal, the LPC (Lift per Cell) of an 8000 TEU will be loaded and unloaded simultaneously with a 31.2% load rate. The amount of LPC of megaships increases by more than 2 times those of 15,000 TEU ships as shown in Table 3. [6]

Ship Classification (TEU)	LPC (TEU)	Load Rate
25001–30000	8567	31.2%
20001–25000	8321	31.2%
10001–20000	3932	26.2%
8001–10000	3248	36.1%
5001–8000	2462	37.9%
3001–5000	2013	50.3%
1001–3000	639	32.0%
501–1000	338	33.8%
1–500	400	80.0%

Table 3 - The estimation of LPC (TEU), [6]

7- Mega ships trade routes

Megaships are being introduced into service between the Far East and North Europe, the world's largest route by volume, where potential economies of scale are greatest, but are having a cascade effect on other routes, figure 9.
Large ships that formerly travel regularly on Far East-North Europe route are being displaced into Trans-Pacific service, and

Fig. 10- World container ships main and alternative trade route.[9]

former Trans-Pacific carriers are moving to the Trans-Atlantic route.
The new generation of ultra-efficient megaships is credited with cutting the cost of shipping even further and lowering greenhouse gas emissions, figure 10. [9]
Cape route diversions also hit authorities and private investors who invested US$8 billion in a 35 kilometre second channel that was expected to increase canal traffic. Two years of declining oil prices have encouraged ship operators to re-evaluate the cost of the additional sea passage against the cost of canal transit. A 13,000-TEU ship, for example, adds 3,500 nautical miles and just over a week using the Cape route. That's a typical a bunker burn of $180,000 against typical canal fees of $350,000. The Suez Canal Authority is now offering a 30 per cent rebate on canal fees for ships from the North American Atlantic seaboard destined for Port Kelang, or other ports east of the Malay hub, figure 11. [11]

Table 11 -Gigantic container ships alternative shipping route from Asia to Europe), [11]

8- Container Vessel Market

8-1- Ordered

Orders for new vessels in the past four years have been reduced in density. Despite some notable exceptions, for the most part, carriers have stayed away from the yards, and have certainly avoided the rapid fleet expansion seen in the years up to 2015.
Carriers have been keen to point out that the orderbook is coming back into equilibrium, claiming that at around 10% of the existing fleet, growth in capacity will be manageable over the next few years. But figures from Lloyd's List Intelligence based on the long-term orderbook and including options for vessels not yet contracted, put the orderbook at 4.2m TEU, representing 18% of the existing fleet of 22.6m TEU, and figure 12. [10]

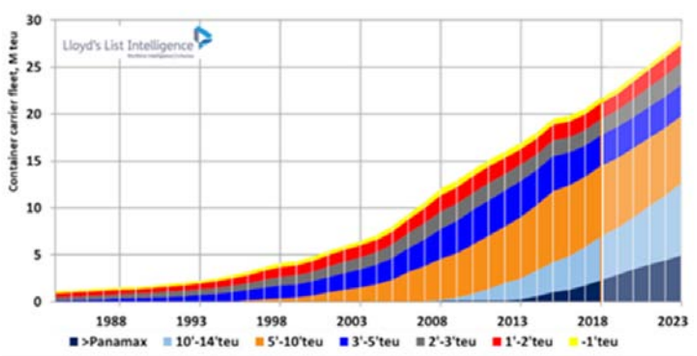


Table 12 -Container carrier fleet, m TEU, Dec 1919, [10]

New orders for container carriers are forecast to 155 vessels in 2019, a significant decrease compared to 2018 but new orders per year are to increase up to 230 vessels in 2023.
In total, 945 containerships are forecast to be ordered in 2019-2023, which is an increase of 110 over the previous five years. This corresponds to 7.4m TEU, an increase of 100,000 TEU.
In 2019 the deliveries of container carriers are forecast to 1.2m TEU or 178 vessels, a decrease of 14% compared to 2018. Total deliveries in 2019-2023 are forecast at 7.2m TEU, which is 10% more than in the previous five years. In the years to 2023, 1,086 boxships will be delivered, of which 371 will be larger than 10,000 TEU, figure 13. [10]

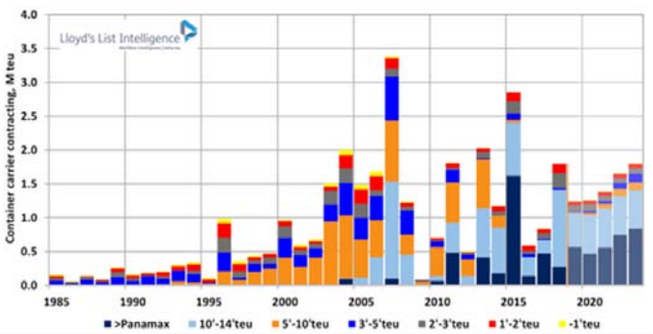


Table 13 - Container carriercontracting, m TEU, Dec 1919 [10]

Containership fleet expansion has been driven by the move to ever-larger tonnage as carriers seek more efficient vessels with lower slot costs. This can be seen in the orderbook as well, where capacity on order for vessels over 14,000 TEU represents 46% of the existing fleet.
The containership fleet capacity will reach 27.9m TEU by 2023, growing at 5.1% annually on average over the five-year period. [10]

8-2- Removed

Due to vessels lifecycle, 103 vessels in total of 201,000 TEU had been expected to be demolished in 2019, up 38% over 2018.
The forecast is for 1.1 m TEU of container capacity to be removed from the market in 2019-2023, which is 37% less than in the previous five years. In number of ships the removals will total 497 vessels, a decline of 186 ships compared to the past five years. Nearly half of the removed capacity will be in 5,000 teu-10,000 TEU segment. [10]

9- Innovation ideas for megaships

Based on the information presented in this study, the possible solutions that will be provided here are focused on the difficulties that the mega container ships might face in future.

- It is already known that the container handling of gantry

cranes is one of the major problems that ports are facing. The increased capacity of the gigantic ships means that more gantry cranes have to be used. This can create lots of problems since there might be a shortage of available port space. One of the solutions is Water Basin, the ship enters inside this basin and cranes from both side s of the ship can operate simultaneously. Thus, a faster container handling rate can be achieved.

- The Floating Container Terminal might be a very good solution if countries want to build a port from scratch, it might be more cost effective compared with a dredging and depth maintenance alternative. A further advantage of floating terminal is that it is flexible in moving around the globe whenever is needed.

- Going through the latest designs of mega container ships, the possibility of changing the position of the engine room or production system might be able to happen for maximizing the payload area and probably increasing a lot of the TEU capacity. Use of Diesel electric generators concept with padded propellers offer smaller engine room that can be placed at free and more congested space. In this way the transmission of power from the main engine to the propellers is achieved by using electric wires and not shaft which itself is space saving. [12]

- Ship automation is the foundation for autonomous containerships. Automation requires a large number of electrical and electronic elements for ship navigation, oceanic meteorology, telecommunication, traffic control, electronic nautical charts, and interconnected networks of on-board systems. A group of these electrical and electronic elements is called an ECU (electronic control unit).
Future autonomous container ships would communicates with a satellite for navigation and collects shipping information via ECUs as well as electronic sensors. Shipping information, including weather conditions, service speed, ballast water level, fuel consumption, longitudinal strength of the hull, equipment conditions, and machinery vibration frequency, will gradually be generated from gigabytes to hundreds of zettabytes; this becomes big data that enables AI-based (artificial intelligence) autonomous shipping. [13]

Conclusion

Innovation in container ships dimension in recent years have brought many difficulties to the biggest ports and containers terminal in the world. The most important among all is depth, Mega container vessels entry to the ports and terminals are actually limited by their capacity.

Ship's length and width are other issues that generate tension on terminal operation to and from the port and delay time for container handling. As the outreach of gantry cranes in most of container terminals have been less than 70.4 m, they can handle container ships smaller than 22000 TEU. Therefore, even if the ports capacity is enough to accommodate them, the problem would arise due unequal distribution of containers and arrival of new ships creates large peaks. To reduce ultra – large container ships waiting time in an efficient manner, a terminal should prepare distinguished berthing plan based on size and capacity, berthing time, and container operation preferences. Docking of ships in only major ports increases the ports occupancy rate in terminals. If these ships are obliged to call few ports on many strategic routes, such as the Asia-Europe route; so what happens to other countries external trades.

By studying cost per units, it seems the development of container ship sizes has reached a level that does not bring any benefit to the container lines any more.

At the present the biggest ship is MSC Gulsun which is 23,756 TEU, but a 30,000 TEU and 50000 TEU mega ships are predicted to appear in the shipbuilding market respectively in 2025 and 2050.

The solution proposed seem to give a lot of options of how to tackle all the problems relating to mega ship design evolution and port terminal adaption. From technical point of view everything is possible, but from the economic point of view the situation seems to be quite complicate.

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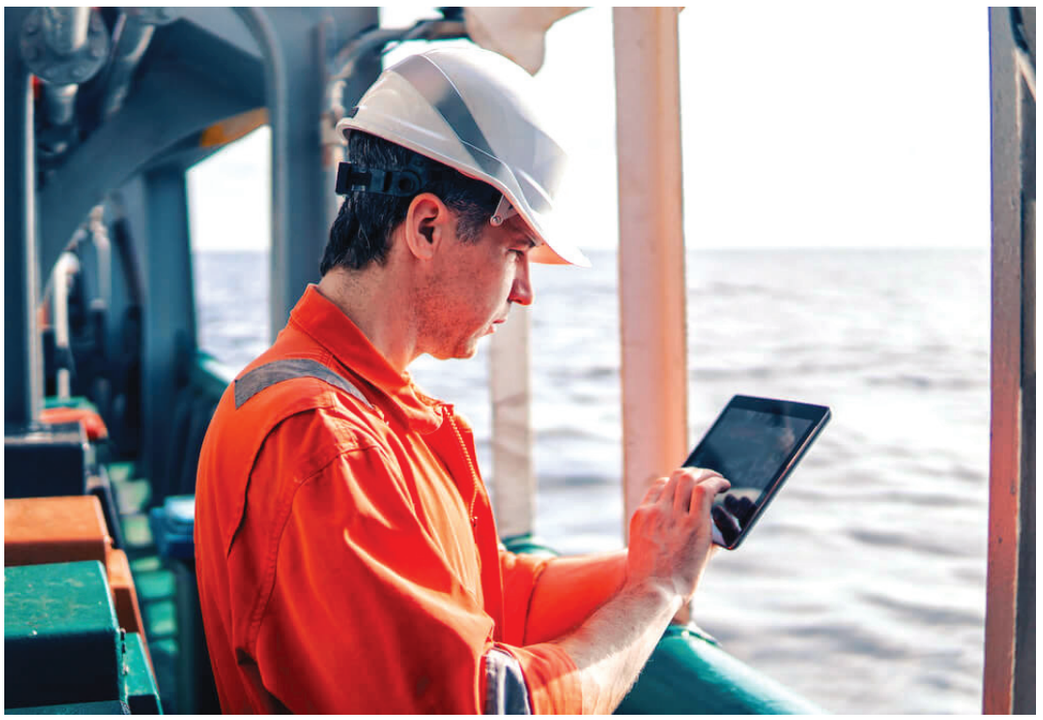
Warning: Digitalisation will change your business



An overlooked consequence of the digital revolution in maritime is that executives will need to have advanced technological skills as well as business acumen. And they will likely be much younger.

Wärtsilä's changed organisational structure is just the latest sign that businesses in the future are unlikely to look like businesses in the past. That could be painful for shipping.

WÄRTSILÄ's decision to change its organisational structure (again) will probably not make many headlines in another week dominated by coronavirus.

Essentially, the Marine business is to be divided into three independent segments focused on propulsion systems, exhaust treatment and electrical systems, and navigational and voyage solutions. Each segment gets a president and responsibility for linking with customers much faster.

Wärtsilä's expansion through acquisition had become unwieldy. Its own middle managers were confused, so its customers must have struggled to reach out to the right person. But that's not a problem faced by this company alone.

Since we started to talk about Industrial Revolution 4.0 it has been clear that the 'traditional' organisational structure was no longer agile enough. Hence the addition of chief technology officers and chief digital officers to what has become the C-suite. Not every company has appointed a CTO, some have added responsibility for digital solutions onto an existing, already overworked, team.

Nor is this redefining of organisation structure limited to technology-focused businesses. Even class societies, those bastions of stability, are rethinking their structure as they move away from testing and verification towards partnerships in drone technology and cyber excellence.

Shipping is often, and often accurately, accused of being conservative, slow to change, even resistant to transformation. But digitalisation has had the effect of cascading decision-making from the end-of-career sixty-somethings in senior management to tech-savvy forty-somethings whose rapid ascent up the managerial ladder – aided by a decent executive MBA – has been unprecedented.

So the top of the executive pyramid will in future no longer celebrate seniority but merit, especially technological skills and vision. While this is good news for the industry and for the high achievers, there are inherent dangers, which must be recognised early on.

The first of these dangers is that digital technology is advancing so rapidly that skills learned over the past five years will be swiftly superseded: in five years' time those same skills will be obsolete. Executives will need to keep on upgrading their skills at the same time as they are tasked with keeping the organisation moving forward.

The second danger is that a business run by technocrats will need to focus their acquisition strategy on how they can maintain a flow of technologically-gifted executives. It takes too long to train up executives; the better option is to buy a company run by executives with the required skills.

The first danger is that executives will have a very short window of opportunity, the second is that companies will become targets based on those executives.

But the third danger, the one to fear most, is that the focus on technology will run faster than the maritime industry's ability to keep up.

Not all employees — even those in their twenties — are tech-savvy. A company encompasses a broad range of skills. Managers have specific responsibilities, which might or might not include leadership. And the essence of leadership is the ability to absorb and distil past experience to set the vision for the future.

ABB and DNV GL make history with first vessel cybersecurity verification

In a milestone for the marine industry, ABB's solutions onboard a large passenger ship have been awarded cybersecurity verification from classification society DNV GL.

As a result, this vessel became the industry's first to achieve system compliance under DNV GL's framework for integrated cybersecurity.

The state-of-the-art cybersecurity resilience for the vessel was enabled by close collaboration of ABB, the shipowner and DNV GL during the construction phase at a shipyard in Europe. Cybersecurity management processes will continue during the ship's operations, with the system's resilience maintained throughout the lifetime of the vessel.

"It is vital that the maritime industry focuses on cybersecurity as an essential part of both design and operation," said Johann Melsted, area manager Benelux & France for DNV GL. "Which is why we are so pleased to be working with forward looking partners, who are prepared to engage with this emerging risk and demonstrate their commitment to tackling cyber threats."

In order to achieve sustainable shipping, vessels are increasingly fitted with integrated automation systems and digital solutions. As part of the Fourth Industrial Revolution, the vessel's systems are more connected than ever before, presenting threat vectors previously unheard of in shipping. This is driving the need for closer and earlier collaboration on cybersecurity between all key stakeholders in the newbuilding process. DNV GL's Integrated Cyber Security Dependent Systems verification establishes a framework to address cybersecurity levels for the main functions of a vessel – both during construction and in operation.

While the framework is applicable to any vessel, greater sophistication and deeper integration of operational technology systems in complex vessels such as cruise ships mean that appropriate cybersecurity management is paramount. While digitalisation offers opportunities to measure and manage efficiencies across the entire fleet, securing these data streams is critical to the safety of the vessels' passengers and crew.

"ABB recognises the importance of cybersecurity in the marine industry and is working closely with shipowners, yards and classification societies to enhance cyber resilience of ships," said Juha Koskela, managing director, ABB Marine & Ports. "As vessels become more electric, digital and connected than ever before, it is of vital importance that we equip and empower seafarers with reliable solutions that are cyber secure."

The vessel is powered by ABB Azipod electric propulsion system.

IMO, WHO issue joint statement on coronavirus Outbreak

The World Health Organization (WHO) and the International Maritime Organization (IMO) have joined forces to issue a joint- statement in response to the challenges faced by the shipping industry during this coronavirus outbreak.

The WHO and IMO have now issued a joint-statement to call upon member government states to respect the requirements of "free pratique" for ships under the International Health Regulations (IHR 2005, article 28).

The statement reiterates the principles of proper care for all travelers and avoiding unnecessary restrictions or delay on port entry for ships and crew as embodied in the relevant IHR and IMO regulations.

This statement also reminds all relevant stakeholders to co-operate during this coronavirus outbreak so as to minimise unnecessary interference to international maritime traffic and trade.

Namely, based on recommendations made by the WHO, IMO has issued the Circular Letter No. 42.4 of 31 January 2020 to provide information and guidance on the precautions to be taken to minimize risk to seafarers, passengers and others on board ships from Covid-19.

Following the advice of the Emergency Committee, the WHO Director General did not recommend any travel or trade restriction. Countries are stepping up their efforts in line with WHO's recommendations for preparedness and response to this public health risk.

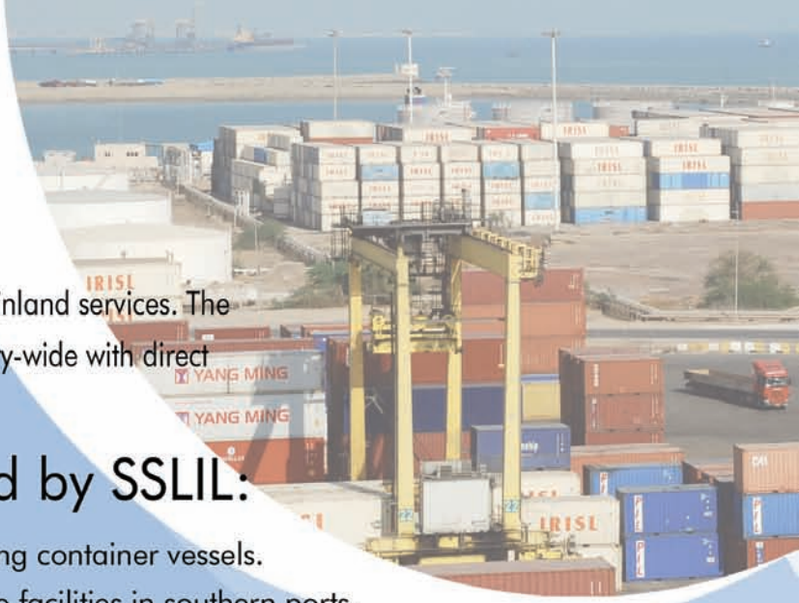
At the same time, additional measures are being adopted by countries, ranging from delayed port clearance or refusal of entry, which may cause severe disruption in international maritime traffic, in particular affecting ships, their crews, passengers and cargo, the statement says.

WHO is working in close collaboration with the IMO and other partners to assist States in ensuring that health measures be implemented in ways that minimize unnecessary interference with international traffic and trade

In this connection, WHO and the IMO, call upon all States to respect the requirements of ''free pratique'' for ships and the principles of proper care for all travelers and the prevention of unnecessary delays to ships and to persons and property on board, while recognizing the need to prevent the introduction or spread of the disease.

What is more, IHR States Parties have committed to providing a public health response to the international spread of disease ''in ways that commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.''

Accordingly, measures interfering with international maritime traffic are subject to provisions of the IHR (2005), including the specific requirements set out in Article 43. Furthermore, it is essential that States Parties implement the IHR with full respect for the dignity, human rights, and fundamental freedoms of everyone.



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In New Year, Our Thoughts Turn Gratefully to Those Who Have Made Our Progress Possible, and in This Spirit We Sincerely Say Thank You and Best Wishes for The Happy New Iranian’ s Year