STUDY BY NORDIC WEST OFFICE

UNLEASH OUR CITIES

A study of maritime transformation as an urban necessity

About this study

This study has been conducted by Nordic West Office, a global affairs consultancy and think tank based in Helsinki, Stockholm, Brussels and Washington DC. Nordic West Office runs the SEA20 initiative, which is a network of the world's most influential and prominent maritime cities. SEA20 is made possible by Wärtsilä, a global leader in smart technologies and complete lifecycle solutions for the maritime and energy markets.

The objective of this study is to assess the key challenges confronting the modern maritime ecosystem from the point of view of sustainability, competitiveness and people. The study also assesses how these challenges could be overcome through cooperation between three key players: cities, the maritime industry and ports. The analysis is based on previous literature, 21 in-depth expert interviews of key actors within the maritime ecosystem, and the outcome of a *High-Level Meeting* that gathered politicians, maritime industry representatives, and experts in Helsinki in June 2019. The analysis is also based on a web-based survey, comprised of 32 responses that represent major companies and academic institutions as well as other public and private institutions. We would like to thank everyone who contributed to the study and provided their valuable insight.

Abstract

This study investigates how maritime cities and their citizens can establish a new relationship with their environment. With the objective of creating a smart, sustainable maritime ecosystem, and finding out what exactly is keeping us from achieving it, compiling this study has involved conducting in-depth interviews, developing a web survey, engaging experts in a high-level meeting and carrying out a broad background analysis. The investigation has examined a range of maritime stakeholders. Their ranks are bound to grow further as climate change and global tensions focus more minds on the maritime industry. In fact, another objective of this study, and of the SEA20 initiative to which it belongs, is to open up maritime issues to a wider audience. This way, for example, the current topics of congestion or pollution – i.e. inefficiencies withholding the maritime system's actual potential – can be placed into a broader framework.

The analysis focuses on three key players present in all maritime settings, (i) cities (and their citizens), (ii) the maritime industry and (iii) ports[1]. A key finding is that a sustainable and smart maritime ecosystem must harness all three to be successful. In this spirit, the study assesses key challenges confronting the modern maritime ecosystem from the point of view of sustainability, competitiveness and people. Some of the challenges are more specific, and often technical in nature, while others are systemic ones which require the participation of the full maritime ecosystem. To make matters more complicated, solving the systemic challenges is key to finding ideal solutions to more specific challenges.

In the end, for a transition into a sustainable maritime future to happen, cities have an essential role to play, especially as they build momentum and increasingly work together to set standards and tackle the most critical challenges our planet now faces. These issues are some of the defining ones of our era: What will the future of globalisation look like? How will climate change alter our cities? In an era of 'global leadership vacuum', networks of cities – in cooperation with industry and other stakeholders – should lead the way. In that spirit, this study borrows at least as much from urban, social and global studies as from approaches that would fit within the more restricted boundaries of marine or environmental science. Another key finding is that the sea must become a subject of interest for us all, if we are to shape a future in which we can all thrive.

[1] However, it is acknowledged that the list of actors is broader than the scope of this study, including regulators and other actors, such as consultancies, maritime legal services, coalitions and clusters, NGOs, shipping and port employee trade unions.

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01.

Introduction

01. Introduction

Is there anything more defining for a city by the shore, than its relationship with the sea? Many of the challenges modern cities are facing today, could be solved by the sea. The purpose of this study is to assess the key challenges confronting the modern maritime ecosystem from the point of view of sustainability, competitiveness and people, and how these challenges could be overcome through cooperation between three key players: cities, the maritime industry and ports.

As urbanisation continues to accelerate, the weight of cities in the world increases, which creates both challenges and opportunities. Growing cities around the globe demand more and more supplies, placing increasing demands on logistics. At the same time, citizens, city dwellers are more conscious about environmental issues such as air quality and climate change. This also affects supply chains and logistics, which have a growing influence on the global carbon footprint. The combination of these circumstances will make the development of sustainable infrastructure – doing away with the inefficiencies inherent to existing models – a priority for city leadership.

Growing cities must also battle with land usage. What land, and how much of it, is allocated to ports, airports, logistics terminals and other uses besides living? And, on the other hand, what and how much is reserved for recreation and living areas? The maritime sector's impact on city planning cannot be overlooked or left to evolve naturally – a unity of purpose must drive how the cities of the future accommodate their sea-front partners.

For cities with ports, climate change is an even more elevated issue. While climate change will impact many people on the planet, those living in coastal areas will be on the frontline. The United Nations Intergovernmental Panel on Climate Change (IPCC) report estimates that "360 million urban residents live in coastal areas less than 10 meters above sea level and are vulnerable to flooding and storm surges[2]." Even more worryingly, 15 of the world's 20 megacities are at risk due to rising sea levels[3]. In fact, the IPCC has predicted "a rise in average sea level over the next 100 years ranging between 13 to 28 centimeters in a low scenario and 26 to 59 centimeters for a high scenario[4]."

The challenges faced by the maritime sector are partially the same as those faced by cities. Urbanisation raises shipping demands in cities. The cargo volumes that cities can receive depend heavily on port infrastructure, how efficient port operations are and the efficiency of communication between different actors at all stages of the journey. On the other hand, the maritime industry is being called upon to do its part in the fight against climate change and emissions. As a concrete example, sulphur content in fuels is being limited by IMO (The International Maritime Organization, United Nations system's regulatory agency for the maritime sector) to 0.5% globally from the current general limit of 3.5%. The share of emissions from shipping is also expected to rise during the coming decades, which places pressure on other climate actions. As ships and their propulsion technologies are advancing, investment decisions for shipowners become harder. Will the 20 to 30-year investment in a ship still use traditional fuels for propulsion or should shipowners go for something greener and more sustainable, for instance Liquefied Natural Gas (LNG) or, in the future, perhaps hydrogen, fuel cells or biofuels? Will the required infrastructure exist at ports? Another factor is advancement of technology and digitalisation, which result in improved efficiency. Digitalisation requires data, which poses new questions: how should data be used – should it be shared or kept only for internal use? These are some of the questions that are relevant for the industry faced with a changing world.

As around 90% of the world's trade is carried by sea[5], the question of how maritime cities and maritime actors can solve the problems they face together is of utmost importance. Solving these challenges will not happen overnight, but they can become easier to tackle by adopting a holistic approach, in which cities and ports, different sectors involved in maritime activities, the users of logistics services and the inhabitants of cities share the same goals. Solving or at least easing data-usage problems, cutting down current pollution levels and combatting climate change are in the interest of the entire maritime ecosystem. The gains will not only be environmental but also financial and social. All these aspects will be elaborated upon in the following sections of this study.

In the ideal scenario, the maritime ecosystem would eliminate waste and inefficiencies by optimising the entire logistics chain, from the supplier to the end-customer, creating a win-win-situation for all parties. Energy efficiency can be subject to a similar process. Many of these technologies already exist to support this transformation – the key is the widespread adoption and standardisation of emerging technologies.

Cities have a lot at stake, as described above, and because their interests are tightly linked to those of the maritime industry, they could work as an important and trusted facilitator in this process, providing the industries with both platforms and support to make these changes desirable to all. As operating activities would enhance performance, this would also positively influence the environmental effects of shipping. Shared trust between all parties creates a situation in which shipowners are willing to make investments and get to the frontline of global technological advances.

[2] Satterthwaite and Moser (2008)
[3] "World Bank. 2010. Cities and Climate Change: An Urgent Agenda. Urban development series; knowledge papers no. 10. Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/17381
[4] IPCC (2007)
[5] IMO: http://www.imo.org/en/OurWork/Environment/Pages/Default.aspx

“Change requires a shared willingness to do things better. This prevents friction with all parties and angles. More concretely, this means more intensive cooperation within the entire logistics chain. The private sector does not mean simply the marine industry, but the entire value chain – and, of course, ports and cities need to be involved.”

TIINA TUURNALA
CEO, Finnish Shipowners’ Association & Chairman,
Finnish Maritime Cluster

“Brexit and other upheavals do not matter; maritime cities and the industry will fix things regardless. Let’s blaze ahead.”

JACQUES VERRAES
Legal Counsel, EU Scientific Advice Mechanism, European Commission
Directorate General for Research and Innovation

“Lowering costs, removing inefficiencies and reducing emissions will benefit all parties – vessels and ports, and the cities and their citizens. Together we can make a significant environmental impact with even small changes. The reason this hasn’t happened yet is because of the various separate silos present in the diverse ecosystem that need to be broken down. Ultimately, the aim is to enable a sustainable future that we can all be proud of – together.”

ROGER HOLM
President Marine & Executive Vice President, Wärtsilä

It is evident that the challenge of a more efficient, ecologically sound and digitally connected future exists on many levels. Some of the solutions are purely technical in nature and others intersect with the superstructures of global trade. As such, there seem to be two main categories into which the solutions and challenges can be divided: specific and systemic.

1) Specific challenges that need to be tackled, such as the reduction of CO_2 emissions to prevent further global warming.
2) Challenges that need to be addressed before concrete solutions can be implemented. For example, global regulation or cooperation between different stakeholders must be increased to streamline infrastructure. These can be called systemic challenges.

It is also evident that what happens at sea and in ports has profound implications on our lives in cities. While there are many challenges, there is much potential for a supremely efficient, ecologically sound, digitally connected and collaborative ecosystem. A modern, sustainable maritime ecosystem should be thriving towards economic, social and environmental sustainability, while limiting negative externalities.

Structurally, the study first identifies the different actors within the maritime ecosystem, before diving deeper into the challenges that these actors face. The key argument of this study is that the best way forward is to work together to conquer the change that is happening. In the end, to be successful, a sustainable and smart maritime ecosystem must harness three key players: cities and its citizens, industry, and ports.

02.

Modern maritime ecosystem – key players

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Modern maritime ecosystem – key players

In this section, the modern maritime ecosystem is defined by identifying its various stakeholders and highlighting the key actors. This study aims to form a holistic view of the modern maritime ecosystem by also examining operators outside the industry and ports. Many of the interviews conducted for this study highlighted the diversity of the actors involved, and that each community affected by the operations of the maritime ecosystem is an actor, with a voice to be heard.

Stakeholders identified during the making of this study include, but are not limited to, the following:

1) Maritime cities,
2) the maritime industry,
3) ports,
4) regulators and
5) other actors (including consultancies, maritime legal services, coalitions and clusters, NGOs, shipping and port employee trade unions)

The study acknowledges that the list is broader than the scope of this study. In this study, the diverse set of actors are divided into three key groups: 1) maritime cities, 2) the maritime industry and 3) ports.

1. MARITIME CITIES

On the city level, actors include city administration, officials, infrastructure providers, utility companies, inland transportation, maritime and port strategy officials and, lastly, its citizens. Maritime cities have various beneficial owners of carried freight and its end consumers, who create the demand for shipping or passenger travel in the first place. Cities also serve on the frontline of standard setting; in many cases, especially in Northern Europe, cities own their local ports.

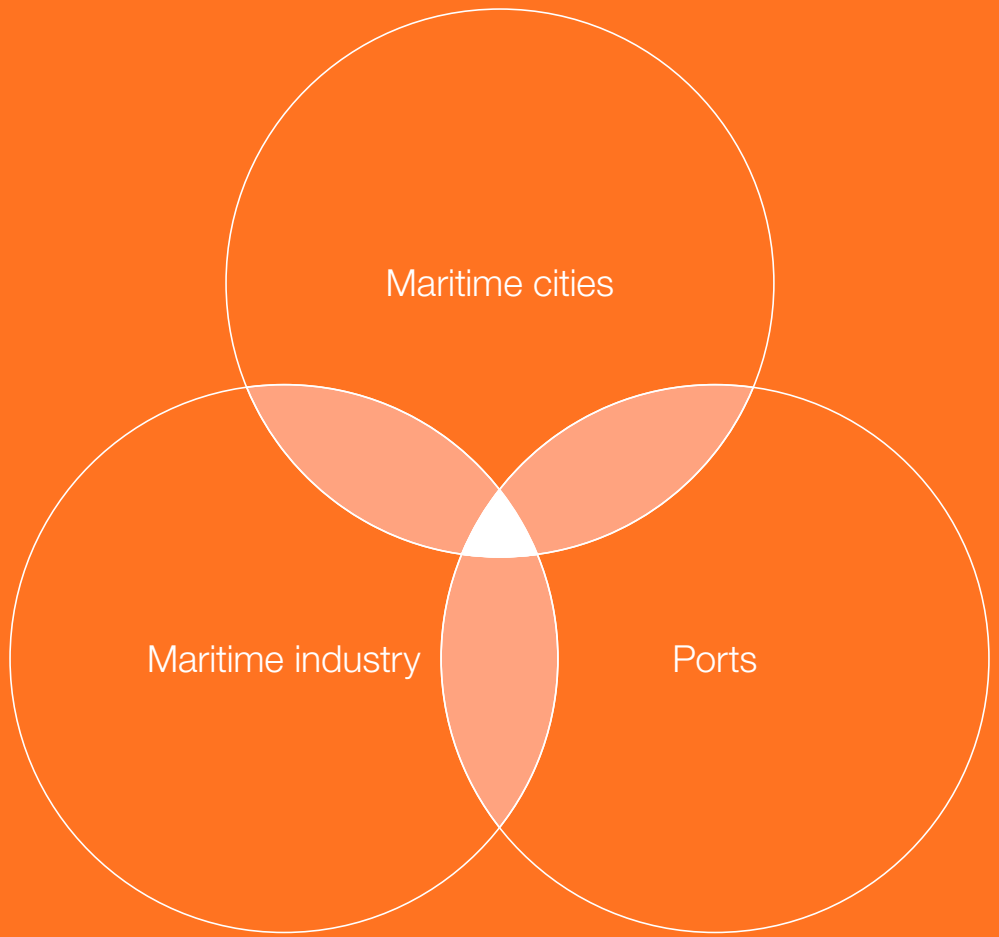
2. THE MARITIME INDUSTRY

The maritime industry holds a plethora of actors. Ships are sold, chartered and brokered. There are numerous capital investors specialised in investing in vessels, including private equity and funds dedicated to the maritime sector. The maritime industry encompasses shipping companies, cruise liners, logistics companies, with links to equipment suppliers, shipbuilders and many kinds of operators involved with constructing and servicing vessels. Each vessel operates under a management team which oversees the daily running of the ship, maintenance and operation. Shipping agencies take on the content of the ship and are often responsible for handling cargo or shipments. They operate on behalf of ship owners, managers or charterers.

3. PORTS

Ports are the main interface between the maritime industry, customers in the transport chain and cities. Ports are responsible for both day-to-day operations and ensuring competitiveness vis-à-vis other ports. Once the vessel reaches port, port operations include the handling of cargo, vessel maintenance and service, passenger operations, waste management, mooring and unmooring, as well as necessities such as selling portable water and electricity.

In addition to the key actors presented above, the importance of different regulators is recognised. National governments, as well as, for instance, the EU, are important financial enablers and regulators. One of the most important international actors in the maritime ecosystem is the IMO, the United Nations specialised agency responsible for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships.



MARITIME CITIES have various beneficial owners of carried freight and its end consumers, who create the demand for shipping or passenger travel in the first place. Cities also serve on the frontline of standard setting; in many cases, especially in Northern Europe, cities own their local ports.

THE MARITIME INDUSTRY encompasses shipping companies, cruise liners, logistics companies and many different kinds of operators that are involved in building and servicing vessels.

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03.

Modern maritime ecosystem – key challenges

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The purpose of this study is to assess key challenges confronting the modern maritime ecosystem from the point of view of sustainability, competitiveness and people. Under competitiveness, advancement of technology and the business case for making investments are discussed. Based on the analysis, it is evident that challenges exist on many levels that prevent us from creating a more efficient, ecologically sound and digitally connected future. It also seems that solutions depend greatly on the position and perspective of the respondent. As one of the interviewees underlined, and as several others echoed, the nature of the challenge depends entirely on its location in the value chain. While some of the solutions are specific, or purely technical in nature, others have to do with the superstructures of global trade or global governance. See Figure 1 as an illustration of the key challenges facing the modern maritime ecosystem.

As many of the challenges stretch through the entire ecosystem, they are overlapping and intertwined. The aim of this study is to identify the challenges relevant to the entire ecosystem and present them with supporting examples. While there are several concrete solutions and innovations already available that help in tackling some of these challenges, an in-depth description of technical solutions, for example, is outside the scope of this study. This study focuses more on understanding the relationships and causal connections between different stakeholders. That said, the following section goes through the key challenges and discusses some of the solutions on a general level. More in-depth analysis of the underlying solutions is presented in the Conclusions section.

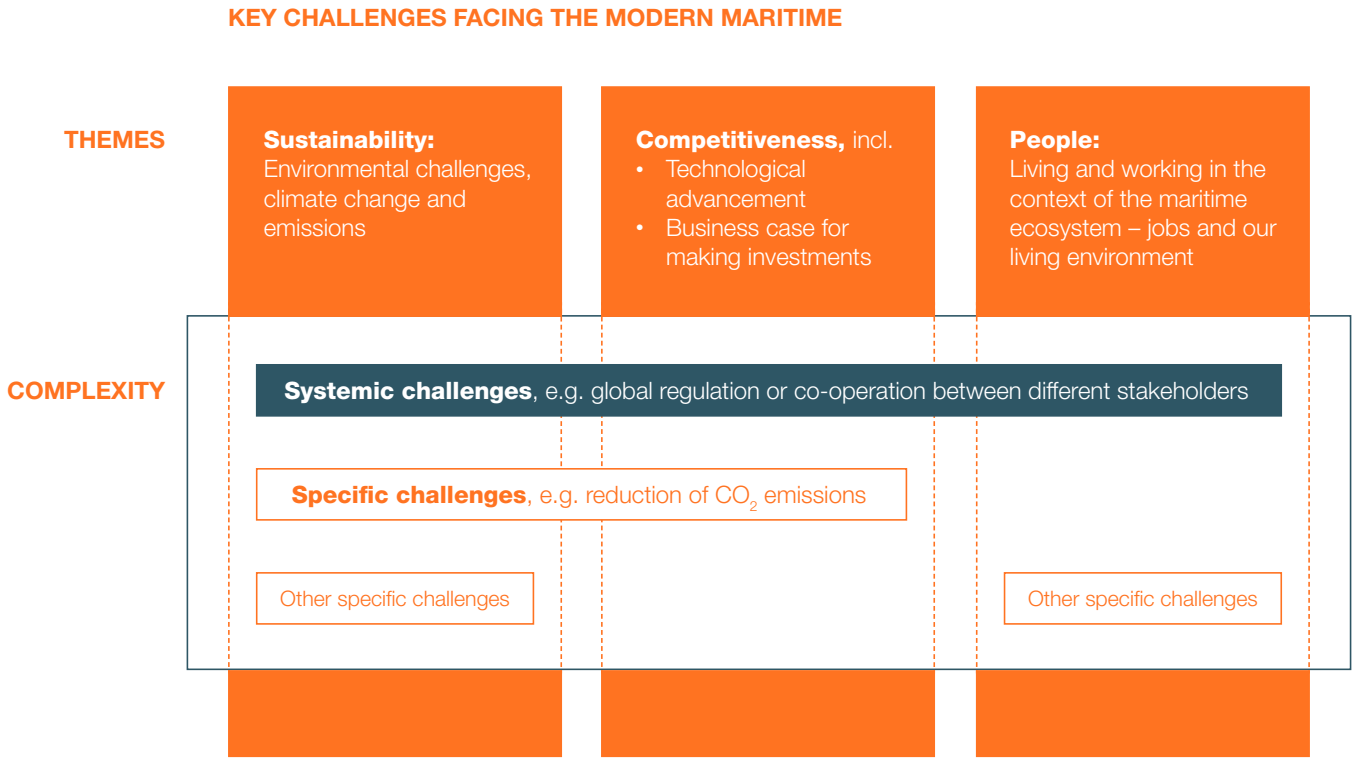

Figure 1: Key challenges facing the modern maritime ecosystem

“Pollution and emissions are connected. More polluted urban environments encourage forms of transportation that also emit more. Different environmental causes are linked to each other.”

ALINE CAVALCANTE
Founder, Coalição Clima e Mobilidade Ativa, São Paulo

“Efficiency and sustainability travel together.”

WILLIAM BURKE
Chief Maritime Officer, Carnival Corp

[6] UNCTAD Review of Maritime Transport 2018, p. 23
[7] ICCT (2017): GREENHOUSE GAS EMISSIONS FROM GLOBAL SHIPPING, 2013–2015, available at: https://theicct.org/sites/default/files/publications/Global-shipping-GHG-emissions-2013-2015_ICCT-Report_17102017_vF.pdf
[8] Zoe Schlanger (2018) Article by Quartz and the World Economic Forum, available at: https://www.weforum.org/agenda/2018/04/if-shipping-were-a-country-it-would-be-the-world-s-sixth-biggest-greenhouse-gas-emitter
[9] https://ec.europa.eu/clima/policies/transport/shipping_en

03.01 Sustainability: environmental challenges, climate change and emissions

Key megatrends facing the world and the maritime ecosystem include climate change and urbanisation. The combined forces of these two put tremendous pressure on maritime cities, ports and the maritime industry, which must prepare for rising sea levels, unforeseen storms, demographic changes and new infrastructure. Key environmental challenges include climate change adaptation and mitigation, emissions and regulation.

Around 90% of global trade is seaborne, which makes shipping the backbone of the global economy. While shipping is a more environmentally friendly industry than certain others, such as aviation or inland transport, there is plenty to improve when considering emission levels per tonne. Over 90,000 vessels sailed the world's seas in 2018[6]. As traffic on key shipping routes is increasing, more pollutants reach the air, especially sulphur dioxide, nitrogen oxides and particulate matter. In 2015 shipping was responsible for 2.6% of global CO_2 emissions[7]. This figure places shipping – if it were a country – in sixth[8] place on the list of greatest emitters, between Germany and Japan. According to the IMO, if business were to continue as usual, by 2050, the share of shipping emissions would increase to anywhere between 50% and 250%[9]. The current IMO target is to, at the very least, halve shipping-related CO_2 emissions by 2050, as compared to the level in 2008.

In the survey conducted for this study, about 70% of respondents believe that shipping will hit its CO_2 emission goal by 2050 and a further 20% think it is attainable by 2030 – a date often mentioned in connection with more ambitious objectives, for example, by the IPCC. This level of optimism demonstrates both the will for change, as well as the fact that there are already some viable alternatives for current engines burning HFO. Viable options include, among others, Liquefied Natural Gas (LNG), Liquefied Petrol Gas (LPG), various biofuels and methanol as a complementary or primary fuel, as well as advanced battery technology to reduce fuel consumption. There are also several emerging fuels that could make the propelling of ships more environmentally sound. These include, for instance, hydrogen, ammonia and synthetic LNG. In addition, the alternative fuels can be complemented with emerging technologies, such as wind and energy solutions, waste recovery and batteries.

Additional pressure towards changes in fuel types is also strongly promoted by international regulation. The global push towards environmentally friendly solutions places pressure on an industry that has, for a long time, relied on traditional fossil fuels, mainly so-called heavy fuel oil (HFO). HFO is a fuel that has both a high density and viscosity (it is not as fluid as diesel oil, for example, in colder temperatures) and is widely available, reasonably low in price and effective. These advantages come at the expense of environmental factors. In particular, the sulphur content of the fuel tends to be extremely high. Currently, shipping is responsible for some 12% of global sulphur emissions, which cause acid rain and respiratory diseases in port cities. However, as an example of the global push, a binding regulation by the IMO, effective as of

[10] IMO The 2020 sulphur limit FAQ, p. 5
[11] C40: "Staying afloat: The urban response to sea level rise. https://www.c40.org/other/the-future-we-don-t-want-staying-afloat-the-urban-response-to-sea-level-rise
[12] Jardas et al. (2018): "The Role of Internet of Things on the Development of Ports as a Holder in the Supply Chain", Pomorski zbornik 54 (2018), 61-73
[13] Richard Meyer (2019): Digital Ecosystem Transformation A Case Study of a Port Ecosystem. Master's Thesis.
[14] Ibid.

1 January 2020, will lower acceptable sulphur levels in shipping fuel from 3.5% to 0.5% globally. Some areas have even stricter regulations, as a 0.1% sulphur limit has been in force since 2015 in the Emission Control Areas (ECAs) of the Baltic Sea, the North Sea and coastal Canada and the United States, including the US Caribbean[10].

Several of the leading ports and pathways suffer from congestion. This lowers the effectiveness of shipping operations, as it is more difficult to plan timetables on congested routes and ports. So-called "just-in-time" (JIT) arrivals form the basis of all logistic operations, both on land and at sea, but arriving just in time in marine operations requires clear knowledge of timetables and good communications and planning between ports and ship operators. This communication should be continuous, as situations tend to change. For example, there may be logistical problems at the ports, while occasionally ships face harsh climates, which hinder their movement. If, for instance, a ship speeds during the voyage to make it into a port in time and is then forced to wait because of problems at port or some late arrivals, there are two negatives. The amount of fuel burned has increased because of the higher speed and engine usage during the voyage, and efficiency has been lost due to the wait. Such a situation is negative both financially and environmentally. The increased cost of logistics affects all participants in the value chain. Also, as many corporations demand punctual and fast deliveries of goods, the costs might also increase because of missed deadlines or missed holiday seasons due to postponed deliveries.

Rising sea levels, destructive hurricanes, droughts, crop failures, the formation of deadly smog, increased movement of 'climate refugees' and geopolitical discourse are some of the challenges that cities and ports are facing because of climate change. As *C40* points out, by 2050, over 570 low-lying coastal cities will face a projected sea-level rise of at least 0.5 metres. This puts over 800 million people at risk from the impacts of rising seas and storm surges. The global economic costs to cities, from rising seas and flooding, could amount to USD 1 trillion by mid-century. Local factors mean that cities will experience rising sea levels at a varying pace. Cities on the east coast of the United States, along with major cities in Asia, are particularly vulnerable. Sea level rises and flooding can impact essential services such as energy, transport, and health. New York in 2012, coastal floods impacted an estimated 90,000 buildings, two million people lost power, which caused extensive damage and disrupted commercial activity at a cost of over $19 billion[11].

03.02 Competitiveness

The purpose of this study is to assess key challenges confronting the modern maritime ecosystem from the point of view of sustainability, competitiveness and people. In this section, competitiveness is discussed with focus on the advancement of technology and the business case for making investments.

03.02.01 Technological advancement

Technological advancement represents great potential for the global maritime ecosystem and can have a positive impact on its competitiveness. For example, with the advancement of IT, it has become possible to prevent unforeseen breaks, increase efficiency and reduce maintenance costs[12]. According to Jardas et al (2018), "IT technology allows constant cargo monitoring (smart containers), the exact time of ship arrival at a port, handling automation at port terminals by using the Internet of Things, in a way that data are collected through various sensors in big data (humidity, temperature, location) where they serve for further processing. In case of unforeseen situations (bad weather, delays in port, damage to containers), intelligent devices provided with software components in themselves are able to diagnose a specific fault. Thus, responsible persons can immediately react and try to solve the problem."

In the context of the maritime ecosystem, digitalisation was the main topic raised by the interviewees. It can be defined as "the process of converting something into digital form[13]." It has resulted in an exponentially increasing amount of digitised data available with the advancement and emergence of mobile technology, the Internet of Things, social networks, and cloud computing[14].

Over 70% of the respondents of our survey agreed either partially or fully with the statement "the maritime sector is lagging behind in the development of digital systems, communication, sustainable standards and the harmonisation of the ecosystem." At the same time, more and more digital technology is being inserted into existing ships and especially newbuild vessels. This is important as more data on journeys provides higher efficiency, for instance, in planning routes and tracking cargo. For example, containers can go missing, and further data on when and where it happened can assist in the decision-making process that aims to lower the amount of damaged cargo. In terms of ports, the data can help with operations efficiency in handling the incoming cargo and planning for arrivals, among other things.


WINCH
ONLY

"Autonomous shipping is inevitable and will drastically alter the marine ecosystem."

PROF SONG KEE HON
Industrial Design Division, National University of Singapore

"A dream vision is that there is no waste and we have optimised processes and transparency in terms of cooperation and coordination. However, in reality, there is still mistrust and change resistance—something we can only change slowly and with the use of digital technologies"

CHRISTIAN ROELOFFS
Founder & CEO, xChange

"Where do the drivers for change come from? Digitisation is a market-driven process and the industry is in the driver's seat. Yet, international cooperation is needed, as being a smart port on your own will only get you so far. Broader trust is built through processes with initial deliberation that includes a wide range of participants. Then data can be increasingly shared and shared more harmoniously."

ANNALEENA MÄKILÄ
Vice Chair, European Port Organisation, CEO, Finnish Port Organisation

"There is a problem of trust in the maritime ecosystem, as different players have different benefits. The authorities look at issues from their point of view, the industry has its own angle and so on. But how to build trust? We need good policies and good regulation. They build trust and lead to more sharing of information and data between different players."

XIANGMING ZENG
Doctor of Engineering, Associate professor, Merchant Marine College,
Shanghai Maritime University

[15] DNV GL Position Paper: Standardization as an enabler of digitalisation in the maritime industry, 2017, p. 20

As digitalisation relies on data, the question is what to do with data? Should the data only be analysed and used by individual corporations to their advantage or could there be data sharing between parties? In fact, cooperation and sharing data within the industry has presented a dilemma, as data and knowledge of optimal ways of handling business form an integral part of operations. These capabilities could be further advanced with shared data between parties. However, as one of the interviewees pointed out, it is rather easy to push the narrative of benefits within the industry, but problems tend to arise when someone volunteers to bring it all together. Fears arise over the ownership of data, and about the way it is shared, and who reaps the benefits in the end. An opposing view from an interviewee stated that as the benefits of sharing data are getting more and more evident, the focus is shifting to finding ways of actually doing it, since there is limited standardisation on land and aboard vessels.

On the ships, the problems can be, for instance, that sensors and data recorders are not compatible, and no data is collected as a consequence. Or that the data collected is in a format that cannot be accessed by the systems that would use the data[15]. Thus, even if there is potential for more data usage, the standardisation problems can stand in the way. In ports, similar problems persist and even the terminology used can vary widely.

As standardisation is an agreed, documented, repeatable and generally accepted way of doing things, it means that someone will have to be the party to bring things together. For example, if every shipping corporation and crane manufacturer decides that their ICT (Information and Communication Technology) unit will create their platforms for themselves, there is no standard. Thus, there are also no benefits from competing

[16] DNV GL Energy Transition Outlook, 2019, p. 44
[17] DNV GL Energy Transition Outlook, 2019, p. 28

suppliers, no guarantees that systems work together and no benefits from earlier experiences with the standardised product. The wheel has to be reinvented for every new project. This decreases efficiency, increases costs and hinders the adoption of new technologies.

Land usage in ports is a related issue. Ports in big cities tend to be located in areas that could be lucrative for other real estate development and as cities are growing globally, the conflict between these interests in land allocation is one partial cause of the aforementioned problems with congestion both at sea and inland. Space for cargo handling and ships is limited and thus operations have to be efficient. The answer to efficiency and thus reduction of congestion could lie within standardised digital platforms, which were called for by several interviewees.

There are technology providers that are constantly seeking new ways to further improve efficiency, sustainability and safety in the maritime industry by addressing inefficiencies at ecosystem level, which means in the interaction between the vessel and its surrounding environment. For example, a solution has been developed to enable streamlined and efficient ship-to-shore information sharing for just-in-time arrival. The RTA, or recommended time of arrival, is generated by the port and sent directly to the vessel navigation system through a standardised data-exchange platform. The captain can accept or reject it. Depending on the specific governance of the ship operator, the RTA can be approved also by the Fleet Operating Centre onshore. When the RTA is accepted by the captain, ship and route are automatically adjusted to arrive just-in-time at the destination port. The voyage is optimised to achieve the highest possible safety and efficiency levels also based on other environmental factors, like weather conditions, sea state, currents, traffic schemes, and so on. The ETA, or estimated time of arrival, is shared in real-time with the destination port. The information comes straight from the navigation system, so it is 100% accurate and enables the terminal to properly plan the workload. This system is being deployed at the port of Hamburg in collaboration with HVCC, the Hamburg Vessel Coordination Centre, to optimise the traffic flow in the Elbe river.

03.02.02 The business case for making investments

The maritime industry is to a very large extent driven by economics and legislation. Compliance at lowest cost is the name of the game here, but there still is a disconnect between yards, owners and charterers which all still strive for sub-optimisation and not overall lowest systemic cost. Investing in new ships and systems brings about additional risks and investment requirements, especially for the first movers. Cleaner vessels, with added systems to reduce emissions, are simply more CAPEX intensive and bring added complications for the shipyards. Ship owners then need to earn back the added investment, either through a reduction in fuel costs or by improved day rates. Today there are very few incentives in the whole maritime ecosystem that drive cleaner solutions forward. For instance, an LNG-powered newbuild ship is more expensive than a counterpart using traditional liquid fuels. The fuel tanks usually demand two to three times the volume needed with traditional fuels for the same vessel range[16]. For other future fuels such as ammonia or even hydrogen, that number grows to a factor of between four and even above ten. Depending on vessel type, such large tank space requirements can drastically cut into the vessel transport performance and profitability, again necessitating the whole value chain to come together and jointly optimise for lowest overall cost instead of sub-optimisations. For LNG, the deficit in infrastructure and bunkering facilities is rapidly fading as its applications mature. Any new alternative fuel introduced to the market will need to go through a lengthy experience and rule-building phase. This is to ensure the fuel can be used onboard responsibly and safely. Previous fuel transitions in the industry (from wind to coal and subsequently to oil and now to LNG) have taken multiple decades because of this.

Thus, the ships nowadays use predominantly traditional fossil fuels. According to DNV GL, these ships account for 99.7% of the global fleet as of 2019. The order books for new ships as of 2018 show that 93.95% of the ships on order will also use traditional fuels. The most prominent alternative fuel for ships currently is LNG, which roughly makes up all the alternative fuel ships today, as well as in the order books. Some methanol, hydrogen and liquefied petrol gas (LPG) ships are also expected to enter service in the coming years[17]. It could be said that change is already happening, albeit slowly. Why is the change so slow?

One reason is that there are few incentives for change. There are several corporations and institutions along with private investors that offer ship financing. Usually, the defining parameter is the return on investment (ROI), which might look very different for a ship that is equipped with environmentally friendly solutions and a similar ship that is not as environmentally sound. In this comparison, the more environmentally sustainable solutions have traditionally lost, but the tide is slowly turning as with LNG, the life-cycle costs of new LNG powered ships are already often lower than the life-cycle costs of ships using traditional fuels. The existing solutions include LNG, LPG, hydrogen, methanol and biofuel powered ships. Battery technology could also play a part in some solutions and fuel cells could be a feasible technology in the future. The problem in the wide adaptation of these fuels stems mainly from supply chain issues, availability and fuel prices.

Liquefied Natural Gas (LNG) is the most widely adapted, cheapest and efficient alternative fuel that can also compete with traditional fuels. Even so, LNG still faces a shortage in bunkering possibilities globally and a large share of the bunkering and LNG distribution to bunkering facilities is still done by trucks. The number of LNG bunker vessels, meaning vessels that can supply LNG, is however increasing steadily as is the overall amount of infrastructure. LNG has been cheaper than crude oil and HFO during the last 10 years. As high-sulphur HFO will not be permitted in the future due to the 0.5% sulphur cap, the competitiveness of LNG will increase.

Liquefied Petrol Gas (LPG) is another potential fuel for which there is already a good network of import and export terminals, and it is relatively easy to add bunkering options. This requires cooperation with cities and ports as they tend to issue permits for these additions. As with LNG, LPG can also be supplied in different ways, for instance by road, by rail or by other ships. LPG is likely the second most competitive alternative fuel, now being cheaper than crude oil but more expensive than LNG.

Methanol is supplied to ships either via other ships or by trucks. Methanol can be produced from a wide variety of feedstock resources, including natural gas and coal as well as renewable sources, such as agricultural waste or black liquor from pulp and paper mills. Methanol is currently more expensive than HFO and MGO and as it is often distilled from natural gas, its price tends to be related to fluctuations in gas prices.

Biofuels is a category of different energy carriers that are produced by converting primary biomass or its residues into gases or liquid fuels. The most promising of such fuels are the hydrotreated vegetable oil (HVO), fatty acid methyl ester (FAME) and liquefied biogas (LBG). HVO can, to some degree, utilise existing infrastructure for MGO and HFO. LBG can in some cases take advantage of the infrastructure for LNG. The most challenging of the three is FAME, which is hard to use with the pre-existing infrastructure, or with infrastructure that is under development. As biofuels are still somewhat in their infancy, their prices are higher than those of traditional fuels (HFO and MGO).

Hydrogen can be produced from a variety of sources, which include electrolysis of renewables and by reforming natural gas. There is currently no infrastructure for hydrogen-powered ships as there is currently no demand for it. With available electrical energy on land, hydrogen could be produced from water through electrolysis to allow ports to produce their own fuel with no extensive infrastructure. In liquid form, liquid hydrogen (LH) could use the infrastructure set up for LNG. Hydrogen's price is pegged to natural gas prices and the price of electricity. Currently, the price is significantly higher than the price of traditional fuels, but technological advancements will likely lead to a price drop.

From hydrogen it is possible to produce **ammonia**, a compound of nitrogen and hydrogen, which could also be used as a fuel for ships. The main benefit of ammonia over hydrogen would be the ease of storage as ammonia liquefies in -33 °C whereas hydrogen liquefies at -253 °C[18].

Batteries and hybrid powerplants transform the way energy is used onboard. Electricity is easier to control and optimise, which leads to efficiency gains. The prices for battery systems are dropping rapidly. Currently, fully electric ships are limited to some special applications, such as ferries. The feasibility of larger utilisation in, for instance, bulk carriers, is mostly hindered by the size of the required battery system or the overall cost of the system. Nevertheless, the already existing battery technologies could be used as supplements.

Fuel cells are electrochemical cells that convert the chemical energy of a fuel into energy by electrochemical oxidation. Possible fuels include hydrogen, carbon monoxide, methanol and methane. Currently, the merchant marine applications of fuel cells are still only small scale (<1MW) prototypes, but there are plans to scale this up for demonstrations over 1MW in the coming years. Fuel cells for marine applications are not yet in mass production. The technology also still lacks infrastructure, such as service network.

[18] Cedric Philibert, 2017, IEA: Producing ammonia and fertilizers: new opportunities from fertilizers

“Cities can create a market for more sustainable solutions by regulating and setting standards. Clarity, uniformity across cities and measurability of these standards will help drive implementation. In all of this, finding common ground between parties concerned is key.”

JESSICA ÖBERG
Head of Business Area Industrial Product & Services, Saab

“Previously, sustainability has been seen as a cost, not an investment, and that is changing.”

TAKA TSUJI
Vice President, Corporate Finance Department, Division 2,
Development Bank of Japan

[19] Port of Rotterdam, General terms and conditions including port tariffs, p.26
[20] https://www.pwc.com/gx/en/mining/publications/assets/pwc-lng-progression-canada.pdf
[21] https://lng-wilhelmshaven.com/en/
[22] https://www.hellenicshippingnews.com/korean-shipbuilders-have-a-growing-lng-tanker-order-backlog/

We should cherish and protect the industries' first movers. Incentives could be derived, for instance, from green bonds that have good terms regarding investments that aim to advance the reduction of greenhouse gas (GHG). Many of the investments and decisions required for the usage of alternative fuels demand permits, that are usually given by ports and cities. Ports and cities could also promote the change by giving preferential treatment to greener ships. In practice, this could mean lower port tariffs and shorter docking queues. For instance, the Port of Rotterdam already has a discount scheme for environmental ships as well as a Green Award Discount[19]. On a national level, tax breaks and subsidies could also work. Small regulatory changes may also be helpful, but stronger changes can have severe and unintended consequences in terms of shipping volumes and supply lines. But what is really needed is coordinated, global action. Here, ports and cities can play a vital role to speed up this process in the IMO.

As stated above, the transition is also hindered by the lack of infrastructure. In terms of the most adopted alternative fuel, LNG, the completion times of major greenfield (no previous infrastructure exists at the build site) LNG export terminal projects can well take 10 years, from inception to first gas deliveries. The process includes the feasibility studies, Front End Engineering Design (FEED) which includes, for instance, permits, location studies, financial studies, etc., and finally the construction phase[20]. The story is similar on the import side. As an example, the current German LNG Terminal Project, Wilhelmshaven, was first studied by the German corporation E.ON in 2005, but the corporation opted out of the project in 2008. The interest in the project was renewed between 2014–2015 and, currently, the project is set to be completed during the second half of 2022[21]. In terms of LNG carrier ships, which could improve the LNG infrastructure in shipping significantly, the build times are typically around 2.5 years[22].

The change also demands commitment from customers. As one interviewee noted, “putting together a broad range of stakeholders has been one of the biggest challenges of the strategy work.” In the end, it is not possible for the shipping corporations to bear all the expenses and responsibilities themselves, but there should rather be a shared ambition amongst all stakeholders. Cities and ports along with governments and international organisations can help in creating and enforcing reasonable initiatives to support the change, whilst the private sector would then fit the new logic of business into their workings. The change towards alternative fuels, new technologies and greener shipping stems from the whole ecosystem, including the maritime sector, ports and customers. The greener options demand investments into infrastructure that only the ports and/or cities can make, and the maritime sector needs to work in cooperation with their customers to bear the investment costs related to new technologies especially during the initial phases. These investments will secure the first-mover advantage for all the participants in the ecosystem. In the end, the cities and ports will gain in efficiency, and the citizens in cities and elsewhere benefit directly from the lowering amount of emitted GHG and other emissions, such as sulphur oxides emissions, that are harmful for citizens and the environment. Customers will benefit from efficiency in terms of lower prices and from the transition towards sustainability.

"We have to reconnect citizens with their marine environment; if people start asking for the return of their water, we will see change."

DONG PING WONG
Founding Director, Food New York

"We brought government, our environmental community, Native American tribal leadership, youth organisations, under-represented communities and labour organisations together with the maritime industry to develop the initiative. And at the same time, we formed an independent organisation to take the strategy forward. It is important that the members and leadership of such an organisation reflect all communities affected by, and can impact, the maritime industry."

JOSHUA BERGER
Governor's Maritime Sector Lead, State of Washington &
Founder/Board Chair, Washington Maritime Blue

"[...] Making operational ports a public walking area? This will not happen as container terminals will become automated and for security and toll reasons it will remain separated. However, port logistics needs to be seamless, work related to ports needs to become tangible for public, areas around ports needs to be visible and accessible."

SEA20 survey, 2019

[23] www.parliament.uk
[24] BIMCO, 17th May 2016

03.03 People: Living and working in the context of the maritime ecosystem – jobs and our living environment

The maritime ecosystem has an impact on the life of every human being. In this study, the focus is on the demographics within the industry and the general interest towards the maritime ecosystem.

Ports have long been a great source of employment. This has direct effects on a city's employment rate and thus indirect effects on consumer behaviour. The close proximity to a city benefits the port since the city provides the employee pool. Both shipping and port employers as well as the cities benefit from a functional infrastructure that enables smooth commute from home to work. The port is then seen as a more viable working place and the city has more employed citizens. Infrastructure, in the form of roads, public transportation and houses, is built by the port and city and calls for collaboration in order to benefit all three key players.

It was pointed out in the interviews that Artificial Intelligence (AI) will both reduce jobs and replace some existing ones with positions that call for higher education required to operate AI technology. The demand for an educated workforce is rising everywhere and ports will face challenges in attracting professionals. Employees with a higher level of education also tend to live in central areas of the city, which will, again, make proximity an asset for the ports as well as cities.

At sea, the maritime industry is facing a workforce crisis; the retirement of an ageing workforce will lead to staff shortages. One interviewee from the US stated that, "currently, the average age for male employees in the maritime sector is 54 years. We operate the largest ferry system in the US, and around 75% of captains, mates and the upper level maintenance crew of our ferries, and 55% of our chief system engineers, will be able to retire in the next five years." The UK Department for Transport (DFT) predicts a shortfall of around 3,500 deck and engineering officers by 2021 in the UK alone[23] and the BIMCO / ICS Manpower Report predicts the global shortfall of 147,500 officers by 2025[24].

Who will fill these positions in the future? The maritime business, ports and cities are facing this challenge together. The industry and ports need to attract young professionals, and cities need to be prepared for this demand by offering efficient transportation from city centres. Diversity in sex and race are also called for in an industry that is currently dominated by middle-aged white men. A career in maritime should be promoted as an attractive and viable career option for the young. Employment offers a great example of an interface where cooperation is vital in order to benefit all – not least citizens.

The final element that breathes new life into the mingling of industry, city and port is the wider public. These are primarily the citizens of the world's great maritime cities but also the public beyond them. While congestion and pollution have the most direct impact along the shorelines, the maritime industry also affects operations on land in numerous ways.

A broader public can demand change and the citizens of maritime cities are both growing in number and the first to experience concrete impacts on their health and employment, or the social tension over land use or congestion. Many of these cities are also home to vocal climate activists and unions. Together, they could place the pressure on local politicians to act for a change in the direction of sustainability. The climate marches and broad public discussions will have an impact on the maritime industry as well. How prepared will they be for an open discussion with the public?

04.

CONCLUSION:

Collaboration between cities, ports and the industry as the key to the solution

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Conclusion: collaboration between cities, ports and the industry as the key to the solution

This study has assessed key challenges confronting the modern maritime ecosystem from the point of view of the environment, competitiveness and people. It has identified both specific challenges, which are often technical in nature, and systemic ones, which require the participation of the entire maritime ecosystem. To make matters more complicated, solving the systemic challenges is key to finding ideal solutions to specific issues. For example, with today's technology, sharing marine data can be considered more of a specific technical issue, but the fact that data, too often, is not shared at all, is an ecosystem challenge and a question of both trust and standards.

There are three key players in all maritime settings: (i) cities (and their citizens), ii) the industry, and iii) ports, and a sustainable and smart maritime ecosystem must harness all three to be successful. As a conclusion, the key to solving the systemic challenges lies in the collaboration between the three key players. In that spirit, the focus should be on the interfaces between the key players.

The research project highlighted the good news that small changes can begin in many corners of the maritime ecosystem and along the value chain that runs through it. The major emphasis, however, was not on isolated change or technical challenges, but on large systemic shifts.

How does systemic change happen? Frontrunners are important but even more important is that they do not act alone. This means that coalitions must be constructed between different kinds of ecosystem players (mainly the industry, ports and cities) and between different players within each field.

Within the maritime industry, partnerships can be built around sustainability perspectives. Ports can join forces in developing their own work by sharing best practices and ways of scaling them. However, direct competition between industries hinders progress. While ports are better able to cooperate amongst themselves, they feel many competitive pressures as well.

This leaves us with cities. Although they certainly feel pressure to compete for investments, talent and commerce, they are ultimately responsible for the broad concerns of their citizens. Cities are, therefore, ideally positioned to build bridges between other cities committed to tackling climate change – the greatest challenge of our time – and many constitutive and smaller problems along the way.

The city is the one thing that both self-regulation and example-setting have in common. The city – and especially forward-thinking cities in coalition – can lead the way in sustainability issues. In fact, when asked about priorities for the future, most interviewees chose clean air or energy, identifying them as issues around which coalitions could be built. Most commonly, the interviewees saw the city as the key actor, sometimes driven by the citizens and, at other times, by the industry.

Our discussion partners believe that coalition builders must make an effort to bring together the right, open-minded people, who will, in turn, attract more people to join. These people must be curious and willing to share their knowledge and act transparently. Even better if they have the spirit of early adopters and are able to deliver valuable proofs of concept. Luckily, this is increasingly what cities do, as they implement practical solutions for maritime development work. According to one participant, this kind of cooperation between cities and the industry "has been much more substantial than any government-led efforts in recent years." This all fits into the broader trend where globalisation and urbanisation work in tandem – the localisation of all politics.

Interviewees highlighted certain cities that are already busy at work developing smart ports. Rotterdam, Hamburg, Antwerp, Vancouver, Long Beach, Barcelona and Shenzhen were mentioned as some of the leaders in this field. Once again, it is important to note that no one wants to be a smart port alone but part of a network. This is also true for clusters of public, private and research partners and their networks across the globe.

The cities cannot do it alone, as they cannot lead on technology. Various players need to be brought together to identify the business case and the source of money. The industry will provide technical solutions and a more global perspective. The port is where the cooperation is realised, a space that brings everyone together and sets boundaries for emissions, as well as other objectives and rules. Clear regulation also makes it easier to invest, not only close to home but worldwide. Regulation is at its clearest when it concentrates first on concrete local needs and is then scaled globally.

Cities are an important platform for setting up collaboration. A coalition of cities could act in a way that supports the entire ecosystem. There are already a multitude of different cooperation projects between cities, and one that protects and develops the vital supply chains of port cities could be one of them. Cities have joined together to push important agendas for other issues as well. For example, the Chicago Climate Charter was signed by over 60 mayors, who strongly believe that their cities are still committed to the Paris Agreement, even though their federal government is not. Similarly, organisations such as the C40 Cities Climate Leadership Group bring cities together to take bold climate action and advocate for cities to take leadership on climate issues. SEA20, for its part, provides a platform for key maritime cities to unite with the maritime industry and ports.

“Building a space to provide a market interface for shipping could create a civic interface that is accessible to all the citizens and even have the added value of being a habitat that could build capacity to encourages biodiversity in the whole ecosystem. Building a city infrastructure needs to be important to all stakeholders.”

THOMAS KOSBAU
Founder & Principal Architect, ORE Design + Technology

“Building partnerships and, for example, sharing data and best practices on sustainable shipping may be easier on a global level, as ports that are geographically closer to each other tend to be competitors in attracting cargo. Rotterdam’s view is that international cooperation between maritime clusters is necessary in order to achieve the best results and provides a win-win situation for all parties. The sheer diversity of the Rotterdam maritime cluster is an important asset for creating innovative solutions to the current challenges. At the same time, this diversity is the main obstacle for getting everyone committed to shared goals.”

MARTIJN TROOST
Project manager Rotterdam Maritime Capital

“Helsinki Western harbor is a world-class example of one of the busiest passenger ports in the world and at the same time frequent ro-ro traffic and a large housing area. This has been made possible by close cooperation with the city and the port, and advanced technology.”

SEA20 survey, 2019

There should be a shared will to push forward development in the following key areas:

1. A CALL FOR LEADERSHIP
The shipping industry can help drive change but cannot create a sustainable maritime ecosystem alone. A power vacuum exists, and must be filled with a leadership model that takes into account the collaboration so clearly required.

2. THE TECHNOLOGY ALREADY EXISTS
A systemic approach to regulation, innovation, processes and collaboration need to be adopted.

3. DATA-SHARING MUST HAPPEN
Data is the way to efficiency and sustainability. We must build interoperability, standards and the trust necessary for the sharing of data.

4. CITIES ARE THE KEY TO OUR MARITIME FUTURE
Cities must wake up and realise the importance of their role, and ports and industry should support their efforts. Cities can spread standards, harnessing their growing clout and accountability to their citizens.

5. EVERYONE NEEDS TO TAKE AN INTEREST IN MARITIME
Shipping can no longer remain a niche or professional interest. It is far too important. Without broader recognition of the challenges highlighted above, progress remains unlikely.

05.

Appendix

05. Appendix

05.01 Research summary

At Nordic West Office, we first studied the relevant literature, addressing both sustainability and the maritime industry. This set the framework for the first part of the data collection; it was clear that we needed to talk with field experts to understand the topic in depth. We formed a set of questions that were designed to map the visions for a sustainable maritime ecosystem, the key obstacles, and who might solve them. We conducted 21 in-depth interviews with various experts representing different stakeholders in the maritime ecosystem. New interviewees were chosen based on earlier interviews, which grew our understanding of the diversity of the ecosystem. Based on the interviews we formed our preliminary findings that were discussed at a High-Level Meeting in June 2019. Participants represented the industry, ports and cities, as well as other fields, such as national and supranational governance.

For the second phase of data collection, we conducted an online survey. The questions for the survey were modified based on earlier interviews and feedback on our preliminary findings; they focused on filling gaps and clarifications as needed. In this manner, we were able to hit the core challenges that the maritime industry is currently facing on the road to a more sustainable future, alongside cities, ports and other operators.

Considering the geographic coverage for the survey, the most widely represented area for the replies is Europe. We also received views from Africa, Asia and North America. In total, the survey has reached 141 people during this round.

Most of the respondents hail from academia and the maritime industry, as well as the broader space of logistics, shipping and technology, with a significant contingent also from cities and ports. International policy and climate were other fields of expertise amongst the respondents, representing major companies and universities as well as other public or private institutions. We focused on gathering different perspectives from people who look at the maritime world both from the inside and outside, and from commercial and non-commercial perspectives. Some have spent their entire careers within the maritime industry, while others have introduced their innovations to it. Some issues also had strong geographic determinants, such as the vulnerability to the rise of sea levels or assumptions about the city-port relationship.

05.02 List of interviews

The authors of this study would like to thank everyone who have contributed to the study and provided their valuable insight.

ACADEMIA:

- Jani Romanoff, Associate Professor, Marine Industry Aalto University Department of Mechanical Engineering
- Song Kee Hong, Professor, Industrial Design Division, National University of Singapore
- Xiangming Zeng, Doctor of Engineering, Associate professor, Merchant Marine College, Shanghai Maritime University

MARITIME INDUSTRY:

- Christian Roeloffs, Founder & CEO, xChange
- Jesse Uzzell, CEO, Climate Futures
- Jessica Öberg, Head of Business Area Industrial Product & Services, Saab
- Roger Holm, President Marine & Executive Vice President, Wärtsilä
- Tiina Tuurnala, CEO, Finnish Shipowners' Association & Chairman, Finnish Maritime Cluster
- William Burke, Chief Maritime Officer, Carnival Corp

COMMERCIAL BUT NOT STRICTLY MARITIME:

- Dong Ping Wong, Founding Partner, Future Map
- Taka Tsuji, Vice President, Corporate Finance Department, Division 2, Development Bank of Japan
- Thomas Kosbau, Founder & Principal Architect, ORE Design + Technology

NGOS:

- Aline Cavalcante, Founder, Coalição Clima e Mobilidade Ativa, São Paulo

CITIES:

- Jan Vapaavuori, Mayor, City of Helsinki
- Joshua Berger, Governor's Maritime Sector Lead, State of Washington & Founder/Board Chair, Washington Maritime Blue
- Martijn Troost, Project Manager, Rotterdam Maritime Capital
- Ulla Tapaninen, Head of Unit, Enterprise Services, City of Helsinki

PORTS:

- Annaleena Mäkilä, Vice Chair, European Port Organisation and CEO, Finnish Port Organisation
- Ville Haapasaari, CEO, Port of Helsinki

OTHER:

- Brian Winter, Vice President, Editor-in-Chief, Americas Society/Council of the Americas
- Jacques Verraes, Legal Counsel, EU Scientific Advice Mechanism, European Commission Directorate General for Research and Innovation

05.03 Survey

Based on our in-depth interview we have also created a survey with the following profiles.

- Academia: 52 people invited to take part
- Maritime Industry: 42 people invited to take part
- Logistics/Transport in general: 10 people invited to take part
- Cities/Urban development: 19 people invited to take part (+ Hamburg, Trieste, Genoa)
- Port: 7 people invited to take part (+ Hamburg, Trieste, Genoa)
- Other related industries: 8 people invited to take part
- European Union representatives: 3 people invited to take part

Geography for the survey: The most represented area for the replies is Europe. Although we received replies from other areas, the study would have benefitted from receiving more replies from Africa, Asia, North America, South America and Oceania. In total, the survey reached 141 people.

About SEA20

SEA20 is a not-for-profit initiative that aims to connect Smart and Ecologically Ambitious maritime cities to facilitate the transition to a smarter and more sustainable global maritime ecosystem. This will be done through sharing best practices, workshops, analyses and insights. “Principles for a smarter and more sustainable global maritime ecosystem” will be published in the summer of 2020.

The initiative is run by Nordic West Office, a global affairs consultancy and think tank based in Helsinki, and made possible by Wärtsilä, a global leader in smart technologies and complete lifecycle solutions for the maritime and energy market.

www.sea20.org

UNLEASH OUR CITIES – A study of maritime transformation as an urban necessity