THE LEADING MARITIME CITIES OF THE WORLD 2022

A Menon Economics and DNV Publication

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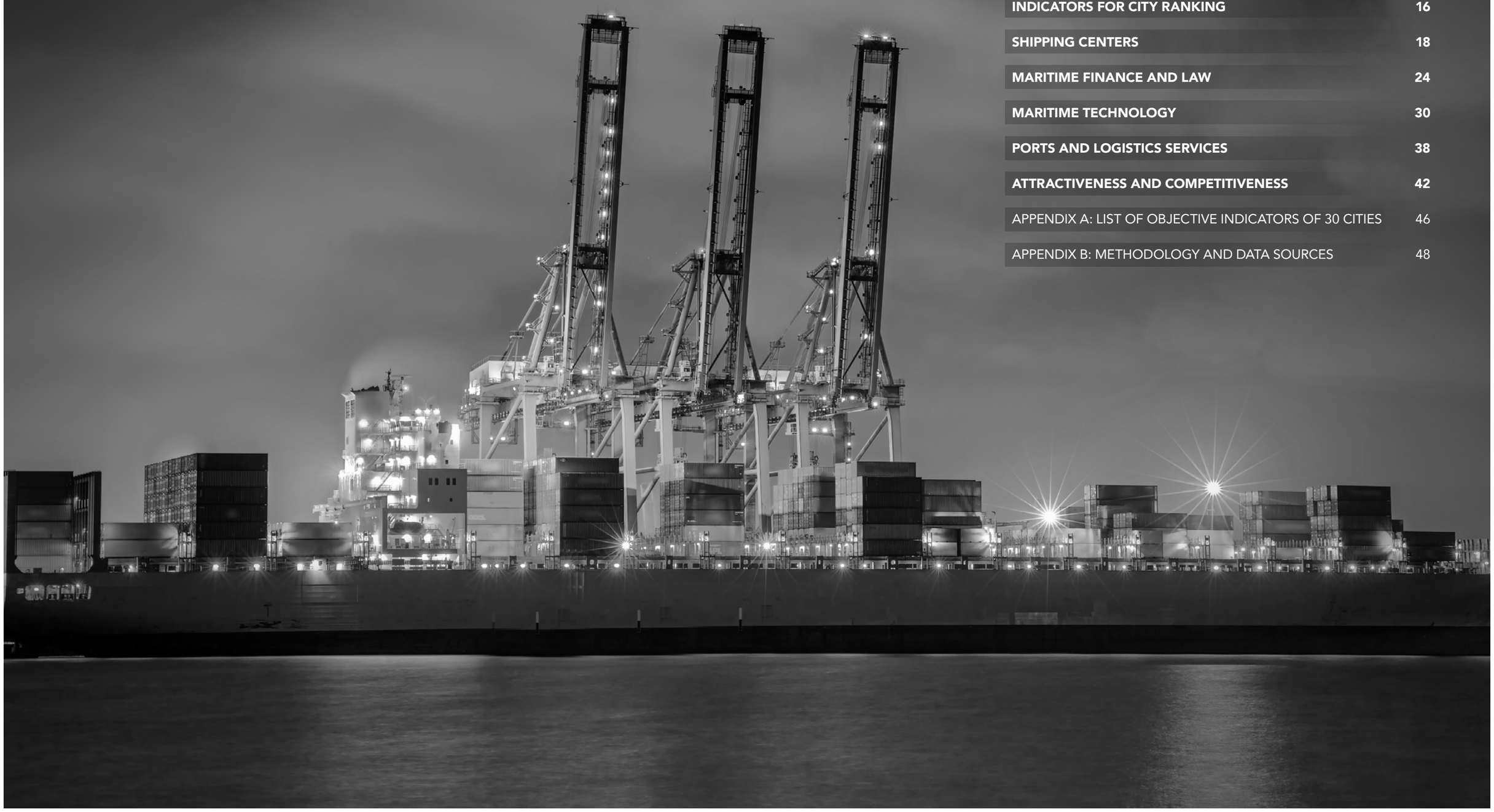

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EXECUTIVE SUMMARY

RANK	SHIPPING	FINANCE AND LAW	MARITIME TECHNOLOGY	PORTS AND LOGISTICS	ATTRACTIVENESS AND COMPETITIVENESS	OVERALL RANK
1	ATHENS	NEW YORK	SINGAPORE	SHANGAI	SINGAPORE	**SINGAPORE**
2	SINGAPORE	LONDON	OSLO	ROTTERDAM	LONDON	**ROTTERDAM**
3	TOKYO	TOKYO	BUSAN	SINGAPORE	COPENHAVEN	**LONDON**
4	SHANGHAI	OSLO	LONDON	HONG KONG	ROTTERDAM	**SHANGHAI**
5	HAMBURG	PARIS	SHANGHAI	GUANGZHOU	OSLO	**TOKYO**

Dramatic changes have occurred since our last *Leading Maritime Cities* publication. We are still in a pandemic, more than two years after its initial outbreak. Countries and cities have been locked down, with severe consequences for trade, travel, and people's mobility. Ships have been stuck in ports, and seafarers have been stuck onboard ships. Cargo delays are common, and container rates have skyrocketed. Still, the world economy is in surprisingly good shape, taking the consequences of the pandemic into account.

The second major change driver is the climate crisis. Although by no means a new phenomenon, the sentiment in the world in general, and the maritime community in particular, has changed dramatically recently. The technological progress is stunning, but we are still far from the GHG goals set by the IMO, the European Union and national authorities. However, shipowners, charterers and cargo owners, and financial providers are preparing for a low- or even zero-carbon future, and we can expect rapid implementation of zero-carbon fuels in the next ten to fifteen years. We are quite certain that cities taking the lead in the green transformation will become the leading maritime cities of the world.

More than half of the world's population live in cities, and it is predicted that two-thirds of the world population will be living in urban areas by 2050, according to United Nations estimates. The importance of city regions will therefore continue to grow. Cities are the centers of knowledge, talent, innovation, and specialization of production and services. In today's world, particularly for the maritime industry, cities are competing to attract the best companies, startups, and most talented people. The winners in this race for attractiveness are – and will continue to be – the leading maritime centers of the world.

The 2022 edition of the LMC (Leading Maritime Cities) report is back, with fresh insight about which maritime cities provide the best support, in terms of soft and hard infrastructure and world-class talent, to allow maritime businesses and people to connect and thrive. Like its previous editions, the LMC 2022 report covers 5 pillars – Shipping Centers, Maritime Finance and Law, Maritime Technology, Ports and Logistics, Attractiveness and Competitiveness – on which the maritime cities are benchmarked. Under each pillar, a comprehensive set of objective and subjective indicators have been considered (40 in total). For the 2022 report, some new and more comprehensive objective and subjective indicators, as well as data sources, have been used to ensure that the analysis is based on reliable and complete data for the various cities, which ultimately allow for a more refined benchmarking of the relative performance of each city compared to the previous report. We have also introduced new objective indicators to benchmark key development in the green transition. The subjective indicators under each pillar come in the form of the perception and assessment by nominated business executives – mostly shipowners and managers – from all around the globe. Of these 280 experts called upon for this study, around 50% are based in Asia, 25% in Europe, and the remaining 25% are from America, the Middle East and Africa.

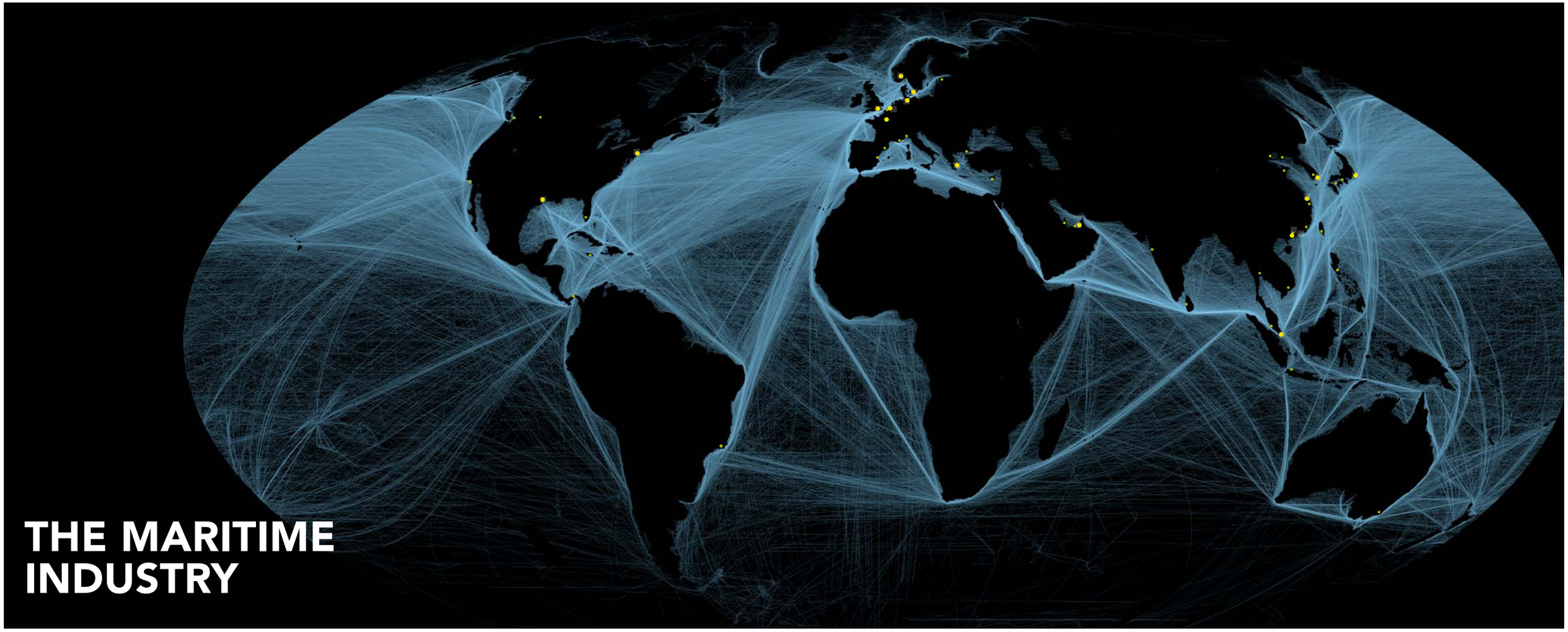
Singapore maintains its position as the leading maritime city of the world during the pandemic and the emerging green transformation of the industry. Singapore has been able to retain its position as a world-leading maritime hub due to its strength in all pillars. However, the top positions on the pillars have changed. Singapore is still number one on the Attractiveness and Competitiveness pillar. This year Singapore has also outperformed all other cities on Maritime Technology. A consistent strategy for innovation, targeting start-ups, and investment in digital technologies has paved the way for Singapore's position on Maritime technology. However, Singapore loses its number one position in Shipping Centers and Ports and Logistics to Athens and Shanghai respectively. On the Maritime Finance and Law pillar, Singapore is losing some ground, going from 5th to 8th place.

Three of the top 5 cities are Asian, and two cities are European. Rotterdam continues to climb up the LMC ranking and takes second place this year. Although holding a 10th position on Shipping and having no first position on any pillar, Rotterdam scores high on most pillars, particularly on Ports and Logistics and Attractiveness and Competitiveness. London has also climbed from 5th to 3rd position overall. Interestingly, though, London also does not have first position on any of the pillars, since New York has outranked London on Maritime Finance & Law. On the overall ranking, Shanghai holds the 4th position, and Tokyo holds the 5th position. Tokyo has always performed strongly on objective indicators. Hong Kong has lost its position within the top 5 in the Shipping pillar, and Maritime Finance & Law, and dropped from 4th to 7th place in the overall ranking. In the 2022 edition of LMC, more objective indicators are introduced, with a stronger weighting of objective indicators compared to maritime experts' assessments.

Athens is back on top of the Shipping pillar, followed by Singapore, Tokyo, and Shanghai. Hamburg, which in previous editions has been among the top 5 cities on the overall ranking, has lost ground. Its 5th place on the Shipping pillar is Hamburg's only top 5 position this year. Consequently, Hamburg has fallen to 9th place overall. New York takes the top position on the Maritime Finance & Law pillar, followed by London, Tokyo, and Oslo. For the Maritime Technology pillar, Singapore claims the top position, with Oslo and Busan ranking 2nd and 3rd respectively. Shanghai takes the top position for the Ports & Logistics pillar, overtaking Rotterdam, Hong Kong, and Singapore.

The maritime industry is on the verge of a digital transformation, including the adoption of disruptive and innovative technologies. These two dimensions cut across the five pillars that the cities are benchmarked on, and are particularly relevant on Maritime Technology. The maritime industry experts voted Singapore, Oslo, Shanghai, and Copenhagen to be the cities best prepared for the digital transformation of the industry. Oslo has also further consolidated its position as the world's leading center for sustainable technologies and solutions for the oceans, followed by Singapore and Copenhagen.

Looking five years into the future, our experts predict that Singapore will keep its position as the global leader, while Shanghai will grow in importance and become the second most important maritime city. The race to be the leading city in Europe is still open, with London, Oslo, and Rotterdam as the leading contenders in this regional race. Hamburg and Athens have lost ground since 2019. In the Middle East, India and Africa region, Dubai is the leading maritime center, and at a global level now ranked 12th, primarily due to the split between Dubai and Abu Dhabi (both parts of UAE) in this year's edition of the LMC. The experts predict that Dubai will continue to grow in importance and is expected to take 6th place by 2027, albeit with strong competition from Hong Kong, Hamburg, and Copenhagen.



THE MARITIME INDUSTRY

2020/2021 – SNAPSHOT

Maritime trade accounts for almost 90% of the world's commerce, but has been severely tested in recent years. The global seaborne trade's current situation is subject to a multifaceted problem. Before COVID-19, strained trade relations among several nations (e.g., between global economic superpowers China and the USA, and in relation to the UK's ratification of the withdrawal agreement with the EU) were already threatening disruptions to maritime trade and supply chains. With the onset of COVID-19 as a global pandemic in March 2020, international trade collapsed with lockdowns, travel restrictions, fast-rising unemployment, and temporary oil and stock market crashes. Supply chain disruptions, demand contractions and global economic uncertainty resulted in a drop in seaborne trade across different shipping segments in all regions.

Since shipping continues to shoulder the responsibility of providing undisrupted shipments of food, energy commodities and medical supplies across the continents, shipping companies, by necessity, must be agile and adaptable to this fluid situation and focus on building effective response strategies and plans. To support the maritime industry in achieving this, the IMO and other systemic maritime organizations joined efforts in defining actions and practices on critical matters such as onboard safety, seafarer contracts and repatriations, and supply of necessary provisions, supplies, and vessel spare parts.

With the IMF forecasting a rise in world GDP in 2022, various growth projections for global seaborne trade have been published, ranging between 4 to 6% in 2021. These growth projections are subject to the extent and effectiveness of policy intervention measures aimed at stimulating growth in various regions, but clear signs of recovery could already be seen by mid-2021 when overall global average trade volumes returned to pre-COVID levels, surpassing most of 2020's expectations. Market performance for different shipping segments has been uneven, with some experiencing exceptional times (with faster recoveries for containers, LPG, dry bulk and LNG, with approx. 6-12 months to recovery from the start of the pandemic in March 2020), while others are continuously struggling to make ends meet (e.g., with oil and cruise segments still under pressure with expected recovery timelines between 24 and 36 months from March 2020).

With the rebound in consumer demand for goods from Q3 2020 onwards, following the initial disruption in the global logistics sector, the effects have been felt differently by various maritime players, leading to new measures of adaptation.

- Ongoing prolonged port congestions and increasing backlogs for most major ports. Indicatively, during November 2021, Singapore recorded close to 60% level of congestion, followed by Hong Kong at 55% and Shanghai at 45%, while LA ports in the USA have had more than 80 vessels anchored during the same period (Bloomberg, 2021). During "normal" times, ports typically experience 10% level of congestion and rarely surpass the 20% mark. As a consequence, shippers are opting to unload goods destined for LA in Seattle or even Florida, then arranging for long rail or truck transportation (Journal of Commerce Online, 2021).
- Booming freight rates for containerships in 2021. Large owners/operators such as Maersk Line, CMA CGM and COSCO are achieving record profits for back-to-back quarters. On the other hand, shippers around the world are looking into adapting their logistics plans and practices to counter the impact of costly freight rates. For example, IKEA has moved a significant portion of its production base from China to Turkey to ease the logistics strain (Reuters, 2021). Coca-Cola is now packaging some of its material and products in large palleted blocks or sacks for transportation in chartered dry bulk vessels (Tradewinds, 2021).

ALWAYS FOR A GLOBAL REACH

The past decade has presented new obstacles and possibilities for organizations vying for a global reach and an international footprint, which impacted markets and the economy on a global scale. Organizations involved in maritime transportation have had a significant impact on the economies of nations regardless of their size or type. Globalization encourages businesses to take active measures to defend their own market from competition while also seeking new, appealing markets for their goods and services. Regulatory and technological trends, such as the presence of trading blocs like the EU/EEA, NAFTA, RCEP and the ability of companies to manage cargo flows, utilizing modern IT systems, are removing barriers to cross-border mobility and reducing associated "barrier costs".

Achieving complex trading networks for these organizations is key, to benefit from opportunities in capitalizing on labor cost differentials and availing raw resources in specific nations. The most prevalent method for transporting raw materials and merchandise has been and will continue to be seaborne routes. In 2019, the total annual global seaborne trade was at 11.8 billion metric tons of goods transported, up from 8.36 billion metric tons in 2011 (UNCTAD, 2021).

Maritime shipping, especially driven by vessel upsizing trends, is utilizing economies of scale and standardization of vessel technologies and design to achieve great reductions in transportation costs. In 2021, the largest containerships can reach up to 23,000 TEU ("twenty-foot equivalent unit") capacity, shooting up from 8,000 TEU capacity in 2006. Sufficient infrastructure needed to accommodate the increasing seaborne trade, led by state-of-the-art international ports, is deemed a necessity. Hence, port cities are being coined "frontline soldiers of globalization" (Ducruet and Lee, 2006). A strong maritime player, Chinese conglomerate and port operator COSCO continues to create an unparalleled global shipping nexus of ports and warehousing infrastructure, lately upping their ownership stake of Piraeus Port to 67%, as well as buying a 35% minority stake at a container terminal in the Port of Hamburg and a 60% stake at Chancay Terminal in Peru, making this the first terminal project invested in by Chinese companies in South America.

Nowadays, most maritime services are globalized and often located around ship owning companies. Ship finance was among the first to globalize, whilst legal services were the least flexible to move across borders due to national jurisdiction limitations. English law firms have been the exception, with branches in shipping hubs across the world, since English law is commonly chosen as the jurisdiction in contracts of trade and chartering.

The maritime industry is supported in its globalization efforts by the technological progress in the transport and transshipment sectors including cargo unitization, and the wide application of IT systems in the planning and control of the delivery process. Trading partners and carriers have come to expect a certain level of service, such as continuous satellite cargo monitoring, prompting organizations to form international alliances or merge their individual regional entities into one global network.

DIGITAL TRANSFORMATION, CYBER SECURITY AND INNOVATION

Digitalization involves the transformation of key business operations and affects products, services, and processes, as well as organizational structures and management concepts (Matt et al., 2015). Digital transformation of the maritime industry is under way, challenging existing business models but also offering new opportunities.

The level of adoption is varied in the sector and still lacking, compared to other industries, in the proliferation of digitalization in the entire scope of maritime transport and services. It is currently most pronounced in vessel navigation systems and in streamlining cargo handling operations, including cargo optimal routing, monitoring, warehousing, and use of AI-powered algorithms for optimized stowage plans for container ships.

Other than the improvement and interconnectivity of information and cargo flows, and vessel monitoring, some of the other digital initiatives are aiming at the automation and centralization of internal and external services, such as bookings, orders, and customer support. For example, in June 2020, MSC introduced the instant-quote tool to provide easy access to its rates for ocean shipping, to make its customers' supply chain easier to manage and improve end-to-end efficiency (UNCTAD, 2020). In April 2020, Maersk's online application – featuring cargo release, calculation of fees and online payment for immediate release functionalities – registered an 85% increase in transactions as customers started ordering more remotely and sought to track cargo more efficiently (UNCTAD, 2020).

Some maritime players are also upgrading their infrastructural and assets' operations based on cyber-physical systems (systems coupling digital software with hardware). Emerging technologies like blockchain-based utilization are proving to be effective in customs clearance and management, and the standardization of paper-based procedures (Yang, 2019). On the vessels side, the need to integrate smart technologies during operation supported by "big data analysis" is becoming more prevalent, although an effective level of integration can be more easily achieved if incorporated during the newbuilding stage (Sullivan et al., 2020).

Such maritime digital transformation causes fundamental organizational changes in traditional business practices by the implementation and use of digital technology, redefining existing business capabilities, processes, and relationships, and thus new possibilities are enabled, and value is created, captured and delivered (Tijan et al., 2021). Crucial for the success of digital transformation is the alignment between both the business and digital strategies as well as the acceptance of involved players (port administrations, shipowners, shippers, service providers) to cooperate. On the other hand, the main barriers for digital transformation appear to be the high initial implementation costs, low quality of offshore internet connections, aging decision-makers, and the lack of investment initiatives and risk aversion especially due to the uncertainty sentiment induced by the COVID-19 pandemic.

With digitalization come cyber security concerns which require constant monitoring of both interconnected IT (standard information systems) and OT (operation and control systems) infrastructures to detect real-time threats. Increasing reliance on automated and networked systems of equipment and technologies greatly affects the safety and livelihood of crews, vessels, cargoes, and ports. Indeed, as vessels increasingly shift their connectivity and control to OT systems (providing tremendous benefits in terms of safety, availability, and energy efficiency) and with ports' control systems for their OT network (connecting RTGs, STS cranes, traffic control and vessel berthing systems, cargo handling and safety and security systems), this is opening doors to cybercrime which is recognized as the biggest emerging challenge of the maritime industry. Hackers do not discriminate – they are hitting organizations large and small, with or without abundant cybersecurity resources (Vessel Automation 2021).

The number of cyberattacks in the maritime industry is increasing at an alarming rate in recent years, some targeting facilities and companies ashore whilst others are focusing on the maritime fleet, resulting in breaches to IT systems, hardware, sensors, data confidentiality, with the gain of unauthorized access to manipulate or disrupt business operations. In 2020, cyberattacks on the maritime industry's OT systems increased by 900% since 2017 with 50 significant OT hacks reported in 2017, rising to 120 in 2018 and more than 310 in 2019. In 2020, more than 500 major cyber security breaches were expected, with substantially more going unreported (Vanguard, 2020).

In October 2021, multiple Greek shipping companies were hit by a ransomware attack that spread through the systems of a popular, well-established IT consulting and service provider, highlighting the risk and the plethora of potential avenues a cyberattack can originate from.

The IMO urges administrations to take sufficient steps in constructing, adopting, and integrating efficient and effective cyber risk management procedures, offering guidance and encouraging vessel operators to ensure that cyber risks are appropriately addressed in their existing safety management systems (as defined in the ISM Code), no later than the first annual verification of the company's Document of Compliance after January 1st, 2021.

The maritime industry has witnessed the impact of digital disruptions and disruptive innovations within several areas such as additive manufacturing, electronic bills of lading replacing the century-old paper-based system, and remote operations and monitoring combined with AI for automatic detection of corrosions, cracks, and deformities. The development within additive manufacturing for maritime applications is most profound in Singapore, with the authorities injecting millions in innovation funding to kick-start multiple joint industry projects to implement a just-in-time provision of marine parts, accelerating the deployment of 3D-printed marine parts aboard several Singapore-registered vessels. In 2021, Singapore and Rotterdam have successfully completed a trial on the application of electronic bills of lading using two different technology platforms. With the Government of Singapore passing a new bill to amend its existing Electronic Transactions Act, recognizing the electronic bills of lading as equivalent to paper-based bills of lading, this development will be a major disruption to the traditional supply chain.

EVOLVING MARITIME REGULATORY FRAMEWORK FOR GREEN TRANSFORMATION

Global concerns about invasion of aquatic organisms, SOx emissions and GHG emissions from the shipping industry have led the IMO to implement three initiatives aimed at limiting the impact of these in recent years. The first two initiatives relate to ballast water management and the carriage ban of fuel with more than 0.50% sulphur content unless scrubbers are installed. The third initiative is the IMO's ambitious GHG strategy (adopted in April 2018) which sets out a vision to reduce GHG emissions from international shipping and phase them out as soon as possible in this century. Regulations around the GHG strategy are expected to be the main challenge for shipowners in the medium to long term.

While the ambitions of the IMO are clear, the road to achieving these ambitions remains less so, e.g., which policy measures can the IMO invoke to incentivize the needed change? This is an ongoing process in the IMO. Different measures were considered and widely discussed, and the IMO decided to introduce a combination of technical and operational measures. Whilst EEXI (Energy Efficiency Existing Ship Index) is a technical measure, looking at the design of the ship in a comparable way as EEDI (Energy Efficiency Design Index) does for newbuildings, the CII (Carbon Intensity Indicator) measure is an operational measure considering the actual fuel consumption and distance travelled for each individual ship in service.

In addition to the IMO's CII Rating Scheme, other organizations – such as the EU, Sea Cargo Charter and financial institutions – have their own environmental compliance requirements (which in some cases are more ambitious than the IMO's GHG Strategy) with a goal to align global shipping with society's goals and to promote and incentivize the decarbonization of international shipping.

- "Green Deal" drives the EU policy initiatives, intending to achieve a climate-neutral Europe (including ships trading in Europe) by 2050. The shipping industry has estimated that a 90% reduction in GHG emissions from maritime transport relative to 1990 is needed by 2050, with an intermediate (and new) overarching EU target for 2030 being 55% (instead of the original 40%) reduction relative to 1990. The "Fit for 55" package of policy measures is under review by the EU Commission.
- "The Poseidon Principles" is an initiative that is being implemented by financial institutions. Some of the signatories include BNP Paribas, Credit Agricole, Citi, Credit Suisse, ING, SuMi Trust, Nordea, DNB, Danske Bank. The Poseidon Principles establish a framework for assessing and disclosing the climate alignment of ship finance portfolios. They set a benchmark for what it means to be a responsible bank in the maritime sector and provide actionable guidance on achieving this. The Poseidon Principles are consistent with the IMO's GHG Strategy.
- "Sea Cargo Charter" was launched in 2020, applicable to bulk ship charterers with signatories such as Trafigura, Dow, Total, Shell, Equinor, Gunvor, LDC, Cargill and AngloAmerican. The Sea Cargo Charter will measure GHG emission intensity and total GHG emissions of the signatories' chartering activities annually and will assess their climate alignment relative to established decarbonization trajectories. Signatories will commit to making compliance with the Sea Cargo Charter contractual in their new chartering activities. They will use the Sea Cargo Charter Clause in charter parties and work together with shipowners, ship managers and business partners to meet this requirement. The Sea Cargo Charter is consistent with the IMO's GHG Strategy.

WHERE NEXT?

Considering where the maritime industry has been in recent years and where it is heading (for a global reach in an evolving maritime regulatory and environmental landscape and bound for a cyber-sensitive digital transformation), which cities around the world will provide the best support, in terms of soft and hard infrastructure and world-class talent, to allow maritime businesses and people to connect and thrive?

THE LEADING MARITIME CITIES OF THE WORLD

CITIES – ENGINES OF INNOVATION AND GROWTH

Urbanization is one of the strongest global megatrends in this century, with a clear shift in importance from nations to cities (Moretti, 2012; Quartz, 2015). Today, close to 55% of the world's population – 4.2 billion inhabitants – live in cities and this trend is expected to continue so that by 2050, nearly 7 of 10 people in the world will live in cities. More than 80% of global GDP is generated in cities (World Bank, 2020). Population projections show that virtually all growth over the next 30 years will come in urban areas. Companies are thus increasingly focusing on city regions when developing their strategies for where to relocate or expand their operations.

Three distinct features or common indicators of "global cities" are (Goerzen et al., 2013):

- High levels of connectivity with other locations, as they typically have a good physical information and communication infrastructure that facilitates the international transfer of goods, people, and information.
- Specialized providers of high value-added services, such as financial, legal, and consultancy, which are important to the functioning and performance of multinational firms' local and global operations. Knowledge-based industries tend to centralize in a few leading city regions – San Francisco for ICT; Boston for biotechnology; Houston for O&G; New York for finance; and Singapore for maritime. This is not, however, a "winner-takes-it-all" game. There is room for cities with leadership in niches of industries, like Geneva in medtech, and London in fintech, or for cities with regional leadership such as Shenzhen in ICT and Singapore's Biopolis for biomedical science.
- An enabling environment, characterized by the presence of a culturally diverse body of players, including big corporations, highly specialized professional talent, and academia. At their core, these cities possess the capabilities for servicing, managing, and financing the global operations of firms and markets (Sassen, 2001). It is where global firms connect, build relationships and transfer knowledge, maintaining a level of connectivity, often seen as a means of achieving economic development and improving their competitiveness (Pain et al., 2015).

Shipping is a global business, encompassing a complex variety of actions taken and services performed, by an equally complex variety of players. Over time, many of these actors gather in specific geographic regions, or cities, thus forming so-called clusters. A maritime cluster can broadly be defined as "a group of industries that are directly and indirectly related to shipping and situated within a certain geographic area" (Shinohara, 2010). Maritime clusters make distinct contributions to the development of national or regional economies and provide strong support for innovation and technological development in maritime industries (Shi et al., 2019). Their vital role in enabling international trade and the global supply chain is also evident in their provision of integrated logistics and maritime services in addition to traditional cargo handling-related activities (Zhang and Lam, 2013).

Critical success factors for a maritime city may include (Monteiro et al., 2013):

- Acknowledgment of the maritime cluster as a cornerstone of the national and regional economy.
- Adoption of favorable policies, to allow actors to stay competitive in a globalized and evolving environment.
- Engagement with other maritime clusters, utilizing own strengths and supplementing for shortfalls.
- Involvement of maritime education centers, financial institutions, trade associations and other stakeholders, allowing for cooperation in businesses and R&D, information sharing, and risk sharing through investments in new markets.

Most maritime clusters owe their existence to the city's past success in its role as regional port/hub of commerce. But this is not enough, as proven by cities with a declining maritime footprint, such as San Francisco, Naples, Liverpool, and New Orleans, due to decreasing demand for traditional port services amid fierce competition (Merk, 2013). On the contrary, the operators of the Singapore maritime cluster successfully maintained their cluster's relevancy by modernizing their capacity to accommodate increasingly large ships and high cargo volumes and to offer complex, highly specialized logistical services, while catering to specialized needs for maritime finance, insurance, bunkering and other value-added services (Jakobsen et al., 2017). Local governmental entities and maritime associations have greatly contributed to that effect by adopting and implementing pro-business policy measures, as well as continuously seeking input and feedback from industry actors, for Singapore to remain an attractive location for maritime business establishments (Osman et al., 2021).

MARITIME COMPANIES – RESTRUCTURING WITHIN A GLOBAL PLAYGROUND

Aware of such international competition, cities are developing strategies to enhance their attractiveness to highly productive and innovative companies, and to talented individuals. The more mobile the companies, the stronger the competition among cities to attract them. As the maritime industry is global in nature, many maritime companies are mobile entities seeking to take advantage of localization advantages in different countries. This, combined with the maritime industry being a high value-added industry, means that the fight to attract maritime companies is tough, especially for shipping being the most highly mobile sector within the maritime industry. This also implies that it may be easy to lose maritime business activities. The gains from winning the location race are hence higher for the less mobile part of the industry.

Specialized knowledge-based services are probably the least mobile companies in the maritime industry. The reason for this is that knowledge-based companies often have links to universities and are deeply embedded in the local milieu; for example in their reliance on specialized local competence. Another important point, following from the fact that firms increasingly split up their value chains, is that cities compete to attract activities – not companies. Winners will be those cities which are able to attract:

- Science and higher education
- Owners and headquarters
- R&D – product and technology development
- Financial, legal, and other sophisticated business services

While many cities are important centers in today's maritime industry, some researchers suggest that we may see a future concentration of shipping activity (Center for Liveable Cities, 2014). The international maritime expert Martin Stopford was one of those who proposed that we will see a development of two or three global centers characterized as "shipping super cities" – one city in each of the eight-hour time zones (Asia, Europe and the Americas). This will mean that some of today's shipping centers will lose importance to a few global centers that will act as shipping service hubs. Stopford also went further, dividing the cities into cargo port and shipping services ports. Cargo port cities, such as Rotterdam and Shanghai, are mainly driven by their role of transporting cargo to the regional markets. In shipping services ports, on the other hand, the port is secondary while offering other services to the international shipping industry will be key.

DRIVERS OF COMPETITIVENESS

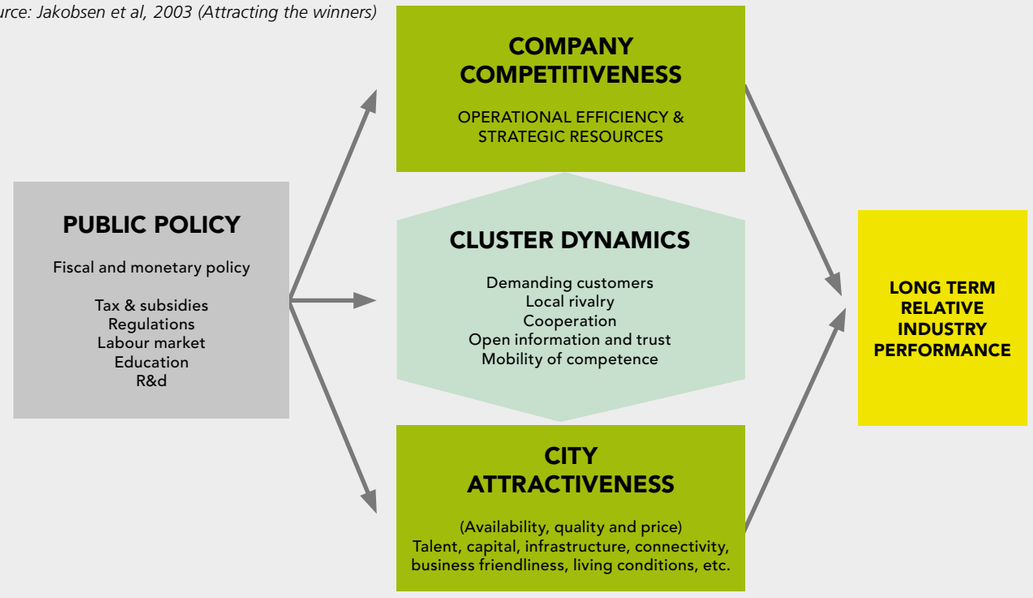
There are many interconnected factors that drive the attractiveness of a city and the competitiveness of the industries located there:

- Strategic location
- Favorable and stable political framework
- Transparent and efficient legal framework
- Proximity to large, demanding customers
- Local rivalry – creates incentives for continuous improvements and innovation
- Abundance of suppliers and service providers
- Specialized universities and research institutions
- Large pool of talent
- Rich and open flow of knowledge and ideas
- Relationships based on trust
- Meritocratic education and career system
- Soft location factors – an attractive place to live for families and individuals

Together, these factors produce spirals of self-reinforcing growth – or decline, if the factors are absent. The mechanisms that drive industry competitiveness are summarized in the model below.

THEORETICAL MODEL OF INDUSTRIAL COMPETITIVENESS

Source: Jakobsen et al, 2003 (Attracting the winners)



For the maritime industry in a city to prosper, two conditions must be satisfied: the companies must be competitive, and the city must be attractive as a host for these companies. These two conditions are mutually dependent: the companies gain their competitiveness from resources available in the city – for example access to capital, talent, and specialized supplies – and the price they must pay for these resources. Accordingly, the attractiveness of the city increases when competitive companies are present in the city. Hence, the clue is to attract the winners (Jakobsen, et al 2003). Over time, the attractiveness of the cities is gradually shaped by the dynamics of the industry. In an industry with strong cluster dynamics, knowledge is continuously improved and dispersed, upgrading both companies and resources. Finally, governments play a central role in defining the attractiveness of the city. Through various public policy factors like taxes and subsidies, they determine the price of capital, labor, and other input factors. The quality of the resources is to a large extent determined by investments in infrastructure, education, and R&D. Key institutions, including cluster facilitators, contribute to making a location attractive through active engagement with the maritime industry and introducing initiatives and programs based on industry feedback (Osman, 2020).

The four main elements in the model, public policy factors, the competitiveness of the companies, the attractiveness of the cities, and finally, the dynamics of the industry clusters, are measured and benchmarked for maritime cities across the world. The results for the top 50 cities are presented in this report.

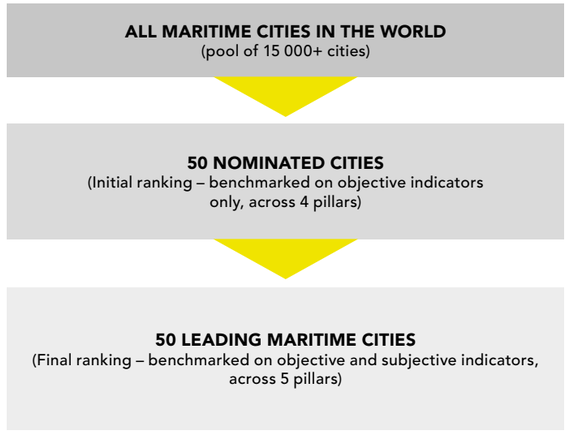
BENCHMARKING BASED ON OBJECTIVE & SUBJECTIVE INDICATORS

This *Leading Maritime Cities* report is in its fifth edition. The ranking is based on a combination of objective data from leading international sources and subjective expert assessment to evaluate and benchmark the top 50 leading maritime cities. This approach offers the advantage of considering both hard facts (objective indicators) as well as the subjective assessment by nominated maritime business executives, owners and academics from all around the globe. Expert opinions are of particular importance in areas that are difficult to measure with available objective data at city level (such as regulations, cluster dynamics, technological expertise etc.).

The identification of the top 50 maritime cities in the world is conducted by using a bottom-up approach, whereby all cities with some level of maritime activity (a sample of 15,000+ cities) are narrowed down to a sample of 50 cities based on a ranking of 25 objective maritime indicators across four (out of five) pillars. The four pillars include Shipping, Maritime Finance & Law, Maritime Technology and Port & Logistics. These cities are thereafter assessed by 280 maritime experts across the world along all five pillars, and their assessment in combination with the objective data is used to rank the sample of 50 cities. This final round of rankings gives us the top 50 leading maritime cities of the world.

Subjective indicators are based on information we have gathered through the "*Leading Maritime Cities 2022*" survey. In this survey, maritime experts from all over the world with different backgrounds were asked to provide qualitative assessments on topics like green transformation, digitalization, competitiveness, and innovation. Furthermore, the 280 experts have ranked the top five or top three maritime cities on shipping, finance, technology and port/logistics, together with six other dimensions. With this data we have created a scoring system based on experts' ranking of cities, where the city ranked first gets 5 points, the city ranked second gets 4 points etc. At the end, the total points under each ranking were summarized for each city, and these points are used as scores on each subjective indicator in our top 50 ranking. Detailed information about the composition of experts can be found in Appendix B.

The ranking approach is illustrated as follows:



Compared to the 2019 edition of the report, several changes were implemented for the 2022 edition, which makes the direct comparison of rankings between 2022 and 2019 impossible. However, these changes were deemed crucial to make the overall assessment as comprehensive as possible and aligned with the global trends in the industry. Furthermore, since the last edition of the report we have gained access to new and more detailed data making it possible to include more cities in the ranking sample and increase the data quality for the cities involved. The most important change in this edition is that we have introduced four "green" indicators to reflect the decarbonization of the maritime industry. Although still in its infancy, we find it crucial to start measuring the transformation now. Other changes in the indicators compared to earlier editions are described in appendix B.

INDICATORS FOR CITY RANKING

There are numerous ways to assess the strength of the maritime cities. Data sources that are widely used and renowned in the industry have been used. Methodology and data sources are described in the appendixes.

In this year's report, for the objective assessment, previously used objective indicators were revised to be based on new and updated databases whilst new objective indicators were also included. The overarching aim has been to ensure that the analysis is replicable and based on reliable, complete and high quality data for the various cities. Hence, adjustments to the data sources and/or indicator set have been made where deemed necessary. For the five pillars in this study, a total of 29 objective indicators have been used.

For the subjective assessment, this comes in the form of the perception and assessment by key business executives – mostly shipowners and managers – from all around the globe. Of the 280 experts called upon for this study, around 50% are based in Asia, 25% in Europe, and the remaining 25% are from America, the Middle East and Africa.

The study uses a ranking model consisting of both objective and subjective indicators for the top 50 maritime cities across five pillars. Each pillar is weighted equally (a weight of 20%) in the global top 50 city ranking. The five pillars of the study are the same as in the last edition of the report: Shipping, Maritime Finance and Law, Maritime Technology, Ports and Logistics, and Attractiveness and Competitiveness. Within each pillar, all indicators are weighted equally (e.g., if a pillar consists of five indicators, all indicators will get a weight of 20%). The full list of indicators is described in the tables below.

PILLAR	SHIPPING		
OBJECTIVE INDICATORS		**DESCRIPTION**	**SOURCE**
	1. Fleet size - management	CGT owned by shipmanagers registered in the city (Size of fleet (CGT) managed from the city)	Clarksons World Fleet Register
	2. Fleet size - owner	Size of fleet (CGT) controlled by shipowners registered in the city	Clarksons World Fleet Register
	3. Fleet value - owner	Fleet value for each city, calculated by multiplying the national fleet value with the city's corresponding national CGT ratio	Clarkson & WFM Vol 9 No 12 December 2018 - estimates of national fleet values
	4. Number of shipping companies with HQ in the city	Number of shipping companies with more than 5 vessels (owner and manager)	Clarksons World Fleet Register
	5. Operational revenue for shipping companies	Operational revenue (turnover) for shipping companies (NAVE rev. 2: 5010 & 5020), allocated to HQ locations for each company	Bureu van Dijk (ORBIS database, most updated data by november 2021)
	6. Low carbon intensive fuel types - share of fleet size	Environmental impact of shipowners' fleet - measured as share of fleet (in GT) with low carbon intensive fuel types. Including current fleet and orderbook	Clarksons World Fleet Register & Alternative Fuels Insights (DNV 2019
SUBJECTIVE INDICATORS		**SURVEY QUESTION**	
	1. Leading shipping center	Which cities do you consider the five leading shipping centers of the world?	Global maritime expert assessments
	2. Attractiveness for headquarter	If your company should consider relocating, which cities would in your opinion be the most attractive location for operational units?	Global maritime expert assessments

PILLAR	MARITIME FINANCE AND LAW		
OBJECTIVE INDICATORS		**DESCRIPTION**	**SOURCE**
	1. Legal Expertice by Who's Who	Number of legal experts per city, assesed by Who's Who.	Who's who Legal 2021
	2. Number of maritime lawyer companies	Number of maritime lawyer companies registered in each city.	World Shipping Register, world-ships.com
	3. Insurance premium	National collected insurance premium for P&I, hull, cargo, offshore from IUMI and CEFOR. Allocated to cities after economic activity of marine insurance companies (NACE code 6512)	IUMI, CEFOR, Bureu van Dijk (ORBIS database, most updated data by november 2021)
	4. Mandated loans	Value of maritime syndicate mandated loans issued from bookrunner/MLA. Sums allocated after location of the HQ to each bookrunner/MLA	Dealogic, Bloomberg and Loan Pricing Corporation. League tables for top 10 Bookrunner/MLA 2020
	5. Shipping banks portfolio	Top 40 shipping portfolies by banks across the world, where sums are allocated to cities after the location of the bank's HQ. Lending as of 31. December 2020	Petrofin Bank Research, 2020
	6. Number of listed maritime owner groups	Number of listed maritime owner groups on citys' stock exchange.	Bureu van Dijk (ORBIS database, most updated data by november 2021)
	7. Market cap of listed companies on the city's stock exchange	Market cap of maritime companies (NACE rev. 2: 5010, 5020, 5030, 5040, 3011, 3012, 3315, 5222, 5224 and 7734). Allocated to cities based on listing information on stock exchange.	Bureu van Dijk (ORBIS database, most updated data by november 2021)
	8. IPO/Bonds/Follow ons	Trading volume of bonds, IPO and follow ons for Q1-Q3 2021 for maritime listed companies. Volumes distributed by location of stock exchanges.	Clarksons Shipping Intelligence Network (Data from DNV GL)
		SURVEY QUESTION	
	1. Leading financial center	Which cities do you consider the five leading centers of maritime finance of the world?	Global maritime expert assessments

PILLAR	MARITIME TECHNOLOGY		
OBJECTIVE INDICATORS		**DESCRIPTION**	**SOURCE**
	1. Shipyards (CGT)	Size of fleet (CGT) delivered by shipyards, including orderbook and ships built later than 2018. Fleet size per yard distributed to the city location of the shipyard.	Clarksons World Fleet Register
	2. Shipyards (CGT) - Low carbon intense ships built	Size of fleet (CGT) delivered by shipyards, including orderbook and ships built later than 2018, measured by low carbon intensive fuel types.	Clarksons World Fleet Register & Alternative Fuels Insights (DNV 2019)
	3. Operational turnover of companies in maritime technology industry	Operational revenue (turnover) of companies in the maritime technology industry (NACE rev. 2: 3011, 3012, 3315). Turnover values are aggregated and distributed to the HQ of the shipyard companies.	Bureu van Dijk (ORBIS database, most updated data by november 2021)
	4. Classed fleet	Share of world fleet in classification society by HQ.	Clarksons World Fleet Register
	5. Market value of ships built at shipyards	Purchasing price of ships built at shipyards, sold in the in the year of 2018, 2019 or 2020. Purchasing price aggregated on city level after location of the shipyard.	Clarksons World Fleet Register
	6. Number of maritime patents	Number of patents produced by maritime firms with HQ in the city. IPC classification: B63B, B63C, B63G, B63G, B63H, B63J	Bureu van Dijk (ORBIS Intellectual Property Database)
	7. Number of maritime education institutions in each city	Number of maritime education institutions in each city.	World Shipping Register: world-ships.com
SUBJECTIVE INDICATORS		**SURVEY QUESTION**	
	1. Maritime technology center of the world	Which cities do you consider the five leading centers for maritime technology of the world?	Global maritime expert assessments
	2. Leading city in terms of green transformation	Which cities are taking the lead in the green transformation of the maritime industry?	Global maritime expert assessments
	3. Best positioned city in terms of digital transformation	Which cities have the strongest capabilities and are best positioned for the digital transformation of the maritime industry?	Global maritime expert assessments
	4. Number one choice for relocation of R&D	If your company should consider relocating, which cities would in your opinion be the most attractive location for R&D unit?	Global maritime expert assessments

PILLAR	PORTS & LOGISTICS		
OBJECTIVE INDICATORS		**DESCRIPTION**	**SOURCE**
	1. TEU in port	Volume of TEU handled by ports around the world for 2020. Measures how "busy" each port is. Data for top 100 ports.	Lloyd's Top 100 Ports 2021 (2020 data)
	2. Size of port operators	Volum of TEU handled by top 21 port operators in the world.	Drewry (2019 data)
	3. Liner Shipping Connectivity Index	Liner Shipping Connectivity Index, dissaggregated on port level. 2020 data.	UNCTAD 2020
	4. LNG available at ports	Ports with available LNG bunkering facilities. Ports are ranked based on the aggregate tank capacity of LNG bunker vessels who use the port for bunkering	Alternative Fuel Insights DNV 2021
		SURVEY QUESTION	
	1. Ports and logistics center of the world	Which cities do you consider the five leading centers for ports and logiatics of the world?	Global maritime expert assessments

PILLAR	ATTRACTIVENESS & COMPETITIVENESS		
OBJECTIVE INDICATORS		**DESCRIPTION**	**SOURCE**
	1. Ease of doing business	Measures ease of doing business, by assessing regulatory performance.	World Bank 2020 (doingbusiness2020.org)
	2. Transparency/corruption	Measures the perceived level of public sector corruption (Corruption Perception Index).	Transparency International (CPI 2020)
	3. Entrepreneurship	Measures, with several indicators, the health of the entrepreneurship ecosystems.	Global Entrepreneurship Index
	4. STRI OECD. Sectors: Maritime transport and logistics cargo handling	STRI OECD. Sectors: Maritime transport and logistics cargo handling. Country-level data	OECD 2020
SUBJECTIVE INDICATORS		**SURVEY QUESTION**	
	1. Leading maritime center of the world in 5 years	Looking forward 5 years from now: Which cities will be the five leading maritime centers of the world?	Global maritime expert assessments
	2. Number one choice for relocation of headquarters	If your company should consider relocating, which cities would in your opinion be the most attractive location for headquarters?	Global maritime expert assessments
	3. The most innovative and enterpreneurial city	Which cities are the most innoative and entrepreneurial in the maritime industry today?	Global maritime expert assessments

SHIPPING CENTERS

"The strong drive in digitalisation, as well as having key stakeholders in close proximity makes Singapore a global hub for shipping."

– CARL SCHOU, CEO, WILHELMSEN SHIP MANAGEMENT

SUMMARY

When assessing the importance of the world's shipping centers, Athens, Singapore, and Tokyo take the top three spots in the total ranking of the leading shipping centers, with Shanghai and Hamburg following, to complete the top 5 placements.

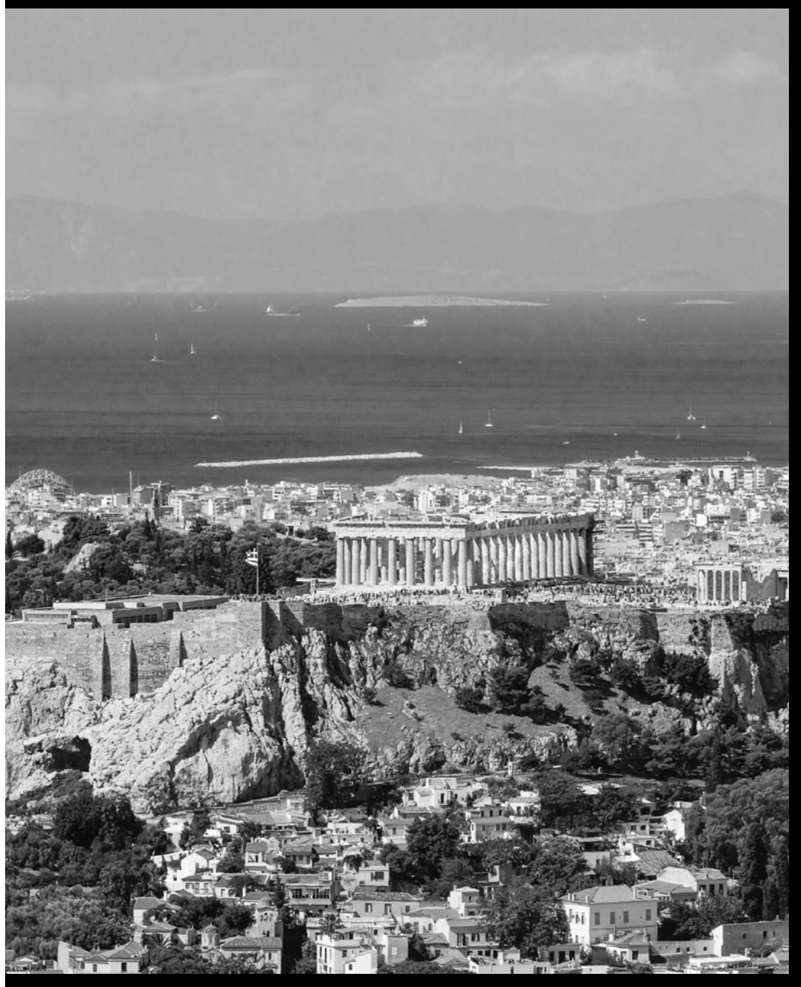
The rankings (when compared to 2019) are in line with the recent growing sentiment and shift seen in the shipping sector, with more and more shipping operational activities moving to Asian maritime centers, resulting in traditional European shipping centers now populating the lower parts of the top 10 ranking. The exception is Athens, whose owners and managers have demonstrated high aversion to risk, stemming from political and COVID-19-related economic uncertainties, and now sit firmly in the 1st position, ousting industry experts' long-time favorite, Singapore.

Globally, there has been a significant rise in the world's fleet value in recent years, from USD 873 bn in 2016, to USD 951 bn in 2019, to about USD 1.2 tn in September 2021. The rise in value is mostly attributed to the better shipping economic outlook that dominant market segments, such as the dry bulk and containership segments, have been experiencing in 2021, compared to the previous decade. At a city level, the top 10 cities in terms of owned fleet value control more than USD 570 bn, which is approaching 50 percent of the world fleet's value, illustrating the importance of these cities in the global world of shipping.

European cities have historically been dominant in terms of ownership, though this is gradually changing, as Asian shipowners have taken most of the fleet growth in the decade. Asian owners have increased their market share to 42% of the global fleet, up from 36% in 2012 (in terms of GGT), with Chinese owners clustered in Shanghai and Hong Kong facilitating most of this change. The European share of the world fleet, however, has only fallen from 45% to 43%, so the remaining shares have been captured from other continents.

Again, Athens has experienced a contrasting development as fleet ownership and ship management levels, in terms of tonnage, have increased by about 20% since 2019. The city's strengths lie in a large and strong ship owning community, with Greek shipowners having played a key role in the industry for decades and expected to remain influential in the future. Its maritime cluster also caters to this community, offering top-notch shipping services covering shipping operations, and technical and crew management while employing qualified local talent. However, it is still being perceived as primarily serving the local Greek shipping companies and less so international shipping entities, hence the experts have opted to give their vote of confidence to other shipping centers, predominantly Singapore and Shanghai.

Singapore's strength lies, to a large extent, in its geographic location on the East-West trade lane and in proximity to populous markets, such as the Chinese and Indian ones, and the



SHIPPING	Fleet size - management	Fleet size - owner	Fleet value - owner	Number of shipping HQ	Turnover shipping companies	Env. friendly fleet size - owner	Q: Shipping	Q: Operations
ATHENS	1	1	1	2	39	1	3	9
SINGAPORE	2	2	6	3	14	8	1	1
TOKYO	7	3	2	6	3	2	11	15
SHANGHAI	5	6	4	9	2	12	5	2
HAMBURG	4	4	3	5	8	9	6	7
LONDON	6	9	9	14	5	4	2	5
HONG KONG	3	5	18	11	21	15	4	4
COPENHAGEN	13	12	7	26	4	7	9	10
JAKARTA	8	10	24	1	33	28	29	30
ROTTERDAM	9	11	11	4	26	16	8	6
OSLO	21	13	10	22	9	3	7	11
SEOUL	16	7	8	12	7	6	26	20
BEIJING	29	21	19	29	1	29	29	27
DUBAI	10	18	26	10	10	24	10	3
IMABARI	15	8	5	8	29	38	15	34

Asian production bases. Singapore is a key location for shipping, and an important center for commercial management. It is home to the second largest fleet in the world owned at city level and the second largest fleet managed from a city (both in terms of tonnage), and scores highly among experts on the subjective indicators, perceived as the leading shipping center to operate out of, and the prime choice for relocating shipping activities. Industry experts have also highlighted the presence of many foreign owners in the city, illustrating Singapore's global attractiveness.

Tokyo has been a leading global shipping center for decades, ranking 3rd in shipping overall in 2021. Tokyo-based owners have been increasingly taking up larger stakes in key growing shipping segments, for instance being the top owners of LNG carriers globally and one of the leading cities in terms of alternative fuel-capable tonnage ownership. They facilitate Japanese and global trade by chartering out many of their vessels on long-term contracts with established ship managers or large players in the manufacturing and energy sectors, ensuring stable sources for their earnings. Despite this, several factors such as high office operational costs have lessened Tokyo's attractiveness as a base for ship management, a sentiment that is also shared by the industry experts.

Shanghai has shown phenomenal growth in terms of its maritime activities in recent years, forming a cluster of Chinese owners and international managers that facilitate the bulk of the Chinese imports and exports, managing to edge out the competition from other shipping centers in the region, most notably Hong Kong. Global shipping organizations are taking notice, establishing regional headquarters, branches or other project companies in Shanghai, empowered by such mechanisms as the local pilot free trade zone, and the increased uptake of digitalization practices in shipping operations, to improve efficiencies and reduce associated costs. The city is home to the Shanghai Containerized Freight Index (SCFI). Also appealing to industry experts are the continuous efforts from local administrations poured into improving the city's modern shipping services, such as shipping finance, with vessel leasing quickly gaining traction from global shipowners, maritime arbitration, and other legal services.

Hamburg has been struggling to keep up with other shipping centers in recent years. The ship owning community had to face some unique challenges, the reason for this being that a portion of their fleet has been financed through the KG system, i.e. by single purpose companies with an asset manager (oftentimes related to a technical ship manager) and hundreds of small equity holders, who had little insight in and control over their vessel and its operation. Many of the KGs could not weather the storms of the global financial and shipping crisis and ultimately collapsed. Many capital holders were disincentivized to continue investing in shipping and moved on to other opportunities, which in turn stunted Hamburg's ship owning tonnage growth. Regardless, due to their expertise, and proven track record, vessel management has remained in Hamburg for many vessels that changed hands to non-German owners, and the city remains a global hub for ship operations, hosting some of the most successful shipping companies, including Hapag-Lloyd in containerships, Oldendorff Carriers in the dry bulk segment and Bernhard Schulte Shipmanagement.

EXPERT ASSESSMENT

When considering the breakdown of the industry experts' assessment for the shipping pillar, it can be seen from the figure below that experts perceive Singapore, London, Athens, Hong Kong, and Shanghai as the leading shipping centers in the near future. Shipping executives, furthermore, indicate that in case their company had to move their operational units, they would choose Singapore as the first option, followed by Shanghai and Dubai.

Unsurprisingly, Singapore's strong holistic focus on the maritime sector and the establishment of a leading global maritime cluster grants the city the top position in both assessments, by a wide margin. The city is attractive due to its location, quality of life, and availability of a knowledgeable work force. The Singapore government has for many years supported this segment both financially, by establishing a stable, pro-business environment, and by taking a consultative approach to the sector. It has retained a strong position for shipping activities, both commercially and operationally, and has also been an important meeting place for international shipowners.

London may not be perceived as the leading maritime center anymore, in the eyes of the industry experts, but its long-established and extensive maritime cluster continues to attract some of the most successful shipping companies, as well as industry professionals globally. The experts believe that London's standing as one of the top shipping centers will not be challenged in the near future, but high costs associated with office operations may disincentivize shipping companies from relocating their operational unit there, choosing a less costly destination instead, and thus ranking the city in the 5th place.

Chinese centers, such as Shanghai and Hong Kong, are coming up strong in the last decade, due to their proximity to the Chinese production bases, needing streamlined shipping clusters to facilitate the ever-growing export volumes. Thus they secure positions in the top 5 as candidates for the leading shipping centers of the future. They predominantly house Chinese owners and managers, but due to their tremendous growth, international players are starting to take notice and to consider establishing branches, ranking Shanghai 2nd, after Singapore, for choice of relocating shipping operations, and Hong Kong 4th.

Athens places 3rd on the subjective ranking of future leading shipping centers, with Greece's shipping magnates having emerged largely unscathed from the country's financial crisis and one of the shipping industry's longest downturns during the 2010s. The city has been developed as a principal ship owning and management location due to its historical position as one of the great maritime centers and its highly qualified maritime workforce. However, it is largely perceived as catering mainly to the numerous Greek shipowners/managers, and less so to international players, thus it does not score as highly when viewed as a choice for relocation, ranking 9th overall.

Dubai has managed to acquire the 3rd place as an appealing location for relocating shipping operations, due to the growing trade needs of the Middle East Region and a strong governmental focus on providing incentives for attracting international investments. Overall, Dubai ranks 10th, just below some established European maritime centers. It is still not considered a leading shipping center by experts, but it is very quickly gathering traction among them as the dominant maritime cluster in the Middle East Region.

Fig. 1 - Score based on experts' answers to "Which cities do you consider the five leading centers of shipping of the world?"

Source: Menon Economics & DNV (2021)

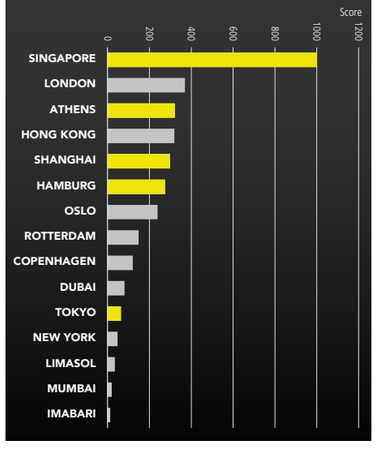
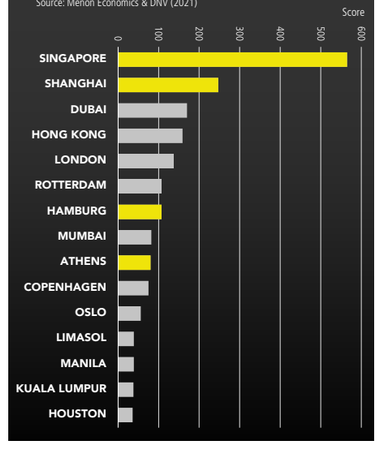


Fig. 2 - Score based on experts' answers to "If your company should consider relocating, which cities would in your opinion be the most attractive location for opertional units?"

Source: Menon Economics & DNV (2021)



OBJECTIVE INDICATORS' ASSESSMENT

The figures used in this chapter present information about the top 50 maritime cities globally. There might be some cases where cities not included in this sample objectively perform better on indicators included in this specific pillar. However, such cities do not perform well enough on an overall level to be a part of the list of top 50 maritime cities globally and are therefore excluded in this chapter.

To be recognized as a leading center for

shipping, a city must be the registered home to a strong number of shipowners and managers, both in terms of their fleet size as well as fleet value. The number of shipping companies that chose to have their headquarters in a particular city will further impact this city's ranking in our benchmarking assessment of the objective indicators for the shipping pillar. As a new addition to this year's report, shipping centers will also be judged based on their respective ownership, in tonnage, of alternative fuels-capable vessels, a sector which is expected to shake up the established status quo in shipping and become one of the deciding factors that will make or break future shipping companies.

"To increase its attractiveness for maritime companies, Hong Kong should improve transparency, maintain the legal system and focus on fairness."

– Manager of a shipping company, Hong Kong

SIZE OF SHIPOWNERS' FLEET AND MANAGEMENT OF FLEET

In the figures below, cities are ranked by the size of total fleet in compensated gross tonnage (CGT) based on shipowners and ship managers located in each city. For an international industry like the shipping business, ownership and management of companies can easily be split up to take advantage of specialized local competence and cost differentials in different cities. Data was compiled for the entire world fleet and vessels were then assigned to the individual cities where their owners and managers are located.

On this indicator, Athens comes out strongly in the 1st position, both in terms of shipowners' and managers' operating tonnage, at about 105 million and 111 million CGT, respectively. Singapore follows in 2nd place, with about 40% more managed than owned tonnage, at 83 million and 52 million CGT respectively, in contrast to Tokyo, Imabari and Seoul, where there is close to 50% more owned than managed tonnage, showcasing a different approach to successful shipping norms and practices.

Hong Kong and Shanghai have been rapidly climbing on this indicator in recent years, as Chinese owners and managers add tonnage to their ranks, at a rate surpassing all other cities. Hong Kong has managed to win the 3rd place from Hamburg, since 2019, in this combined ownership/management measurement, but has not achieved Shanghai's rate of growth. Shanghai has easily surpassed London and now aims to take on Tokyo, potentially indicating that it is the city with the potential to win over the bigger piece of the Chinese ship management/ship ownership pie in the future.

Lastly, Jakarta has managed to land in the 8th place on this chart, up 3 places since 2019, despite Indonesia being severely hampered by the COVID-19 pandemic. Its GDP/population growth levels, the regional trade volumes growth leading to higher needs for shipping tonnage, coupled with the low office overheads, formulate a mix of favorable conditions for shipping activities.

VALUE OF CITY-CONTROLLED FLEET

Another means of benchmarking the cities is by considering the value of the fleet owned from these cities. As opposed to the size of a fleet, fleet value offers a better reflection of its economic importance. This evaluation is based on data from Clarksons World Fleet Register with the estimated value of the share of the fleet controlled from the city.

The current state and economic outlook of the underlying shipping segments play an important role in measuring a vessel's value, meaning that if a city's fleet is largely concentrated in a specific segment, then the fleet's value will also largely depend on said market's state and outlook. For example, cities in the Gulf Area, such as Dubai, Abu Dhabi and Doha, possess a high ratio of offshore vessels, so the offshore market's state greatly affects the value of the fleet in those cities. Obviously, this phenomenon is weaker for cities that showcase a variety of vessels in their owned fleets.

The world's total fleet value is concentrated in Athens, Hamburg and in Asian centers, such as Tokyo, Imabari and Shanghai, and the composition of the merchant fleet differs between them. Athens may be best known for being home to a large tanker fleet, but the city also has a substantial fleet within the bulk and gas carrying segments. Tokyo has a well-diversified fleet consisting of bulkers, containerships, ro-ro vessels and gas carriers. Hamburg is quite specialized within containerships, while Singapore has its strength within tankers, bulkers, offshore and containerships.

Athens and Tokyo have recently added quite a few vessels to their arsenal, increasing their fleet value by about 20% from 2019 to 2021, viewing vessel ownership as a prime form of capital investment, and sit comfortably in the top positions. Hamburg's large stake in containerships and dry bulk vessels, coupled with the respective markets' booming state, have elevated the city to the 3rd position in terms of total vessel value. Shanghai houses the bulk Chinese-owned ocean-going fleet, including the fleet of COSCO Shipping, the largest shipowner in the world in terms of total gross tonnage, whose aggressive tactics in ship acquisition and ship newbuilding have contributed to Shanghai taking the 4th place from Singapore, which is now almost in a tie with Imabari for the 5th position. Copenhagen is following in the next place, to a large extent due to the world's most valuable shipping company, Maersk.

Cities making up the rest of the top 10 have all witnessed an upward trend in terms of their fleet's total value since 2019, due to the aforementioned favorable state of most shipping markets, but not many individual changes in their respective positions relative to each other, have occurred.

TOTAL ANNUAL TURNOVER OF SHIPPING COMPANIES

The total annual turnover of shipping companies located in each city can be an important indicator of the local shipping community's size and importance to the global shipping markets. It is important to emphasize, however, that many shipping companies prefer not to have equity traded publicly and thus tend to keep their financial results hidden from the public to maintain their competitive edge. These facts, coupled with differences in reporting methods and local legal requirements, makes measuring the financial results in each city a challenging task.

The ranking on this indicator reveals a strong corporate factor, where several businesses might be grouped in one large corporation. Chinese cities, such as Beijing and Shanghai, are good examples. They showcase high turnover from shipping activities, spread across a relatively small number of companies (with COSCO the largest corporation), mainly due to the booming state of the containership market and the high global demand for Chinese goods.

Copenhagen, London and Marseille also retain high positions in total turnover, mainly due to the presence of very large shipping corporations (AP Moller-Maersk Group, BP Shipping, CMA CGM etc.), of which some are traded publicly on national or foreign stock markets, and their corporate reporting requirements provide a high level of transparency.

Tokyo gets the 3rd position and Seoul is ranked 7th, with companies' reports indicating that they generate most of their annual revenues from chartering out their owned vessels to established ship managers worldwide, on medium- to long-term contracts. Hamburg and Oslo follow in the next places, both with a fairly high number of medium-size shipping companies.

Finishing the top 10 is Dubai, where the shipowners'/ship managers' revenues are generated primarily from transporting general cargoes in the Middle East Region, crude oil or oil product shipments originating from the local production bases or serving the Gulf offshore rigs. Miami's score is based on the cruise company Carnival. Athens, number 1 on the shipping pillar as a whole, scores poorly on this indicator. This is likely due to lack of reporting of their economic results to the public.

NUMBER OF SHIPPING HEADQUARTERS

The number of shipping companies located in a city may give a different perspective on the shipping community than the value of the ships and revenues of the companies. Figure 7 shows the number of shipping companies with headquarters in each city, with Jakarta leading this indicator with 233 shipping companies registered there. Most of these are very small in size, operating small regional vessels that service the needs of the archipelago islands. Athens follows closely with 221 shipping companies, but again the majority are predominantly family-owned small enterprises and exhibit low volumes of communication or cooperation with each other. Singapore ranks 3rd, attracting owners and managers from all around the world, servicing every segment of the shipping industry, and the city owes much of its success to the incentives provided by Singaporean Register and the active role of MPA Singapore in attracting shipping companies to the city. There are far fewer shipping companies based in the trailing cities of Rotterdam, Hamburg, Tokyo, Imabari and Shanghai, but these are, for the most part, large corporations, owning a diverse portfolio of vessels. Dubai and Istanbul have become attractive locations for shipping operations in the last decade, with offices being established primarily by local operators active in feedering and servicing the regional trade requirements (Gulf area, Black Sea, East Mediterranean area), and the offshore and passenger sectors.

ALTERNATIVE FUELS CAPABLE FLEET SIZE

In line with the recently adopted resolution to reduce GHG emissions by 50% by 2050, some shipowners have started to install engines capable of using alternative fuels on their newbuild projects, such as LNG, LPG, or methanol. However, significant barriers still exist on many levels for different fuels – ranging from *technical maturity* (of designers, yards, engine/equipment suppliers, ship/cargo owners), *fuel availability* (from feedstock suppliers, fuel suppliers and authorities), *infrastructure* (by fuel supplier, authorities, bunkering terminals, ports), *capital expenditures* (for shipowners, including support from incentive schemes) and *regulatory status* (from IMO, Class, regional and national). Shipowners must weigh in these factors in their decision to invest in alternative fuels-capable vessels, where the initial investment costs for new technologies are high. To lower their investment risks, large shipowners such as Mitsui O.S.K., BW Group and Angelicoussis Group secure long-term deals, ranging from 5 to 15 years, with established charterers like BP and Total, and then undertake alternative fuels-capable newbuild projects, with the vessels deployed under charter contracts.

From a cities' point of view, Athens and Tokyo lead comfortably in terms of alternative fuel-capable tonnage, owning about 1.3 and 1.2 million GT respectively. With less than half of the alternative fuel-capable tonnage compared to Athens or Tokyo, shipowners in Oslo, London and Marseille nevertheless demonstrate an increased rate of integration. In the rest of the top Asian shipping centers, such as Seoul, Shanghai and Singapore, local owners have not yet invested significantly in environmentally friendly tonnage compared to European cities.

Fig. 3 - Size of fleet (CGT) owned by shipmanageres registered in the city

Source: Clarksons Research & Menon Economics (2021)

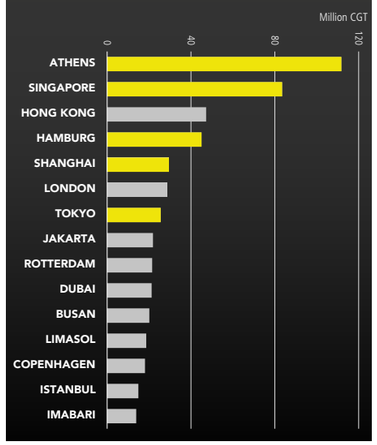


Fig. 4 - Size of fleet (CGT) controlled by shipowners registered in the city

Source: Clarksons Research & Menon Economics (2021)

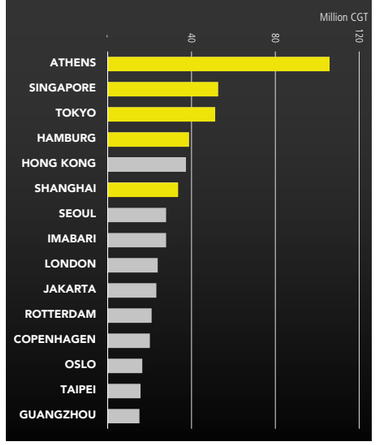


Fig. 5 - Fleet value assigned to cities

Source: Clarksons Research & Menon Economics (2021)

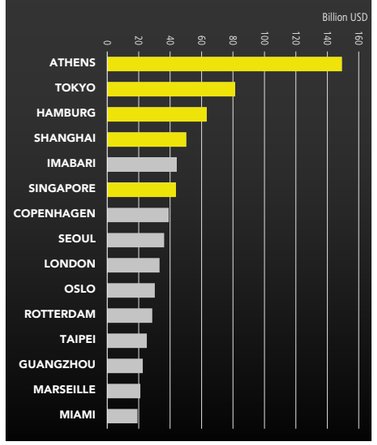


Fig. 6 - Operational revenue (turnover) for shipping companies

Source: Bureau van Dijk (2021)

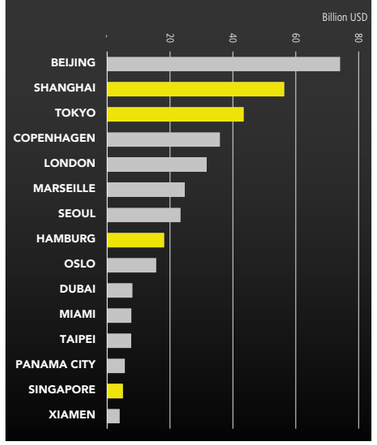


Fig. 7 - Number of shipping companies registered in the city with more than 5 vessels

Source: Clarksons Research & Menon Economics (2021)

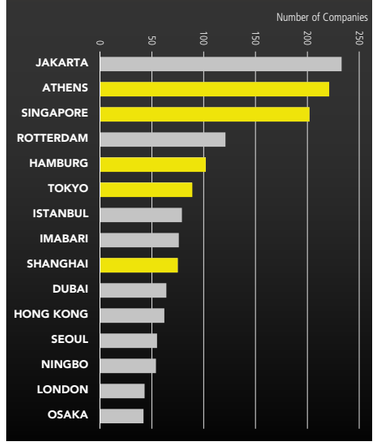
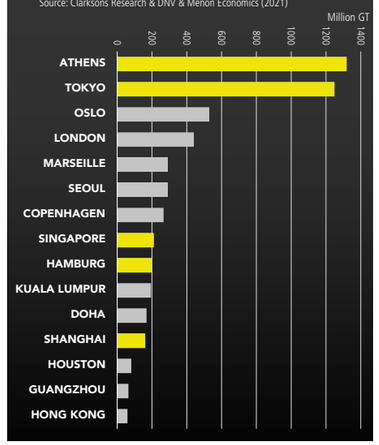


Fig. 8 - Environmental impact of shipowners' fleet - measured as share of fleet (in GT) with low carbon intensive fuel types, including current fleet and orderbook

Source: Clarksons Research & DNV & Menon Economics (2021)



MARITIME FINANCE AND LAW

SUMMARY

"In the years ahead, we will see continued and accelerating focus on ESG: companies that wish to thrive must be seen as contributing meaningfully to the advancement of the maritime ESG agenda."

– SHIP FINANCE MANAGER, OSLO

Overall, New York is ranked first in the world for maritime finance and law, followed by London, Tokyo, Oslo and Paris. New York is home to the world's largest stock exchange for maritime listings and plays a key role in financing maritime operations. London is widely recognized for its maritime law-related and marine insurance services. It is home to world-leading institutions, such as Lloyd's for insurance, and English law is the most widely applied in shipping disputes.

Tokyo is the center of gravity for the Japanese shipping community with several banks that are strong in ship finance and the presence of a strong Export Credit Agency (ECA). Its insurance companies (covering for cargo, H&M, P&I) generate the 2nd largest insurance premiums and many of its maritime companies are stock listed. Tokyo ranks 3rd overall but does not perform well on legal indicators, since its law firms are less recognized on a global scale.

Oslo's strong position in maritime finance is mainly due to Norway's strong historical position in the maritime industry and the development of world leading financial services that have supported this industry. Oslo is home to the world's two leading shipping banks and has a strong position with a maritime focused stock exchange and leading insurance and brokering entities.

Paris, an inland city without a significant port and a shipping community, ranks 5th on the Maritime Finance & Law pillar, due to being home to the headquarters of leading ship financing banks such as BNP Paribas, Credit Agricole and Société Générale, and its strength on insurance.

Recently, Asian (particularly Chinese) banks have emerged in ship finance and as of today, three out of the global top ten banks are now Chinese (e.g., Bank of China, ICBC, China Exim). When assessing top shipping portfolios by banks headquartered in various cities across the world, Beijing is the top performer.

According to the industry experts, the top 5 cities for maritime finance are London, Singapore, New York, Oslo and Hong Kong. Paris and Tokyo, which score high on the objective indicators, are not acknowledged among the top cities by the industry experts; instead, they rank Singapore as the second most important city, even though the city is in the 8th position on the objective criteria.

MARITIME FINANCE AND LAW	Legal experts	Maritime lawyers	Insurance premiums	Mandated loans	Shipping banks portfolio	Liste maritime owner groups	Market cap maritime companies	IPO/Bonds/Follow ons	Q: Finance
NEW YORK	2	2	24	1	8	1	1	1	3
LONDON	1	1	1	6	6	12	13	9	1
TOKYO	14	26	2	3	3	4	6	10	7
OSLO	14	16	9	2	5	2	10	2	4
PARIS	10	12	4	4	2	16	11	-	15
ROTTERDAM	7	5	7	5	4	-	-	6	9
HONG KONG	10	10	19	-	-	3	2	7	5
SINGAPORE	7	8	3	-	13	7	7	3	2
BEIJING	-	24	5	-	1	-	-	-	13
SHANGHAI	-	15	16	-	-	9	3	8	6
COPENHAGEN	5	36	29	7	9	18	15	12	11
SYDNEY	2	20	13	-	12	19	16	-	20
ATHENS	16	3	28	-	10	16	19	-	12
HAMBURG	9	9	10	-	11	21	22	-	8
MUMBAI	16	24	26	-	-	6	5	-	21

EXPERT ASSESSMENT

Maritime activities tie up large amounts of capital. The industry is characterized by cyclical markets. Hence, access to capital will determine the long-term success of many companies. Companies raise capital with debt, by taking on bank loans or issuing bonds, or with equity, by issuing shares or receiving private investment. London, Singapore, New York and Oslo remain the clear leaders within this field, according to the industry experts, due to their strong positions in banking, law, insurance and brokering services. The top 5 includes the same cities as the 2019 assessment, while Tokyo continues to rise and is now ranked 7th, by the experts and 3rd on the pillar as a whole. Similarly, Paris, which is 15th in the expert assessment, makes it to our overall top 5. Judging by this it appears the experts prioritize a strong stock exchange over the bank loan indicators. In addition, the deals and transactions often take place where the large maritime companies are located, not necessarily in the cities of the banks and other financial providers.

OBJECTIVE INDICATORS' ASSESSMENT

The figures used in this chapter present information about the top 50 maritime cities globally. Hence, there may be some cases where cities not included in this sample objectively perform better on indicators included in this specific pillar. However, such cities do not perform well enough on an overall level to be a part of the list of top 50 maritime cities globally and are therefore excluded in this chapter.

Eight objective indicators were chosen to benchmark the leading maritime financial and legal centers. These indicators measure the volume of legal and financial expertise and associated activities in each selected city – from the number of maritime legal experts rooted in each location to the volume of mandated loans issued from the financial institutes and companies that provide financing (debt, equity, mezzanine) for the industry, primarily for the sale and purchase of vessels. These companies also include international and investment banks, private equity firms as well as smaller boutiques, which act as arrangers or introducers of capital. Data on the number of listed maritime companies, and volume of traded bonds, IPO and follow-ons from stock exchanges headquartered in each city was also used as an objective indicator.

LEADING FINANCIAL CITIES

Maritime cities have been benchmarked based on the market value and the number of listed maritime companies on their local stock exchanges. New York is by far the largest equity market in the world for maritime stocks, both in number of tradable stocks and market capitalization of the companies.

Compared to the 2019 results, New York and Oslo have maintained their first and second positions when it comes to the number of tradable stocks. There is a clear trend towards de-listing however, as all the highest ranked cities from our last assessment have suffered large drops in the number of listed maritime companies.

In terms of market capitalization of maritime stocks, New York has maintained its leading position, even though there was a reduction in values from 2019. Hong Kong and Mumbai are the biggest leapers from the last assessment, with the former reaching the 2nd rank, while the latter appears 5th on the list after not featuring last time. Rounding out the rest of the top 5 are Shanghai and Busan. In Shanghai, two major companies dominate the value of maritime stock. China Shipbuilding Industry combined with Shanghai International Port Group has a market capitalization of USD 32.3 bn.

When considering the trading volume of bonds, IPO and follow-ons from each city's stock exchange during the period 2019 to 2021, New York is leading, followed by Oslo, Singapore, Taipei and Rotterdam. New York as the leader traded more than sixfold the volume of Oslo, which in turn traded more than double that of Singapore.

"To increase its attractiveness for maritime companies, Rotterdam should invest even more in sustainable energy solutions, such as increasing shore power connections."

– Owner of a Maritime tech company, Rotterdam

BANKS – SHIP FINANCING

Whilst New York stands out as the leading financial city of the world, Paris is now the leading European city for ship finance followed by Oslo and Rotterdam. Paris has grown since 2019, with BNP Paribas now the leading ship finance bank in the world measured in terms of loan books, as well as Credit Agricole CIB and Société Generale. Oslo-based DNB and Nordea (shipping division) are also among the leading ship finance banks measured in terms of book runner and MLA (Mandated Lead Arranger) portfolios. In Rotterdam, ING and ABN AMRO have boosted their position for both bookrunner loans and in MLA.

Many ships are financed by syndicated loans, which reduce the risk for the individual lenders. In this process, one bank usually functions as the mandated lead arranger. That means that the bank has the leading role in the financing stage of a project. During the syndication process, one of the banks may also fulfil the role of book runner. When the structure and terms of the loan have been agreed, one (or a number) of banks will be appointed "book runner" and sell the loan to other banks in the syndicated loan market. In some markets, national export credit banks also

play a key role in the financing process. New York is the most important center in the world for this kind of financing, followed by Oslo, Tokyo and Paris. Citi, Bank of America and Merryll Lynch have their headquarters in New York, and while they are not among the top 10 banks worldwide for their shipping loan portfolios, they do lead as MLAs.

However, in general, traditional European banks are gradually cutting back on ship financing, with the exception of French banks. With owners increasingly looking for alternative ways to finance their fleet renewal and investment programs, Chinese lenders, leasing institutions and export-credit agencies are quickly filling a critical void left by the retreat of European commercial banks, especially for newbuilding orders. Prior to the shipping crisis, European banks dominated in the global ship financing sector. Five out of the global top ten were in Germany, two in Scandinavia, one in the UK, and one in France, while only one was based in Asia. However, with the crisis many traditional lenders experienced heavy hits on their P&L and were forced to write-off, reduce or even exit their shipping portfolios. Due to the shipping crisis, Asian (particularly Chinese banks) have emerged in ship finance and as of today, three out of the global top ten banks are now Chinese (e.g., Bank of China, ICBC, China Exim). When assessing top shipping portfolios by banks headquartered in various cities across the world, Beijing is the top performer, followed by Paris and Tokyo.

LEGAL CENTERS

To assess the strength of cities when it comes to maritime law, the use of indicators such as the number of leading legal experts in shipping law as well as the number of maritime law firms give an indication of a city's importance for financial and legal transactions. Strong knowledge centers with many experts also attract more business to a city. Who's Who Legal, which identifies the foremost legal practitioners in business law based upon comprehensive and independent research, shows that London has the largest number of leading legal experts (16) in maritime law. Behind London are New York, Sydney, Rio de Janeiro and Copenhagen. When considering the number of maritime law firms operating in each city, the situation stays unchanged from 2019, with London in the lead, followed closely by New York, Athens, Panama City and Rotterdam. Whilst Athens is home to 60 maritime law firms, Singapore, Hamburg and Hong Kong have an average of 30 such firms.

This shows that with English law widely used in shipping disputes, London has sealed its position as the best location to resolve maritime disputes and for international maritime arbitrations. In that aspect, Singapore and Hong Kong could be London's strongest competitors. In Singapore, the efforts of the Singapore Maritime Foundation (SMF) to develop the city's own Ship Sale Form and SMF's involvement in the development of a

Fig. 9 - Score based on experts' answers to "Which cities do you consider the five leading centers of maritime finance of the world?"

Source: Menon Economics & DNV (2021)

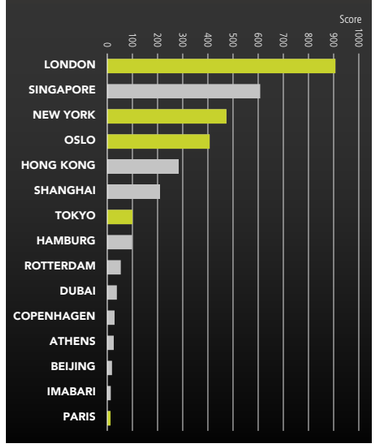


Fig. 10 - Market value and number of listed maritime companies on local stock exchange

Source: Bureau van Dijk (2021)

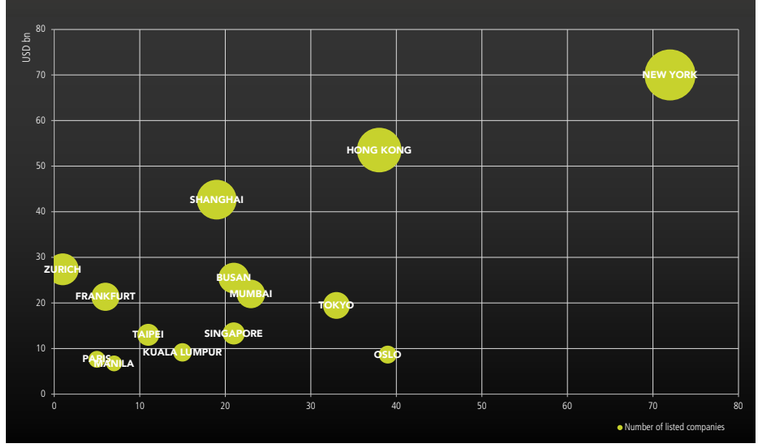


Fig. 11 - IPO/Bonds/Follow-ons during the period 2020 to 2021

Source: Clarksons Research & DNV & Menon Economics (2021)

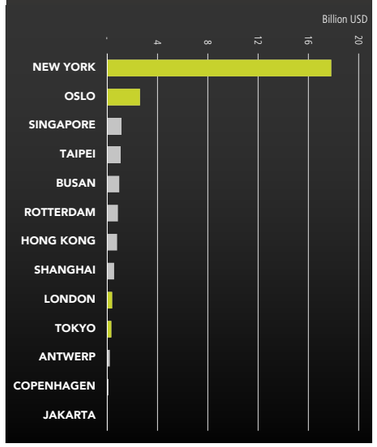


Fig. 12 - Top 40 shipping portfolios by banks across the world, where sums are allocated to cities after the location of the bank's HQ. Lending as of 31. December 2020

Source: Petrofin Research (2021)

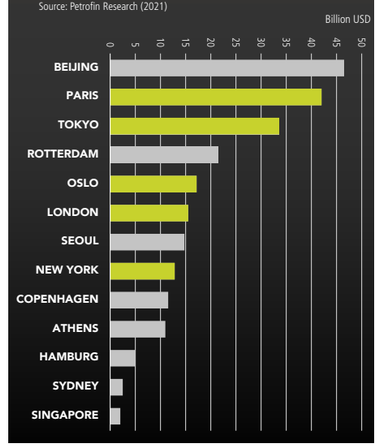
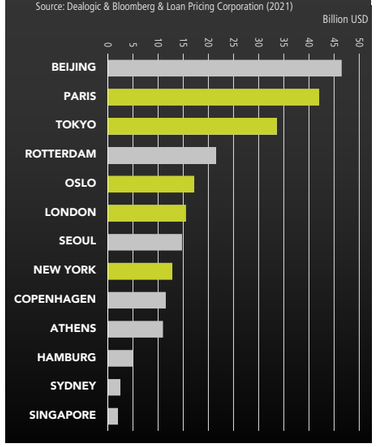


Fig. 13 - Value of maritime syndicate mandated loans issued from bookrunner/MLA. Sums allocated after location of the HQ to each bookrunner/MLA

Source: Dealogic & Bloomberg & Loan Pricing Corporation (2021)



modern Charter Party Form together with BIMCO and Association of Shipbrokers and Agents (ASBA) incorporating Singapore as the location of arbitration (in addition to New York and London), reflects the growing importance of Singapore as a leading international maritime legal center. The strength of both Singapore and Hong Kong seems to be related to their proximity to commercial operations and access to key industry players, with Hong Kong positioned as a gateway to mainland China.

MARINE INSURANCE

Marine insurance was the earliest well-developed kind of insurance, with origins in the Greek and Roman maritime loan. Marine insurance in the modern world is a prerequisite for a functioning shipping market. Large shipping companies transport cargo worth hundreds of millions of dollars every day on large ships that themselves may be as valuable as their cargo. To reduce risk involved in such operations, shipping companies insure both the cargo and the hull of the ship.

To assess a city's position in terms of its reputation as a marketplace for insurance coverage and its marine insurance services, several factors were considered such as concentration of P&I clubs and the collected insurance premium at city level, and the presence of commercial insurances covering cargo, hull and machinery (H&M). This assessment shows that London, home to the first marine insurance company in the early 18th century with Lloyd's of London and complemented by the International Underwriting Association (IUA), continues to be the unrivalled city for marine insurance with more than 50% of International Group (IG) of P&I clubs covered gross tonnage served by UK-based clubs, over 30% of global cargo and H&M premium collected by UK-headquartered insurance companies and the highest number of representation offices of all clusters. Other European cities with a significant role in marine insurance are Paris, Genova and Rotterdam.

In Asia, Tokyo and Singapore have maintained their positions within the top 5, their focus being mainly on domestic clients. Singapore's 3rd position on this indicator is due to its efforts to increase its marine insurance activities by introducing its own Singapore War Risk Mutual supported by its industry association (Singapore Shipping Association, SSA). In China, Shanghai and Beijing have swapped places with the latter taking the former's place in the top 5, while Shanghai has dropped to 16th. This is most likely due to a change in reporting standards which has moved some of the insurance premiums produced in Shanghai over to Beijing.

Fig. 14 - Number of legal experts

Source: Who's Who (2021)

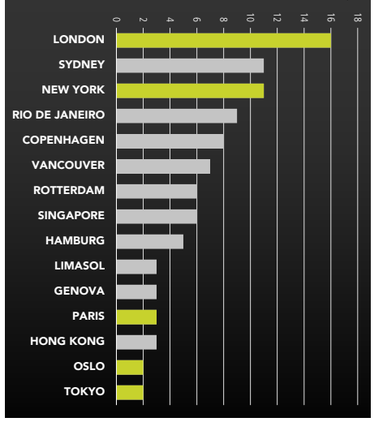


Fig. 15 - Number of maritime law companies

Source: World Shipping Register (2021)

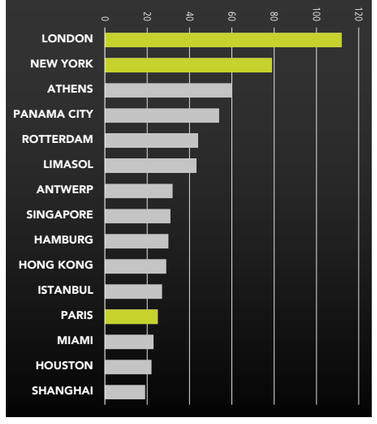
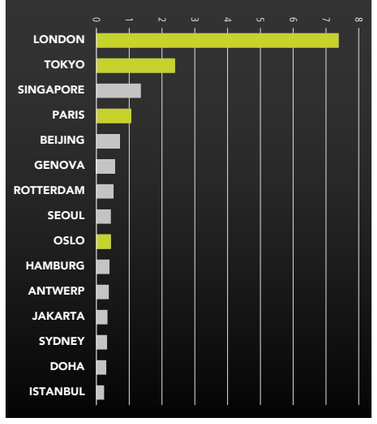


Fig. 16 - National collected insurance premiums for P&I, hull, cargo, and offshore disaggregated to city level

Source: IUMI & CEFOR & Bureu van Dijk (2021)



MARITIME TECHNOLOGY

SUMMARY

1	2	3	4	5
SINGAPORE	OSLO	BUSAN	LONDON	SHANGHAI

"I am delighted to witness the traction of tech companies coming to Singapore and fostering an ecosystem of tech immersion and growth."

– STEEN LUND, CEO, RIGHTSHIP

Benchmarking of cities based on objective indicators for their standing on maritime technology is challenging. Ideally, measures of R&D, education and innovation should be used. However, it is hard to find global data sources at city-level that compare the magnitude, relevance and quality of maritime research, education and innovation. Such factors are more suited to subjective assessments by maritime experts. Still, seven objective indicators, revealing different dimensions of maritime technology are used in our ranking: the size of fleet (CGT) delivered by shipyards, including a separate indicator on low- or zero-carbon fuels-capable tonnage; the share of world fleet by classification societies; market value of ships built at shipyards; the number of patents by maritime companies based in a city as well as the number of maritime education institutions found there.

Singapore is ranked as the world leading city when it comes to maritime technology, followed by Oslo, Busan, London, and Shanghai. Tokyo, Hamburg, and Rotterdam are now moving down in the maritime technology ranking.

While not known for its shipbuilding capabilities, Singapore nevertheless shows a lot of promise when it comes to setting up a framework for maritime R&D projects, as the government is willing to provide support schemes to maritime companies, and especially maritime technology start-ups, that will increase their ease of access to markets, funding, and talent. One such program is the Pier71, set up by the Singapore MPA, which strives to create an international ecosystem of maritime technology providers, investors and clients. It also includes educational institutions, such as the National University of Singapore, providing experts that can assist in the development and trial phases of innovative projects. The city has set itself the bold target of housing 150 startup companies in the maritime technology sector, and being dubbed the Silicon Valley of marine technology, by 2025.

Oslo, ranked as the world's 2nd leading city overall, is considered one of the prime hotspots for maritime technology and innovation. One of the most important technology companies in the Norwegian cluster is DNV with its head office in Oslo. DNV is one of the world's leading maritime R&D companies, investing 5% of its revenues into new technology development, as well as the world's largest ship classification society according to Lloyd's List. The Oslo region also hosts world leading equipment producers, like Kongsberg Maritime, and various specialized tech-companies, like Cognite.

In third position is Busan, thanks to its big fleet size (CGT) delivered by its shipyards, the market value of the ships built there, as well as leading in the number of patents produced by the maritime firms headquartered in the city. Busan is the center for the South Korean shipbuilding cluster where the major shipyards focus on offshore units and high value-added "mega-ships" such as container ships, VLCCs

MARITIME TECHNOLOGY

	Shipyards deliveries	Shipyards deliveries - eco friendly ships	Turnover maritime technology companies	Classified fleet	Market value of ships	Maritime patents	Maritime education institutions	Q: Technology	Q: Sustainability	Q: Digital	Q: R&D
SINGAPORE	13	11	5	16	8	11	5	1	2	1	1
OSLO	22	15	13	1	10	9	10	2	1	2	2
BUSAN	1	1	2	7	1	5	31	4	12	13	11
LONDON	-	-	8	4	-	6	1	7	6	5	3
SHANGHAI	2	2	3	18	2	17	10	3	7	3	3
TOKYO	8	5	6	2	6	3	16	6	8	10	8
ROTTERDAM	9	9	10	-	18	2	2	8	4	6	7
HAMBURG	17	16	18	19	17	4	3	5	5	7	5
BEIJING	11	21	1	5	15	20	23	26	23	23	20
SEOUL	26	19	4	24	-	1	31	10	17	17	17
HOUSTON	31	21	28	3	-	8	15	13	23	14	15
COPENHAGEN	-	-	32	-	-	12	10	9	3	4	6
PARIS	-	-	9	6	-	7	31	31	26	26	30
IMABARI	3	8	7	-	3	18	-	14	26	26	30
ATHENS	28	21	39	9	-	39	3	15	16	14	12

"In green transition, cities such as Oslo and Copenhagen are on the forefront, with Singapore and Tokyo the leading lights in Asia. There have been many MOUs signed between Norway, Denmark, and Singapore. With the growing interest in Singapore about the green transition, the gap between Europe and Singapore is narrowing, which is very pleasing."

–ESBEN POULSSON, CHAIRMAN, INTERNATIONAL CHAMBER OF SHIPPING (ICS)

and LNG tankers.

London scores greatly from its prestigious maritime education institutions and for being the home of the oldest classification society with a history from 1760, Lloyd's Register.

Shanghai closes the top 5 list, driven by the presence of its modern shipyards with major newbuild projects gravitating towards them. These shipyards have made phenomenal leaps in terms of quality of production in a relatively short time, while also retaining a high degree of competitiveness due to the economic incentives offered by the Chinese administrations such as extended financing to 80-90% of a newbuild project's total cost if a shipowner chooses a Chinese shipyard.

EXPERT ASSESSMENT

In this year's report, industry experts have been asked to rank cities on a variety of indicators where the focus has been on their status as leading maritime technology centers, their efforts in driving forward the maritime digital and green transformations, and their attractiveness for relocating maritime R&D activities. It seems that the maritime industry is on the verge of important changes driven by a sense of urgency in terms of the climate crisis and increased efforts to cut emissions by regulatory bodies. While the majority of experts point out the financing of the green transformation as an obstacle, a significant share of experts, 40%, mention availability of alternative fuels and technology as a barrier to green transformation. Many experts emphasize that the majority of the green technologies available has not reached commercial maturity, which is also the biggest challenge when it comes to financing the green transition.

There is generally a demand for specialized equipment in the maritime industry to cater for improved efficiency under sea conditions and to address new operational limitations to comply with recent environmental regulations. Such regulations create niche markets for maritime equipment, from marinized long-life batteries and new designs of engines running on unconventional marine fuels or other solutions for compliance with the upcoming IMO regulations. The experts have also pinpointed the cities that produce world-class maritime IT services and IT-based products, as a city willing to provide advanced digital infrastructure and an environment that is conducive to innovation will generally have a strong competitive edge. When it comes to cities being considered for relocating R&D activities, factors such as local labor costs, quality of life, the presence of advanced educational institutions, and the level of cooperation and information-sharing between different stakeholders are considered by the experts' assessment.

Singapore and Oslo are consistently in the top 2 places for all 4 indicators, both standing out as the main centers for digital and "green" technologies. Singapore's top ranks are mainly due to the city being a marketplace where maritime technology producers and clients usually meet, a place where all major marine equipment players are operating and where a high level of sophistication and competence exists locally to support high-value newbuilding of maritime and offshore assets, conversion projects, fabrication of process modules or to perform complex repair activities, even if the actual production procedures are not generally located within the bounds of Singapore. Furthermore, the Maritime and Port Authority of Singapore (MPA) has put tremendous focus on R&D and advanced maritime technology as one of their core pillars in promoting Singapore as a global maritime hub. The city seeks close cooperation between publicly funded institutions and private companies, with digital innovation and growth of marine tech entrepreneurship in mind. A key example is the establishment of the Singapore Maritime Datahub to serve as a collaborative platform for technology companies, start-ups and maritime stakeholders to co-develop innovative and data-driven maritime solutions and promote collaboration with organizations such as the Research Council of Norway (RCN) in Oslo, to focus on Maritime Digitalization and Autonomous Vessels and Systems.

Oslo houses top-notch R&D organizations and is home to a highly advanced maritime equipment industry, considered to be at the top in terms of solutions offered in the field of environmentally sustainable technologies. Kongsberg Maritime is the world's leading producer of digital products and solutions to more than 30,000 ships around the globe, including positioning systems, bridge systems and control centers. Oslo is also considered leading in the green transformation of the maritime industry. Almost four out of ten maritime experts point to Oslo as the leading city in the green transformation. It is also interesting to observe that Copenhagen scores highly both on green and digital transformation.

Together with Hamburg, Rotterdam, and London, Oslo has a long tradition of producing maritime technology solutions by focusing on the development and delivery of innovative equipment. All these cities are recognized as the home of excellent educational centers and main beneficiaries of advanced education clusters in their respective nations, which make the sourcing of competent researchers an easier task, thus ranking them highly in the top 5 for all our subjective indicators.

Shanghai is ranked among the top 4 on the subjective indicators, except for green transformation. It is regarded as a city of world-class maritime IT, driven by governmental focus on streamlining operations for the shipping industry and port infrastructure. The presence of a Free Trade Zone also increases the city's appeal as a candidate for relocating R&D activities.

OBJECTIVE INDICATORS' ASSESSMENT

The figures used in this chapter present information about the top 50 maritime cities globally. Hence, there may be some cases where cities not included in this sample objectively perform better on indicators included in this specific pillar. However, such cities do not perform well enough on an overall level to be a part of the list of top 50 maritime cities globally and are therefore excluded in the following chapter.

SHIPBUILDING

At shipyards, the demands from design and industry standards are put into action. Modern ships are a mosaic of parts from numerous subcontractors that become high-tech industrial assets for their owners. Assembling ships is a technologically and logistically demanding operation. Some shipyards build the entire ship in

Fig. 17 - Score based on experts' answers to "Which cities do you consider the five leading centers for maritime technology of the world?"

Source: Menon Economics & DNV (2021)

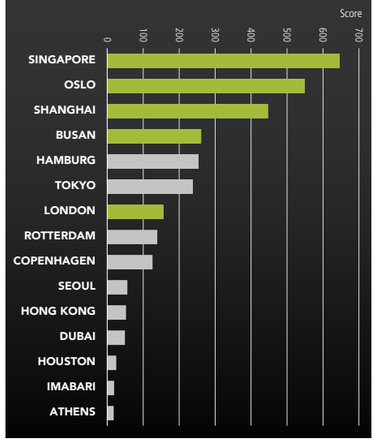


Fig. 18 - Score based on experts' answers to "Which cities are taking the lead in the green transformation of the maritime industry?"

Source: Menon Economics & DNV (2021)

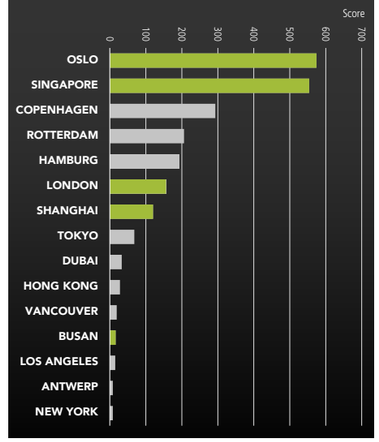
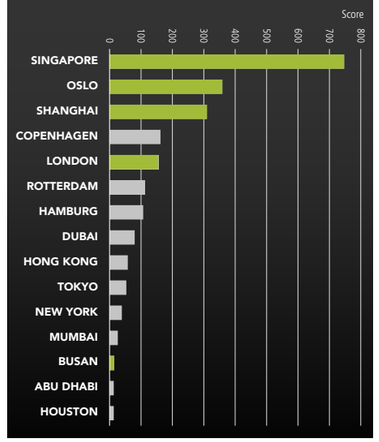


Fig. 19 - Score based on experts' answers to "Which cities have the strongest capabilities and are best positioned for the digital transformation?"

Source: Menon Economics & DNV (2021)



one location. For more technologically advanced ships, it is common for hull construction to occur in low-cost countries before outfitting is done in countries with more highly skilled and costly labor. Shipyards are often surrounded by maritime equipment companies that supply them.

In the last two decades, Asian centers have been rapidly growing in strength, so that nowadays they are responsible for more than 92% of the global CGT output. Focusing on the shipbuilding activities in 2019-2021, South Korea, China and Japan have been the main beneficiaries of this trend, gathering around 88% of the global output, cumulatively. European centers have been struggling to keep up with the competition and have largely shifted their focus to more niche and sophisticated markets, such as cruise ships, complex offshore vessels, and navy ships.

When considering only the currently active shipyards and the 50 cities for which the overall benchmarking is being done, a ranking based on both delivered CGT in 2019, 2020 and 2021 and current orderbook from these yards shows that Busan is by far the leading city in this field. The region surrounding Busan is the center for the South Korean shipbuilding cluster. The major shipyards focus on offshore units and high value-added "mega-ships" such as container ships, VLCCs and LNG tankers. The total CGT output and CGT on order with Busan's shipyards (DSME, Kangnam Corp & HHI) is almost three times higher than in Shanghai and nearly five times higher than in Japanese shipyards (such as Imabari and Sumidagawa yards). Busan is the biggest beneficiary from the spike in global orders in 2021 compared to the previous years, and accounts for the largest share of the global order book in terms of CGT. Shipyards in Busan are currently the major site to build container vessels and make up 45% of the total shipbuilding production in South Korea.

Shanghai is placed second, being the most advanced maritime manufacturing center in China. Total CGT delivered by the local shipyards for the same period is lower than in Busan but twice as high as for Imabari. Overall, Chinese shipyards managed to outperform South Korea for the first time in the containership segment in terms of CGT built since 2019.

Imabari is primarily concentrating on the dry bulk, tanker and general cargo segments. Imabari's share of CGT delivered and on order accounts for 8 million CGT which is fifteen times higher than Singapore, even though Japanese yards have been steadily losing ground to South Korean and Chinese ones in terms of CGT output and contracting volumes.

Making up the remainder of the top 10 are the Chinese yards in Guangzhou, Ningbo, Dalian, and Qingdao, which are not yet considered as technologically advanced as the South Korean and Shanghai shipyards. The main vessel types leaving these yards have been bulkers, fishing vessels, tugs, general cargo ships and products tankers. Rotterdam and Genova are the only cities outside of Asia that reached the top 10 in this chart, having chosen to focus on and developing a good reputation for the passenger cruise and luxury yacht segments.

MARKET VALUE OF SHIPS BUILT AT SHIPYARDS

The market value of the ships built is not only a matter of size, but also the complexity of the equipment outfit, together with second-hand prices and the availability of "newbuild slots" in the larger yards. When considering the purchasing price of ships built the last three years, the top three performers are Busan, followed by Shanghai and Imabari.

Busan's shipyards have manufactured vessels at a cumulative price of USD 18.9 billion, greatly surpassing every other city, by at least a five times margin – being the strongest in oil tankers, container ships and gas carrier segments. Availability of high-quality labour force, in-house design competencies and world class engineering services makes the city a leading hub for this indicator. Ships built at yards in Shanghai and Imabari were valued at USD 3.9 billion, for each city, whilst yards in Tokyo and the rest of the Chinese centers have been producing vessels with total values in the range of 1 to 2 billion USD. It is worth noting that Singapore scores significantly higher on market value than on CGT, reflecting that Singaporean yards build semi-submersibles, FPSO conversions and other advanced units. The total value of ships built in Singapore and Oslo, our top cities for this pillar, has not managed to surpass the 1 billion USD mark for any of these cities.

SHIPBUILDING - ALTERNATIVE FUELS CAPABLE VESSELS

As sustainability becomes a greater priority in the maritime industry, shipyards start to capitalize on design and manufacturing innovations to produce low-carbon-emission ships. As shipyards worldwide iron out their strategies on how to improve their competitiveness and try to find an innovative approach that will differentiate them from competitors, Busan's shipbuilders are already accelerating their efforts, viewing this trend as a new business opportunity. At the national level, South Korea continues to invest billions of USD into eco-friendly and smart ship technologies, managing to gain ground against China and Japan.

Busan is a stellar performer scoring highest on this indicator. A significant share of all low carbon ships, measured by GGT, that have been built in the last three years or are in orderbooks originates from Busan. Korean shipyards benefit from the ongoing sound policies implemented by the government in response to the decarbonization push. The Korean government launched a USD 144 billion package called the "Korean New Deal", consisting of environmental reforms targeting green technologies, including an overarching policy aimed at strengthening employment in the shipbuilding sector.

Shanghai ranks second, with total GT delivered by local shipyards for its current fleet and/or orderbook being four times lower than in Busan. Overall, aggregated GT with five Chinese yards (such as Shanghai, Guangzhou, Dalian, Qingdao and Xiamen) is three times lower than in Busan alone.

Japanese shipyards, having the third largest newbuilding capacity, have not yet committed to building alternative-fuels capable tonnage on a large scale. Saint Petersburg's 4th place is due to its production of nuclear fueled units.

OPERATING REVENUE OF COMPANIES IN THE MARITIME TECHNOLOGY SECTOR

The indicator, operating revenues of maritime technology companies, focuses on the headquarter function of the corporations, where strategic decisions of investments, technological direction and geographical expansion are executed. Hence, revenues are aggregated and distributed to the HQ of the shipyard companies, so yards with revenues from drydocking and retrofitting activities will also be placed under consideration in this section.

Shipyards headquartered in Beijing have the highest operating revenue compared to other top 15 cities, due to the fact that state-owned shipbuilding entities are grouped within the corporation "China Shipbuilding Industry Corporation", which has its headquarters in Beijing. Similarly, the results from Shanghai, which ends up in 3rd place, are driven by state-owned "China State Shipbuilding Corporation Limited" with its headquarters located in Shanghai.

Korean cities Busan and Seoul end up in 2nd and 4th place respectively for this indicator. In total, the two cities constitute the bulk of the maritime yard activities in South Korea, with the industry being vital to the entire nation economic state. Companies that lead the results are "Daewoo Shipbuilding and Marine Engineering" for Busan, and "Korea Shipbuilding and Offshore Engineering" for Seoul. European centers, in general, fare better in this metric, but their high costs associated with labor and material sourcing make them less attractive to vessel operators.

CLASSIFICATION SOCIETIES

A classification society is a non-governmental organization that establishes and maintains the technical standards for ships and offshore structures. All class societies, and especially the members of IACS (International Association of Classification Societies), have a strong focus on R&D and on supporting the environment and safety at sea. They certify technological changes in constructions and play a vital role in quality assurance in the maritime industry. Most societies have an international presence as this has become a prerequisite for serving the global shipping industry.

When ranking the classification societies in terms of the size of their classed fleets, DNV, formed through the merger between Norway's DNV and Germany's Germanischer Lloyd and with its headquarters based in Oslo, takes the first place and thus pushes Oslo ahead in the city ranking. Tokyo with ClassNK takes the second position, followed by Houston which does well on this objective indicator much due to the presence of American Bureau of Shipping (ABS). Houston is also one of the leading centers of the world for offshore oil and gas activities, and the world's leading center for oilfield equipment. Lloyd's Register, the oldest classification society with a history from 1760, headquartered in London,

Fig. 20 - Score based on experts' answers to "If your company should consider relocating, which cities would in your opinion be the most attractive location for a R&D unit?"

Source: Menon Economics & DNV (2021)

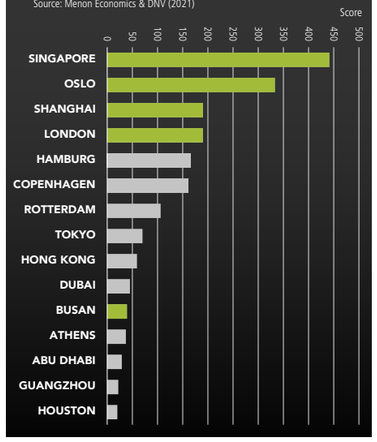


Fig. 21 - Size of CGT delivered by active shipyards later than 2018 and orderbooks

Source: Clarksons Research & Menon Economics (2021)

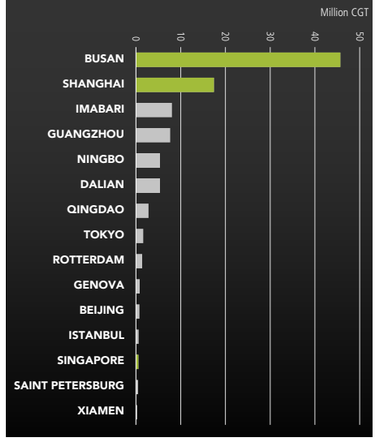


Fig. 22 - Purchasing price of ships built at shipyards, sold in the years of 2019, 2020 or 2021

Source: Clarksons Research & Menon Economics (2021)

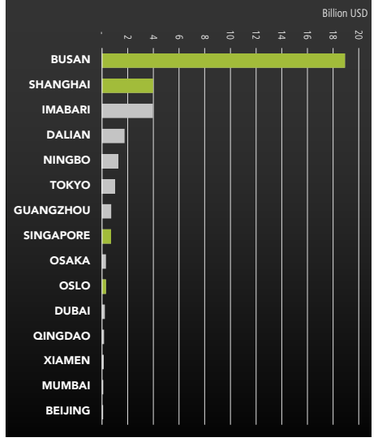


Fig. 23 - Size of fleet (GGT) delivered by shipyards, including orderbook and ships built later than 2018, measured by low carbon intensive fuel types

Source: Clarksons Research & Menon Economics (2021)

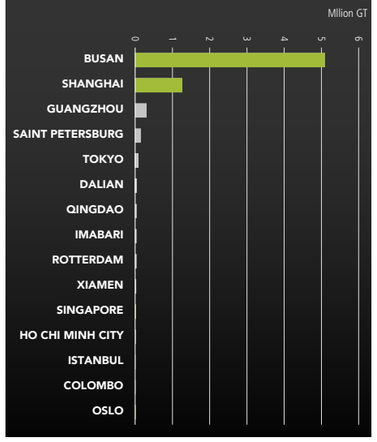


Fig. 24 - Share of world fleet in classification society by HQ

Source: Clarksons Research & Menon Economics (2021)

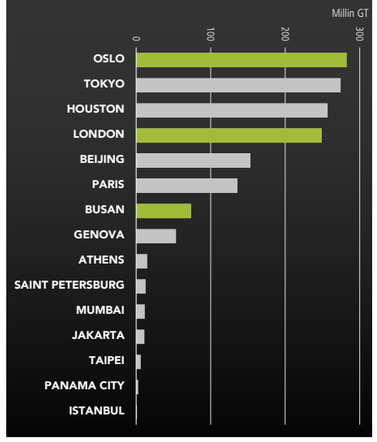
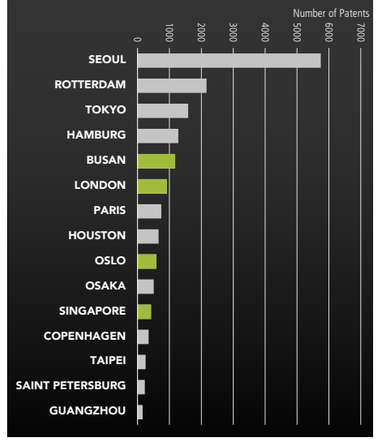


Fig. 25 - Number of maritime patents owned by firms with HQ in each city

Source: Bureau van Dijk (2021)



places this city the fourth place. Next in line come Beijing with China Classification Society and Paris with Bureau Veritas.

PATENTS BY MARITIME COMPANIES

Patent applications and registrations in the maritime industry are growing, especially in the field of ship design and equipment. The overall numbers are consistently going up throughout the last decade, indicating a rise in innovation in ship design and equipment. Recent trends show that several companies are using patented robotic technology for ship building and ship repair, while also exploring avenues like 3D-scanning, 3D-printing, virtual and augmented reality applications. Furthermore, there is a substantial increase in patent filings, aimed at providing solutions for environmentally friendly vessels.

The patents analyzed for this indicator have been accumulated over several years and are a good measure of the technological sophistication and innovation within a company and an industry.

At present, Seoul holds the largest number of active maritime patents owned by firms headquartered in the city. The highest portion of them belongs to Samsung Heavy Industries. Still within South Korea's bounds, Busan ranks 5th on this indicator, with Daewoo Shipbuilding & Marine Engineering Co. Ltd. which holds almost 80% of the patents in Busan. The remaining 20% of patents in Busan are split between more than 100 companies, primarily connected to repair and maintenance of ships and boats.

The share of the total number of patents in Rotterdam, the best ranking city in Europe and 2nd overall in this ranking, has increased over the past decade to about 2,100 due to a range of support measures introduced to boost R&D projects. A short distance away, Hamburg ranks 4th overall, and has been a hotspot for innovation, concentrated in green maritime technology solutions.

Japan remains an innovation powerhouse with Tokyo taking the third position. More than 90% of its total patents are held by Mitsui E&S Holdings Co. Ltd. Remaining patents are mostly held by Nippon Yusen Kabushiki Kaisha connected to sea and coastal freight water transport.

London, Paris, Houston, and Oslo are considered top centers for innovation and research in new technologies, for a variety of fields, so maritime companies have greatly benefitted from the trickle-down knowledge phenomenon, and the availability of competent research personnel, allowing the cities to secure positions in the top 10 field.

"The green transformation of the maritime industry is the most important change in the years ahead. However, the main obstacle will be lack of renewable energy sources."

– Academic scholar, Singapore

MARITIME EDUCATION INSTITUTIONS

The number of maritime education institutions found in a city, including dedicated academies and universities offering courses catering to the maritime sector, is a good indicator to assess a city's culture of learning and the level of competency of its graduates. From this, maritime companies can greatly benefit by sourcing skilled local maritime personnel.

When considering the number of maritime educational institutions, London is the leading city in this indicator, being home to prestigious maritime academies such as Cass Business School and London Shipping Law Centre. Rotterdam places second, with the maritime education offered in the city having a strong global reputation for excellence, and a variety/specialization of different courses available.

Athens and Hamburg are equally sharing the 3rd position, both cities have 13 maritime related institutions and training facilities, whilst Singapore holds the 4th position, where the Bachelor and Master in Maritime Studies degree programs offered by NTU has been a significant source of the maritime talent pipeline for more than a decade. Mumbai, Antwerp, Manila and Seattle follow with a similar number of maritime institutions present in each city, though specialization varies between seafarer training and business or technology focused institutions.

Shanghai provides a wide range of maritime education and training, mainly covering the needs of the Chinese centers. The system received a strong governmental push following the intention to strengthen Shanghai as an International Maritime Center, offering a significant number of grants and scholarship funding for institutions, such as the Shanghai Maritime University. Similarly, in Singapore, the Bachelor and Master in Maritime Studies degree programs offered by NTU have been a significant source of the maritime talent pipeline for more than a decade.

Fig. 26 - Number of maritime education institutions

Source: World Shipping Register (2021)

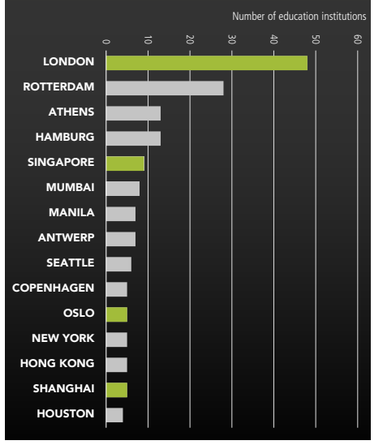
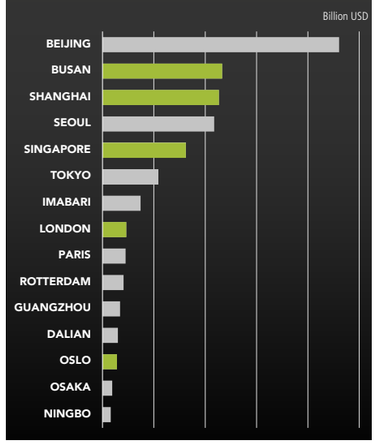


Fig. 27 - Turnover by maritime technology companies

Source: Bureau van Dijk (2021)



PORTS AND LOGISTICS SERVICES

"The main obstacle against the green transformation is the costs involved; who is going to pay and the uncertainty about which solution is the right one for the long term."

- MANAGER OF A PUBLIC BODY, MIDDLE EAST

SUMMARY

Overall, Shanghai ranks first for the port and logistics services due to its high weighted average score on various indicators – namely port volume, size of port operator and the PLSCI. Shanghai is the most well-connected port on the PLSCI scale, with 265 regular liner shipping services from and to its port, with an average size of 20,182 TEU for containerships deployed by scheduled service (UNCTAD 2019).

Rotterdam is in the 2nd position of leading port cities, followed by Singapore, Hong Kong, and Guangzhou. Whilst the world's largest ports in terms of container volume handled are found in Asia at Guangzhou, Shanghai, and Singapore, Rotterdam's strength on the ranking assessment is primarily due to its score for the size of the LNG bunker vessels deployed in that city. Rotterdam also has the largest port in Europe, with the 3rd largest port operator in the world. Its diverse port with well-established links to the European continent is supported by the expert assessment. The port remains at the forefront for its automation and innovation efforts to leverage new technology that will complement its core port activities. Rotterdam Maasvlakte II terminal, opened in 2015, is the world's most advanced fully automated terminal with 80% of crane movements automated and remaining manual operations performed remotely. In July 2021, the port of Rotterdam installed the world's first 3D-printed steel bollards, an outcome of its infrastructure innovation program. It is now set to investigate 3D-printing for hydraulic engineering, with on-site repairs for nautical objects.

Whilst Singapore is still considered as having the best port and logistics services by global experts, its overall ranking for this pillar puts it now in 3rd position. Strategically located on the East-West trade lane, Singapore boasts a connectivity to 600 ports in 123 countries. It also maintains its competitiveness with its 20% port dues concessions for container ships un/loading in its port, and 25% concessions on its Green Port Program for ships using abatement technology, clean fuel or LNG during their port stay. Like Rotterdam, Singapore caters for ship-to-ship LNG bunkering and is currently developing its container terminal at Tuas Port which will become the world's largest fully automated terminal with a capacity of 65M TEU.

In 4th position is Hong Kong, largely thanks to its high score on the indicator for size of port operators headquartered in the city. With Hutchison Ports and China Merchants Ports based in Hong Kong, Hong Kong is thus home to two giant port operators controlling a 14.7% share of the world container throughput in 2019 from their operations in an average of 60 ports in 26 countries.

Guangzhou holds the 5th rank for the ports and logistics pillar, due to its highest score on the port volume indicator. Guangzhou is not yet offering LNG fuel but plans to build eight LNG bunkering stations for main navigation channels by 2022.

PORTS AND LOGISTICS	TEU in port	Size of Port Operators	Line Shipping Connectivity index	LNG available at ports	Q: Ports
SHANGHAI	2	2	1	-	3
ROTTERDAM	10	4	6	1	2
SINGAPORE	3	3	2	4	1
HONG KONG	8	1	4	-	4
GUANGZHOU	1	-	10	-	8
DUBAI	11	5	12	-	6
NINGBO	5	-	3	-	12
QINGDAO	4	-	5	-	20
HAMBURG	12	7	11	-	5
KUALA LUMPUR	13	-	8	4	23
ANTWERP	15	-	7	7	11
TOKYO	22	8	13	-	9
XIAMEN	16	-	9	-	30
LOS ANGELES	9	-	22	-	7
COLOMBO	24	-	14	-	30

EXPERT ASSESSMENT

The increasing size of modern cargo ships and increasing world trade puts pressure on ports to become larger and more automated. All around the world, ports are constantly upgraded and modernized to lower the cost of transportation and be more competitive. The shipping industry's ability to deliver reliable logistics services at a low cost is a prerequisite for the modern world economy. Many companies rely on supply chains that stretch over vast distances, even continents. It is important for cities that companies can use them as hubs for carrying out complex, highly specialized logistical services.

For the last 6 years, the experts' assessment on the world's leading centers for ports and logistics services has remain unchanged towards Singapore and Rotterdam. Global experts have a clear preference for Singapore, one of the world's busiest ports, with the benefit of proximity to the Asian market, ease of doing business, excellent connectivity, and long history as a trading hub, combined with the city's highly efficient port.

Whilst Rotterdam is still the second choice of global experts as the most important center for port and logistics services, it is now almost in a tie with Shanghai. Rotterdam as the largest port in Europe has the capability to handle the largest container vessels. From the city, goods are transported either by smaller ships or trucks or by the railway system that is closely linked to the rest of Europe. Rotterdam's advantages include great connectivity, a business-friendly maritime environment, stable political environment, favorable tax legislation and proximity to major ports. Shanghai's support by global experts is due to its role as the gigantic gateway to the world's manufacturing center. It is now in third position, displacing Hamburg in the experts' opinion from the 2019 ranking.

In fourth position from the assessments of the global experts is Hong Kong. The city has lost ground compared to Shanghai since 2019 but has strengthened its position compared to European cities like Hamburg and Antwerp.

Hamburg is next in this subjective ranking behind Hong Kong. Hamburg is by far the most important German port. The Hamburg city region includes the port of Bremen. Together they form the biggest port area in Europe. Eurogate with its head office in Bremen is one of Europe's leading container terminal logistics groups.

Dubai is also ranked highly by the experts. Dubai is a regional maritime center that focuses on increasing its presence in the industry. Currently Dubai's port, its status as an important logistics hub and, to a certain degree, its pro-business environment are its strengths as a city for maritime business activities.

Of the top 5 pillar-specific cities, Guangzhou is ranked 8th by global experts, after Hamburg, Dubai and Los Angeles.

OBJECTIVE INDICATORS' ASSESSMENT

The figures used in this chapter present information about the top 50 maritime cities globally. Hence, there may be some cases where cities not included in this sample objectively perform better on indicators included in this specific pillar. However, such cities do not perform well enough on an overall level to be a part of the list of top 50 maritime cities globally and are therefore excluded in the following chapter.

PORT VOLUME

Port cities are at the frontline of globalization, with approximately 90% of external trade volume transported by ship – loaded and unloaded at world ports. A study by the OECD concluded that well-run ports produce many economic benefits such as lowering the cost of trade, increasing value creation, job creation and attracting related maritime services. To get the best economic benefit from port operations, port cities must facilitate an increase in the maritime service offering and take advantage of possible spill-over effects for industrial development.

The world's largest ports in terms of container volume (TEU) handled are still found in Asia at Guangzhou, Shanghai, and Singapore, despite the COVID-19 pandemic. While the port in Shanghai plays a key role in supporting the manufacturing industry in the larger region, Singapore and Hong Kong are more important as transshipment ports. If all Chinese ports were considered (some of which are not within the 50 top cities ranked across the 5 pillars in this study), the importance of China as a center for world trade would be even clearer. Seven of the world's ten top container ports are found in China. In recent years, Hong Kong's position as a gateway to the world's manufacturing sector has been challenged by the phenomenal growth of nearby Shenzhen and Guangzhou, as well as Shanghai, leading to a reduction in Hong Kong's market share. Singapore maintains its competitiveness with its efficiency in container handling, and the key gateway to the high growth Southeast Asia economies.

Of the top 5 pillar-specific cities, Rotterdam has the largest port in container handling after eight Asian ports and Los Angeles port. It is the largest cargo port in Europe with an extensive distribution system (rails/roads/waterways), offering port dues discounts (transshipment, cargo-specific, Environmental Ship Index, Green Award) and the Incentive Scheme for Climate-Friendly Shipping to support the shipping industry to impact cargo trade through its port.

Dubai dropped on this indicator, losing its top 10 status with it now ranked 11th as opposed to its previous 7th position. The main reason is that Abu Dhabi is now treated as a separate maritime city in the LMC report. Abu Dhabi has state-of-the-art port infrastructure for different cargo types, with its container operations backed by long-term concession agreements with container shipping giants (MSC, COSCO, CMA CGM). Dubai is still the largest port in container handling in the Middle East region, playing a role as a transit hub strategically located between Europe and Asia. It is currently the only major Middle Eastern port not to be backed by carrier interests (whether terminal stakes or tenancy). Its strategic location for transshipment and free zone have meant that liner-affiliated backing has not been deemed necessary (so far). However, regional competition is growing for port transshipment, with Port of Salalah offering minimum deviation time on the main East-West shipping lane.

SIZE OF PORT OPERATORS

To strengthen their position in a competitive world, the largest and best port operators branch out to operate new ports and terminals. The "Top 4 Port Operators" control 50% of global terminal operations. The largest port operator handled 110 million TEU globally in 2019. The ranking in Figure 28 shows the leading cities which are home to the biggest port operators based on the total container volume handled at a global level.

No significant changes have happened since the 2019 edition of this report, with Hong Kong still in the leading position thanks to Hutchison Ports and China Merchants Ports. COSCO, the largest port operator, operating 100 ports in 63 countries and owning 13.7% of the world throughput (Drewry 2019), contributes to Shanghai's second place on the list. In 3rd position, Singapore has now surpassed Rotterdam on this indicator. Singapore is home to PSA International, one of the leading global port groups which participates in 31 ports in 19 countries across Asia, Europe, and the Americas, with flagship operations in PSA Singapore Terminals and PSA Antwerp. Covered under the city of Rotterdam, APM Terminals has terminal operations in 75 ports across 58 countries. In 5th position on this ranking is Dubai, home to DP World which has operations reaching 65 ports in 51 countries, with a total estimated share of 8.7% of the world throughput in 2019.

After Dubai, there is a large jump in TEU handled by port operators based in the next cities in the ranking, highlighting how port business is dominated by few global operators. For example, Marseille's CMA CGM is a 62% drop from Dubai in the ranking of total TEU handled globally.

PORT LINER SHIPPING CONNECTIVITY INDEX (PLSCI)

This new indicator for the Ports and Logistics Services pillar in the 2021 edition relates to the Port Liner Shipping Connectivity Index (PLSCI) which is generated by UNCTAD for more than 900 container ports in the world annually since 2006, by considering six key aspects of connectivity. The PLSCI values generated for 2020 relate to Hong Kong's original value in Q1 2006 (which was 100).

Top of the ranking on this indicator is Shanghai, with an average of almost 300 scheduled (container) ship calls per month in its port, 68 liner shipping companies that provide services from and to the port and 295 ports that are connected to it through direct liner shipping services (UNCTAD 2019). Of the top 5 pillar-specific cities, Singapore and Hong Kong follow Shanghai on this indicator. Singapore is the center of the main Europe-Far East trade and is well connected to all the ports in Southeast Asia, the Indian subcontinent and the Pacific countries. Hong Kong has a large logistics and value-added service base and provides 300 weekly container liner services connecting to 420 destinations worldwide. As a regional hub port, it also provides 200 intra-Asia shipping services and maintains marine cargo movements with over 90 of 140 countries covered under the Belt and Road Initiative (HKMPB Hong Kong, 2019).

In 4th position is Rotterdam, while Guangzhou takes the 5th rank. Guangzhou has maritime trade reaching over 300 ports in more than 80 countries and districts worldwide.

LNG AVAILABLE AT PORTS

With the IMO's ambitious goal of reducing GHG emissions from international shipping by 50% by 2050 and phase them out before 2100, one of the GHG strategy requirements is the Carbon Intensity Indicator (CII). CII addresses actual emissions of vessels in operation and will be assessed annually as from 2023, with yearly stricter emission limits. A vessel can reduce its CII by a combination of measures, including use of alternative fuels.

Ports around the world are thus looking into onshore power capabilities and offering alternative fuels such as LNG or other low-carbon fuels, to cater for the refueling demands of vessels calling there. Note that this benchmarking indicator is expected to include other low- and zero-carbon fuels, as they gradually will become commercially available in ports.

Of top 5 pillar cities, only Rotterdam and Singapore have LNG bunker vessels. However, apart from Northern Europe and the Americas where emission control areas and strict national environmental regulations dictate the limitation of shipping emissions, the other cities in our pillar ranking are also heading in the same "green" direction. Guangzhou is converting 8 domestic/inland vessels for use of LNG as fuel and building 6 LNG bunkering stations for inland river waterways before 2021 and is planning the construction of 8 LNG bunkering stations for main navigation channels by 2022. Hong Kong's FSRU is set to begin operations in 2022 and could cater for LNG bunkering through its LNG bunker port.

Various LNG bunkering projects are also currently under decision in the Middle East region. A major LNG bunkering hub (annual capacity of 1 million ton) is under construction at Sohar Port and expected to come on stream by 2025, to be operated by Total and Oman Oil Company. Across the Arabian Gulf, Shell and Qatar Petroleum have an agreement to establish a global LNG bunkering venture. In the UAE, ADNOC and INPEX have an agreement on LNG bunkering, in addition to ADNOC's blue ammonia facility (currently in design phase at the TA'ZIZ industrial ecosystem and chemicals hub in Ruwais, with carbon capture).

Fig. 28 - Score based on experts' answers to "Which cities do you consider the five leading centers for ports and logistics services of the world?"
Source: Menon Economics & DNV (2021)

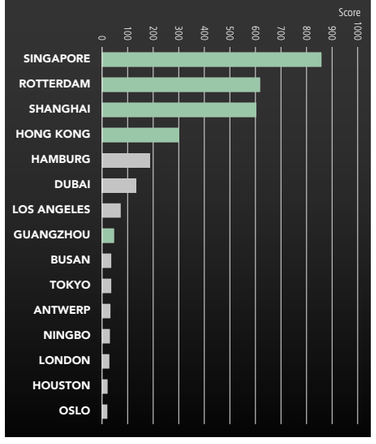


Fig. 29 - Volume of TEU handled by ports around the world, 2020
Source: Lloyd's (2021)

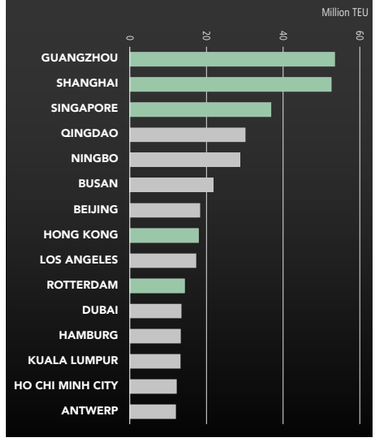


Fig. 30 - Size of port operators
Source: Drewry (2021)

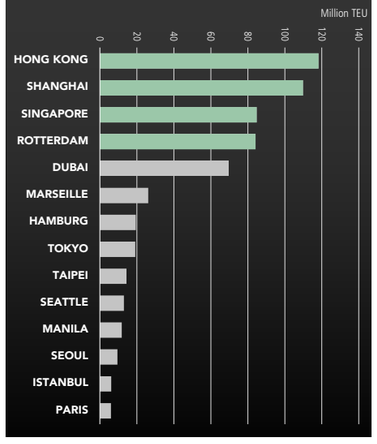


Fig. 31 - Port Liner Shipping Connectivity index
Source: UNCTAD (2020)

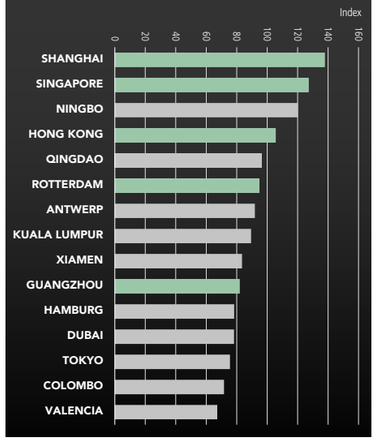
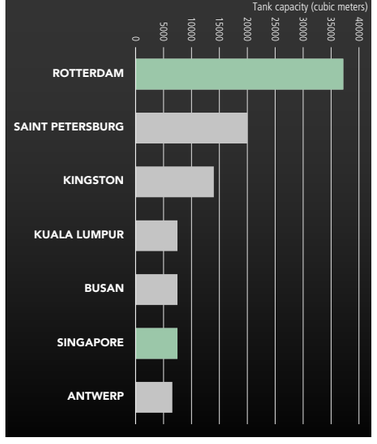


Fig. 32 - LNG available at ports
Source: DNV (2021)



ATTRACTIVENESS AND COMPETITIVENESS

"The most important factors for staying competitive are infrastructure and world class talent to allow both businesses and their people to not only connect but to thrive. Furthermore, commitment to improving technology and laws which support the digital space so that people can function and thrive."

-MARITIME LAWYER, EAST ASIA

SUMMARY

The final pillar in our ranking, the attractiveness and competitiveness of the cities, points to the future. The more attractive a city is, the stronger the growth that can be expected for it in the future. Cities must be regarded as attractive by their incumbent companies for the city to retain them, and by external companies to be attracted to them. Cities are complex economies with a range of factors that impact the decision-making process of a business to stay in an existing location or to move to a new one. Hence, industry experts' judgement and objective indicators related to cities' ease of doing business, the health of the entrepreneurship ecosystem, the competitiveness of maritime companies as shaped by cities' cluster dynamics, cities' attractiveness for relocating headquarters, operations and R&D, were used to benchmark the maritime cities in this study.

Overall, Singapore remains the most attractive and competitive maritime city in the world, measured by objective indicators and experts' assessments. Singapore is unsurpassed in most of the benchmarking criteria used in this pillar, except for three of the objective indicators where Copenhagen (on Corruption Perceptions Index), New York (on Global Entrepreneurship Index) and Rotterdam (on Services Trade Restrictiveness Index) each take the first position.

London and Copenhagen are next in the ranking behind Singapore for this pillar, maintaining the same top 3 as in 2019. Compared to Copenhagen, London is relatively stronger in its subjective assessment, being in the upper echelons for its attractiveness for the relocation of headquarters, operations and R&D functions of companies, for having a complete maritime cluster and for acting as an innovative and entrepreneurial center for maritime activities. On the other hand, Copenhagen's main strength lies in its top scores for several of the objective indicators, including ease of doing business and for being the most transparent and uncorrupted city in the world. Even on the subjective side, when industry experts are asked to rank their choice of the top three cities acting as the most innovative and entrepreneurial center for maritime activities, Copenhagen is in 4th position whilst London is in 7th position.

Rotterdam, Oslo and Hamburg are next in the ranking for this pillar. Rotterdam has significantly improved its score for the attractiveness and competitiveness pillar compared to 2017 where it held the 8th rank, improving on both subjective and objective indicators. Rotterdam scores the highest in the Services Trade Restrictiveness Index which is used to identify which policy measures restrict trade. When looking at the Middle East, Dubai is a rising star amongst other traditional maritime cities of the world, although it is showing an overall reduction in the combined ranking in terms of attractiveness and competitiveness. Dubai ranks low for the objective indicators as these are measured on the country level, but is ranked much higher for subjective indicators, and is regarded by the industry experts as one of the top five most attractive locations to set up their operational offices.

ATTRACTIVENESS AND COMPETITIVENESS	Ease of doing business	Transperancy/corruption	Entrepreneurship	STRI Index	Q: Maritime Center	Q: HQ	Q: Enterpreneur
SINGAPORE	1	2	25	10	1	1	1
LONDON	11	6	8	6	3	2	7
COPENHAGEN	2	1	7	13	9	8	4
ROTTERDAM	37	4	10	1	5	9	6
OSLO	12	3	19	15	4	6	2
HAMBURG	19	5	14	2	8	7	5
VANCOUVER	20	6	6	3	20	19	20
SYDNEY	14	6	9	14	33	36	26
NEW YORK	4	18	1	29	12	10	13
HONG KONG	2	6	11	-	7	4	8
HOUSTON	4	18	1	29	16	15	15
LOS ANGELES	4	18	1	29	16	19	22
SEATTLE	4	18	1	29	27	36	26
MIAMI	4	18	1	29	33	36	26
TOKYO	22	11	22	7	11	13	10

OBJECTIVE INDICATORS' ASSESSMENT

The figures used in this chapter present information about the top 50 maritime cities globally. Hence, there may be some cases where cities not included in this sample objectively perform better on indicators included in this specific pillar. However, such cities do not perform well enough on an overall level to be a part of the list of top 50 maritime cities globally and are therefore excluded in the following chapter.

EASE OF DOING BUSINESS

The maritime industry is international in nature, and that makes competitive regulation important for cities to attract and retain business. Both maritime specific regulations and the overall regulatory framework for conducting business are important in this aspect. While it is difficult to measure maritime specific regulations on a global scale, the Ease of Doing Business Index developed by the World Bank gives an insight into the wider set of regulatory environments. A higher ranking indicates better, usually simpler, regulations for businesses and stronger protections of property rights. Empirical research indicates that the impact on economic growth of improving these regulations is strong.

Looking at the maritime cities studied, small city states perform very well on the index, with Singapore and Hong Kong the top two performers.

Singapore ranks 1st, representing a competitive, growing economy, where incorporating a company takes only a short amount of time, is available at a low cost, and the process is largely digitized. It maintains a flat corporate tax rate of 17%, making it one of the lower corporate tax rates in the world. Hong Kong ranking 2nd is also a strong city in terms of doing business owing largely to the policies of starting a business (less bureaucracy with simple procedures resulting in a cost and time efficient process) and taxation system in the city. Copenhagen is 3rd and has adopted fast-paced, digitized, one-window policies for business start-ups, and gains its strength from a very efficient public sector, which in turn ensures fast acquirement of permits, ease of paying taxes and fees, and ease of cross-border trading.

TRANSPARENCY / CORRUPTION

The Corruption Perceptions Index by Transparency International was used to rank the maritime cities for their transparency and corruption level. The index ranks 180 countries and territories by their perceived levels of public sector corruption according to experts and business organizations. A scale of 0 to 100 is used, where 0 is highly corrupt and 100 is very clean. In 2020, more than two-thirds of the countries scored below 50, which indicates that most countries fail to address corruption in their public system. The average score across all countries is 43.

For the maritime cities in this study, the Scandinavian cities and Singapore remain strong in this category. While Greece is ranked 59th with a score of 50, China's maritime cities come out poorly in this indicator, with a value of 42 which is below the global average score of 43.

> **"The Norwegian government should take actions to attract foreign maritime companies to Oslo and other maritime cities in Norway."**
>
> *– Academic scholar in Norway*

ENTREPRENEURSHIP

Entrepreneurship is one of the key drivers of economic growth and development and is used to assess a city's relative attractiveness and competitiveness. The Global Entrepreneurship Index was selected to evaluate the health of the entrepreneurship ecosystem in each location which was further complemented by the results from the experts' assessment.

New York and the US-based maritime cities lead in this indicator. Some American cities, such as Seattle, New York, Miami and Los Angeles, have managed to develop vibrant start-up ecosystems, clustered in specific centers, at the forefront of technological advancements. By taking advantage of a critical mix of available venture capital funding, a local, highly educated workforce, and networking capabilities, they manage to consistently rank at the top of this chart.

Not far behind New York are European cities such as Copenhagen, London, and Rotterdam. They may rank lower than American cities, but they have recently managed to demonstrate exceptional growth in their respective start-up ecosystems, also taking advantage of highly qualified local talent and cheaper operating costs when compared to the US. Whilst the other Asian maritime cities such as Singapore, Busan, Tokyo and Shanghai are not within the top 15, they have a general high score in this category. Interesting to note that the Middle Eastern cities are performing on-par/better than Asian cities in this indicator.

SERVICES TRADE RESTRICTIVENESS

Obstacles to global services trade are pervasive as national trade and regulatory policies in individual services sectors are often made with limited regard for economy-wide impacts. STRI measures and provides information regulations affecting trade in services in 22 sectors. For this study, only maritime transport and logistics cargo handling sector has been considered.

Rotterdam leads this indicator followed by Hamburg, Vancouver, and the French cities Paris and Marseille.

Rotterdam has been at the forefront for many decades, owning some of the most advanced port facilities globally, and has been the gateway for much of Europe's total incoming and outgoing trade, taking advantage of the national government policies on instituting few legislative barriers on foreign trade. Local educational & research centers have been the benefactors of many financial incentives' programs, originating from the city administration or other business stakeholders, pursuing innovative solutions for the provision of streamlined, high quality cargo handling services.

EXPERT ASSESSMENT

Any company will seek to be present in a location which will cater for its business needs, provide the necessary environment for it to grow in a cost-efficient manner, and support as far as possible the desired work benefits and lifestyle of its employees and new recruits. The industry experts in this study were thus asked to rank their choice of the most attractive maritime cities, with the following questions:

- "Looking forward 5 years from now: Which cities will be the five leading maritime centers of the world?"
- "If your company should consider relocating, which cities would in your opinion be the most attractive location for headquarters?"
- "Which cities are the most innovative and entrepreneurial in the maritime industry today?"

Singapore stands out as the most competitive city on all three dimensions, while Shanghai, London and Oslo take the second place on each of these.

> **"To be a leading maritime city in the next five years, cities should invest in talent development, logistical network onshore, digital infrastructure, and in availability of hydrogen, electricity and other zero-emission fuels."**
>
> *– Maritime expert, Rotterdam*

INNOVATION AND ENTREPRENEURSHIP

When the maritime experts are asked "What will be the most important factors for being a LMC (leading maritime city) in the future?", answers connected to talent, competence and technology are most common. One of the experts said: "It is crucial to be more open-minded for new technology, and to attract more talents all over the world to join in the industry". Hence, future-oriented cities are innovative and entrepreneurial in spirit.

When the industry experts are asked to rank the top three cities acting as the most innovative and entrepreneurial center for maritime activities, Singapore is in the lead, followed by Oslo, Shanghai and Copenhagen. Both Singapore and Oslo have vibrant ecosystems for start-up firms, both connected to digitalization and environmental solutions. Singapore has been ever-growing in terms of the number of start-ups and is an important hub for R&D and high-tech industries, as the local economic policies based on low fees and taxes have attracted venture capital funds keen on investing in cutting-edge technologies.

In Oslo, an ecosystem of industrial investors, venture companies and business angels is fostering start-up firms, particularly connected to maritime cleantech and renewable energy carriers like batteries, hydrogen and ammonia. A major share of the startups spins out of R&D activities, both in universities, research institutes and R&D intensive companies.

Other European cities at the forefront of innovation are Copenhagen, Hamburg and Rotterdam, with adoption of smart technology based on IoT, improving energy efficiency, city transportation and access to open data, which makes it easier for entrepreneurs, innovators and others to identify problems and opportunities and develop solutions.

MOST ATTRACTIVE CITIES FOR RELOCATION OF HEADQUARTERS

When the industry experts are asked to choose and rank the cities they consider most attractive if they were to relocate their headquarters, Singapore ranks first, followed by London, Shanghai, Hong Kong, Dubai and Oslo.

Singapore has consistently attracted international maritime firms to set up their base, strategically positioned at the crossroads of major trade and shipping routes connecting the East and the West, enjoying a tremendous aviation connectivity level, and serving as gateway for businesses to access high growth markets, such as China and India.

London has kept its position as the second most attractive city for maritime headquarters. There are no signs that Brexit has weakened London's position. In East Asia, Hong Kong has lost attractiveness, particularly compared to Shanghai. In 2019, Hong Kong was preferred by twice as many experts, while Shanghai now is regarded as slightly more attractive for headquarters than Hong Kong.

Dubai's attractiveness seems also to be strengthened in recent years. Being ranked at position 7 in 2019, Dubai has now passed both Oslo and Hamburg. For other cities, there are only minor changes.

LOOKING FORWARD: LEADING MARITIME CITIES OF THE WORLD IN 5 YEARS

The maritime experts were asked to make predictions about the leading maritime cities of the world five years ahead. There seems to be a clear consensus among the experts that Singapore will remain the most important maritime city in 2026, while Shanghai is expected to become the second most important. Singapore is expected to retain its position as the leading maritime city of the world due to the size of its port, number of internationally focused shipbrokers, financiers, lawyers and insurers present there, as well as the plethora of supportive government policies. Shanghai's increased importance is related to the growing influence of the Chinese economy, with an increasing number of maritime players moving establishments there, to capitalize on their proximity to the Chinese production bases. China has the world's second-largest economy, and its export-oriented business environment is dependent on the trade of goods. China is expected to bypass the US as the world's largest economy before 2030 (Centre for Economics and Business Research, 2020).

London's performance may have faced disruptions, during the Brexit transitional stages, but it still remains one of the most popular choices to conduct maritime business, assisted by the high competency level of its training centers, maritime education institutions, maritime law & finance establishments. According to the maritime experts, London has strengthened its future importance as a leading maritime city, overtaking the 3rd position from Oslo, which is now ranked 4th. Oslo is regarded by the maritime experts, most of them located in Asian cities, as the global center for "green" technologies for the oceans, and also a vibrant city of entrepreneurship.

Rotterdam follows Oslo on the future perspective, while Dubai, Hong Kong, Hamburg and Copenhagen are potential contenders for the sixth position in this predictive ranking in the next five years. Dubai is in the same league as these other "traditionally" well-established maritime cities because the maritime industry experts recognize that the city is developing quickly due to the strong backing from the local government to increase Dubai's presence in the global economy. Dubai is today an important trading center and is becoming the preferred city for maritime activities within its wider region covering the Middle East, the Indian subcontinent and Africa.

> **"Strategy wise, Singapore is very supportive of the maritime sector. It has a huge advantage and leverages on that advantages, it is an island, city-state and a country and as such all three are aligned. In the case of other regions, the national and regional goals/objectives may not be aligned. The Singapore government, the ministers, MPA and PSA, and all other supporting government associations are aligned with one vision and one strategy. You feel like somebody's watching your back, you have a voice, you have access to government events, you feel like you have a place here."**
>
> *– Jeremy Nixon, CEO, Ocean Network Express (ONE)*

Fig. 33 - Score based on experts' answers to "Looking forward 5 years from now: Which will be the five leading maritime centers of the world?"
Source: Menon Economics & DNV (2021)

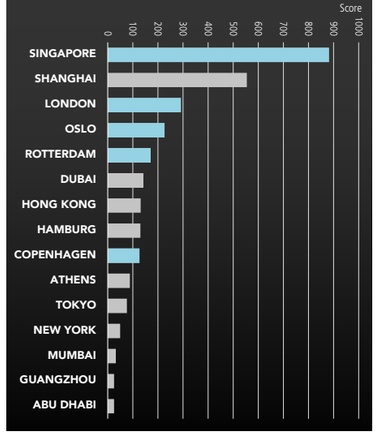


Fig. 34 - Score based on experts' answers to "If your company should consider relocating, which cities would in your opinion be the most attrative location for the headquarters?"
Source: Menon Economics & DNV (2021)

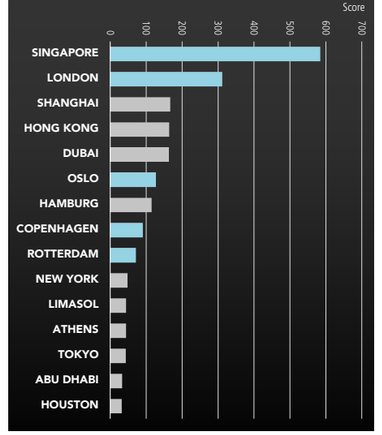
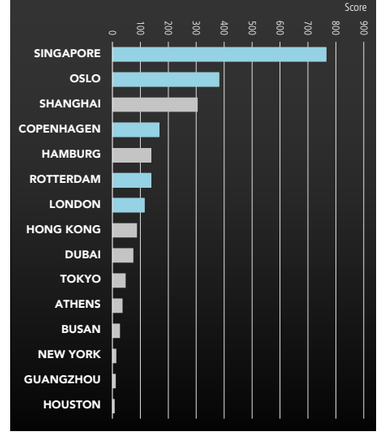


Fig. 35 - Score based on experts' answers to "Which cities are the most innovative and entrepreneurial in the maritime industry today?"
Source: Menon Economics & DNV (2021)



APPENDIX A – INDICATOR RANKINGS FOR TOP 50 MARITIME CITIES GLOBALLY

		SHIPPING								MARITIME FINANCE AND LAW							
		Fleet size - management	Fleet size - owner	Fleet value - owner	Number of shipping HQ	Turnover shipping companies	Env. friendly fleet size - owner	Q: Shipping	Q: Operations	Legal experts	Maritime lawyers	Insurance premiums	Mandated loans	Shipping banks portfolio	Liste maritime owner groups	Market cap maritime companies	IPO/Bonds/Follow ons	Q: Finance
SINGAPORE	SINGAPORE	2	2	6	3	14	8	1	1	7	8	3	-	13	7	7	3	2
ROTTERDAM	NETHERLANDS	9	11	11	4	26	16	8	6	7	5	7	5	4	-	-	6	9
LONDON	UNITED KINGDOM	6	9	9	14	5	4	2	5	1	1	1	6	6	12	13	9	1
SHANGHAI	CHINA P.R.	5	6	4	9	2	12	5	2	-	15	16	-	-	9	3	8	6
TOKYO	JAPAN	7	3	2	6	3	2	11	15	14	26	2	3	3	4	6	10	7
HONG KONG	HONG KONG	3	5	18	11	21	15	4	4	10	10	19	-	-	3	2	7	5
OSLO	NORWAY	21	13	10	22	9	3	7	11	14	16	9	2	5	2	10	2	4
NEW YORK	USA	30	19	16	21	24	38	12	21	2	2	24	1	8	1	1	1	3
HAMBURG	GERMANY	4	4	3	5	8	9	6	7	9	9	10	-	11	21	22	-	8
COPENHAGEN	DENMARK	13	12	7	26	4	7	9	10	5	36	29	7	9	18	15	12	11
BUSAN	SOUTH KOREA	11	31	31	16	20	30	21	19	-	-	-	-	-	7	4	5	25
ATHENS	GREECE	1	1	1	2	39	1	3	9	16	3	28	-	10	16	19	-	12
DUBAI	UAE	10	18	26	10	10	24	10	3	16	18	17	-	-	26	26	-	10
PARIS	FRANCE	46	45	36	45	35	19	29	34	10	12	4	4	2	16	11	-	15
HOUSTON	USA	23	20	17	29	19	13	16	15	-	14	-	-	-	-	-	-	17
SEOUL	SOUTH KOREA	16	7	8	12	7	6	26	20	-	36	8	-	7	-	-	-	27
VANCOUVER	CANADA	26	43	25	37	40	22	29	24	6	21	-	-	-	-	-	-	27
BEIJING	CHINA P.R.	29	21	19	29	1	29	29	27	-	24	5	-	1	-	-	-	13
ANTWERP	BELGIUM	32	22	23	20	23	20	19	30	16	7	11	-	-	21	24	11	17
SYDNEY	AUSTRALIA	45	46	45	43	41	33	29	34	2	20	13	-	12	19	16	-	20
LOS ANGELES	USA	41	40	37	37	44	38	17	34	-	21	36	-	-	-	-	-	21
GUANGZHOU	CHINA P.R.	19	15	13	18	16	14	21	18	-	36	32	-	-	-	-	-	21
MIAMI	USA	20	17	15	34	11	17	29	34	-	13	39	-	-	-	-	-	27
SEATTLE	USA	39	38	35	37	17	23	29	34	-	23	37	-	-	-	-	-	27
NINGBO	CHINA P.R.	24	23	21	13	31	36	25	27	-	-	33	-	-	-	-	-	25
KUALA LUMPUR	MALAYSIA	22	26	28	24	36	10	24	14	-	28	22	-	-	10	9	-	24
IMABARI	JAPAN	15	8	5	8	29	38	15	34	-	-	35	-	-	-	-	-	14
OSAKA	JAPAN	25	29	29	15	18	26	29	34	-	42	-	-	-	-	-	-	27
TAIPEI	TAIWAN	17	14	12	26	12	38	29	34	-	26	20	-	-	11	8	4	27
QINGDAO	CHINA P.R.	28	33	33	37	32	31	23	23	-	44	-	-	-	-	-	-	27
MARSEILLE	FRANCE	31	25	14	43	6	5	-	-	-	32	-	-	-	-	-	-	-
ABU DHABI	UAE	38	36	41	26	47	32	18	17	-	28	23	-	-	21	25	-	19
VALENCIA	SPAIN	47	47	46	47	45	21	29	30	-	34	25	-	-	-	-	-	27
BARCELONA	SPAIN	49	49	48	47	42	38	29	34	-	16	-	-	-	-	-	-	27
XIAMEN	CHINA P.R.	42	41	38	37	15	35	29	34	-	44	34	-	-	-	-	-	27
ISTANBUL	TURKEY	14	16	22	7	38	37	29	34	-	11	15	-	-	19	23	-	27
DALIAN	CHINA P.R.	34	32	32	29	37	38	29	34	-	44	38	-	-	-	-	-	27
GENOVA	ITALY	43	34	20	37	22	25	29	30	10	19	6	-	-	-	-	-	27
MUMBAI	INDIA	18	24	30	19	27	18	14	8	16	24	26	-	-	6	5	-	21
JAKARTA	INDONESIA	8	10	24	1	33	28	29	30	-	28	12	-	-	5	14	13	27
LIMASOL	CYPRUS	12	28	40	33	43	27	13	12	10	6	30	-	-	-	-	-	16
BANGKOK	THAILAND	35	35	39	22	28	38	29	22	-	28	18	-	-	13	18	-	27
DOHA	QATAR	37	27	34	36	48	11	29	34	-	40	14	-	-	26	17	-	27
SAINT PETERSBURG	RUSSIA	40	42	43	34	30	34	26	27	-	42	-	-	-	-	-	-	27
HO CHI MINH CITY	VIETNAM	36	37	42	32	34	38	29	24	-	32	21	-	-	13	20	-	27
PANAMA CITY	PANAMA	44	44	47	45	13	38	29	34	16	4	27	-	-	26	28	-	27
KINGSTON	JAMAICA	50	50	-	49	-	38	-	-	-	44	-	-	-	21	21	-	-
MANILA	PHILIPPINES	27	39	44	17	46	38	19	12	-	34	31	-	-	15	12	-	27
COLOMBO	SRI LANKA	48	48	-	49	49	38	29	34	-	40	-	-	-	21	27	-	27
RIO DE JANEIRO	BRAZIL	33	30	27	24	25	38	26	24	4	36	-	-	-	-	-	-	27

		MARITIME TECHNOLOGY										PORTS AND LOGISTICS				ATTRACTIVENESS AND COMPETITIVENESS						
		Shipyards deliveries	Shipyards.deliveries - eco friendly ships	Turnover maritime technology companies	Classified fleet	Market value of ships	Maritime patents	Maritime education institutions	Q: Technology	Q: Sustainability	Q: Digital	Q: R&D	TEU in port	Size of Port Operators	Line Shipping Connectivity index	LNG available at ports	Q: Ports	Ease of doing business	Transparency/corruption	Entrepreneurship	STRI index	Q: Maritime Center	Q: HQ	Q: Enterpreneur
SINGAPORE	SINGAPORE	13	11	5	16	8	11	5	1	2	1	1	3	3	2	4	1	1	2	25	10	1	1	1
ROTTERDAM	NETHERLANDS	9	9	10	-	18	2	2	8	4	6	7	10	4	6	1	2	37	4	10	1	5	9	6
LONDON	UNITED KINGDOM	-	-	8	4	-	6	1	7	6	5	3	18	-	19	-	13	11	6	8	6	3	2	7
SHANGHAI	CHINA P.R.	2	2	3	18	2	17	10	3	7	3	3	2	2	1	-	3	25	34	29	21	2	3	3
TOKYO	JAPAN	8	5	6	2	6	3	16	6	8	10	8	22	8	13	-	9	22	11	22	7	11	13	10
HONG KONG	HONG KONG	25	21	35	-	19	23	10	11	10	9	9	8	1	4	-	4	2	6	11	-	7	4	8
OSLO	NORWAY	22	15	13	1	10	9	10	2	1	2	2	-	-	44	-	15	12	3	19	15	4	6	2
NEW YORK	USA	-	-	34	-	-	16	10	16	14	11	18	20	-	23	-	16	4	18	1	29	12	10	13
HAMBURG	GERMANY	17	16	18	19	17	4	3	5	5	7	5	12	7	11	-	5	19	5	14	2	8	7	5
COPENHAGEN	DENMARK	-	-	32	-	-	12	10	9	3	4	6	-	-	45	-	16	2	1	7	13	9	8	4
BUSAN	SOUTH KOREA	1	1	2	7	1	5	31	4	12	13	11	6	-	-	4	9	4	27	17	19	16	24	12
ATHENS	GREECE	28	21	39	9	-	39	3	15	16	14	12	25	-	18	-	19	46	32	40	36	10	11	11
DUBAI	UAE	18	21	25	21	11	46	23	12	9	8	10	11	5	12	-	6	15	14	20	-	6	5	9
PARIS	FRANCE	-	-	9	6	-	7	31	31	26	26	30	-	14	-	-	30	34	16	12	4	33	36	26
HOUSTON	USA	31	21	28	3	-	8	15	13	23	14	15	34	-	30	-	14	4	18	1	29	16	15	15
SEOUL	SOUTH KOREA	26	19	4	24	-	1	31	10	17	17	17	32	12	-	-	30	4	27	17	19	23	18	16
VANCOUVER	CANADA	29	21	36	-	-	27	16	31	11	21	23	30	-	33	-	27	20	6	6	3	20	19	20
BEIJING	CHINA P.R.	11	21	1	5	15	20	23	26	23	23	20	7	-	46	-	21	25	34	29	21	19	28	16
ANTWERP	BELGIUM	-	-	24	-	-	22	7	23	14	26	26	15	-	7	7	11	38	10	15	16	27	24	26
SYDNEY	AUSTRALIA	-	-	40	-	-	30	23	31	17	26	30	36	-	37	-	23	14	6	9	14	33	36	26
LOS ANGELES	USA	-	-	42	-	-	28	-	26	13	23	26	9	-	22	-	7	4	18	1	29	16	19	22
GUANGZHOU	CHINA P.R.	4	3	11	-	7	15	-	19	21	17	14	1	-	10	-	8	25	34	29	21	14	19	14
MIAMI	USA	-	-	23	17	-	26	16	31	26	26	30	-	-	39	-	18	4	18	1	29	33	36	26
SEATTLE	USA	30	17	31	-	-	21	9	31	17	26	30	31	10	35	-	30	4	18	1	29	27	36	26
NINGBO	CHINA P.R.	5	18	15	-	5	36	31	18	26	22	30	5	-	3	-	12	25	34	29	21	20	36	26
KUALA LUMPUR	MALAYSIA	23	21	19	23	21	37	23	31	26	26	20	13	-	8	4	23	13	31	38	28	33	16	26
IMABARI	JAPAN	3	8	7	-	3	18	-	14	26	26	30	-	-	43	-	30	22	11	22	7	26	36	26
OSAKA	JAPAN	19	20	14	-	9	10	23	31	26	26	26	37	-	27	-	27	22	11	22	7	33	30	26
TAIPEI	TAIWAN	33	21	26	13	-	13	-	29	26	23	30	39	9	26	-	30	15	23	16	-	33	36	26
QINGDAO	CHINA P.R.	7	7	20	-	12	35	31	23	26	19	19	4	-	5	-	20	25	34	29	21	20	23	22
MARSEILLE	FRANCE	-	-	38	-	-	32	16	-	-	-	-	-	6	47	-	-	34	16	12	4	-	-	-
ABU DHABI	UAE	36	21	27	25	-	39	31	23	17	14	13	33	-	20	-	22	15	14	20	-	14	14	18
VALENCIA	SPAIN	-	-	47	-	-	42	-	29	26	26	30	26	-	15	-	30	25	25	27	11	31	30	26
BARCELONA	SPAIN	34	21	30	-	-	28	31	31	26	26	30	35	-	16	-	25	25	25	27	11	33	36	26
XIAMEN	CHINA P.R.	15	10	44	-	13	43	-	31	26	26	30	16	-	9	-	30	25	34	29	21	33	36	22
ISTANBUL	TURKEY	12	13	29	15	16	33	31	20	26	26	30	27	13	25	-	30	34	41	39	18	33	36	26
DALIAN	CHINA P.R.	6	6	12	-	4	25	31	16	23	19	30	17	-	17	-	30	25	34	29	21	24	30	26
GENOVA	ITALY	10	21	22	8	-	24	23	22	21	26	26	-	-	24	-	30	40	30	37	17	27	28	22
MUMBAI	INDIA	27	21	16	11	14	37	6	20	26	12	16	28	-	28	-	25	41	41	45	35	13	19	20
JAKARTA	INDONESIA	20	21	46	12	-	-	23	31	26	26	30	23	-	29	-	30	44	45	42	39	33	36	26
LIMASOL	CYPRUS	-	-	43	20	-	34	16	31	26	26	30	-	-	40	-	30	39	29	36	-	24	11	26
BANGKOK	THAILAND	-	-	33	26	-	31	-	31	26	26	23	21	-	42	-	30	18	46	41	38	33	17	26
DOHA	QATAR	32	21	-	-	-	43	31	31	26	26	30	-	-	32	-	30	45	24	26	-	33	36	26
SAINT PETERSBURG	RUSSIA	14	4	21	10	20	14	23	31	26	26	30	38	-	41	2	30	21	50	46	37	30	30	18
HO CHI MINH CITY	VIETNAM	16	12	37	-	-	-	16	31	26	26	30	14	-	21	-	30	42	46	42	-	33	36	26
PANAMA CITY	PANAMA	-	-	-	14	-	39	31	31	26	26	30	19	-	31	-	27	47	48	44	-	33	30	26
KINGSTON	JAMAICA	-	-	-	-	-	-	31	-	-	-	-	-	-	34	3	-	43	33	46	-	-	-	-
MANILA	PHILIPPINES	24	21	45	-	-	-	7	31	26	26	20	29	11	36	-	30	48	49	48	-	33	24	26
COLOMBO	SRI LANKA	21	14	41	-	-	43	16	31	26	26	30	24	-	14	-	30	49	43	49	-	33	30	26
RIO DE JANEIRO	BRAZIL	35	21	17	22	-	19	-	26	26	26	23	-	-	38	-	30	50	43	50	34	31	27	26

APPENDIX B: METHODOLOGY AND DATA SOURCES

DEFINITIONS

WHAT IS THE DEFINITION OF MARITIME ACTIVITY?

During almost 20 years of research, Menon Economics has defined maritime activity as: "All companies that own, operate, design, build or deliver equipment or specialized services to all kinds of ships and other floating units." More specifically, for data collection purposes, we defined the maritime industry as economic activity of firms registered in the following NACE rev. 2 codes: 5010, 5020, 5030, 5040, 3011, 3012, 3315, 5222, 5224 and 7734. This industry categorization is broad in the sense that it covers four different sub-sectors, which all include maritime activity. The NACE rev. 2 codes 5010, 5020, 5030 and 5040 account for the shipping industry, while the codes 3011, 3012, 3315 account for the shipyard industry. The NACE rev. 2 codes 5222 and 5224 account for the Ports & Logistics industry and the last code, 7734, leasing and renting activities. For a detailed description of the different NACE rev. 2 codes, please visit https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF. For countries that do not report data on NACE, we have used the corresponding alternative to NACE (e.g. NAICS in the United States).

Where we use data sources which are specialized at providing maritime data only, such as Clarksons Research and Lloyd's List, we have not made use of these NACE rev. 2 codes.

WHAT IS A CITY AND ITS GEOGRAPHIC BOUNDARIES?

In this report, we defined a city as encompassing an area that can be reached within a two-hour drive from the city center, approximating to a radius of 200 km from the city's center. This definition is not sensitive to artificial administrative borders, and captures most, if not all, relevant maritime economic activity related to a city.

DESCRIPTION OF DATA SOURCES AND METHODOLOGY EXPERTS' ASSESSMENT

We have built up a global panel of Maritime Industry Experts who have made thorough assessments of their own cities as well as ranked the nominated cities on a wide range of indicators. From a total of 285 respondents, 280 experts stated a city. These experts are based in 38 different cities, from a total of 28 countries.

Almost 50% of the experts are from Asian countries, in particular from Singapore. Accordingly, 100 out of 280 experts are from Singapore, followed by 25 experts from Dubai, and 22 experts from both Oslo and Shanghai. To avoid home bias, we have only utilized the questions where we asked experts to rank cities in terms of different aspects and indicators and have not used own city assessments. In addition, we repeated our analysis with the sample of experts without the ones from Singapore as a robustness check against a potential home bias these could create. The robustness check was clear: The rankings did not change significantly after omitting the respondents from Singapore. Thus, we have utilized all answers in this year's ranking.

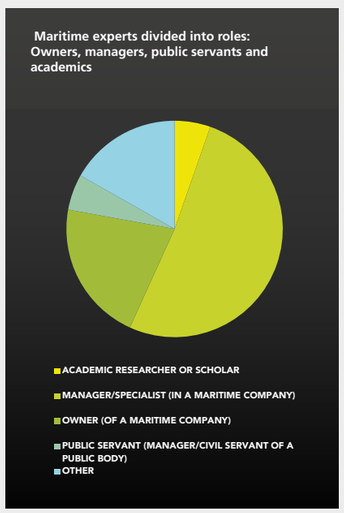
SHIPPING CENTERS

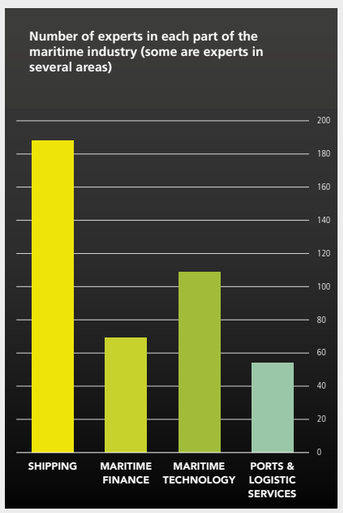
CLARKSONS DATABASE

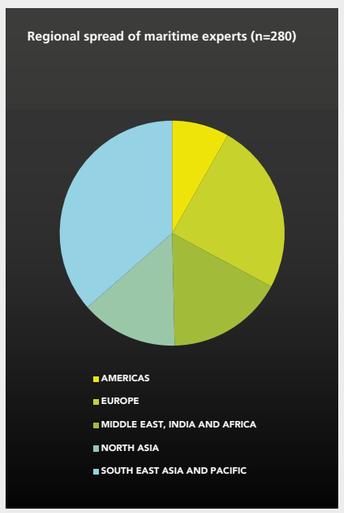
The Clarksons database (World Fleet Register) was used in multiple indicators. Under the shipping pillar, we have utilized information about both owners and managers, fleet size in terms of CGT, fleet value in terms of USD billions and number of shipping companies with HQ in each shipowners' city of registration (for shipping companies with more than five vessels in their portfolio). To evaluate fleet value at city level we have used WFM Vol 12 No 10 October 2021. We have used Clarksons database also to assess environmental friendliness of the world fleet where we utilized information about vessels' engine and fuel type to measure carbon intensity in accordance with DNV's Alternative Fuel Insights. The data were analyzed by Menon Economics.

BUREAU VAN DIJK - ORBIS DATABASE

Bureau van Dijk's Orbis database was used to gather information about operational revenue of shipping companies, which are defined as companies with NACE rev.2 codes: 5010 and 5020. The values were then allocated to the cities based on where the companies are registered.







MARITIME FINANCE AND LAW

WHO'S WHO LEGAL AND WORLD SHIPPING REGISTER (WORLD-SHIPS.COM)

In each of the cities, Menon has identified the number of experts in maritime law on Who's Who Legal and the number of maritime lawyers on World Shipping Register. These two sources include a comprehensive list of experts and firms in over 100 national jurisdictions, and the two sources enable us to capture both the expertise and the extensiveness of maritime law activity in each city.

THE INTERNATIONAL UNION OF MARINE INSURANCE & BUREAU VAN DIJK

The International Union of Marine Insurance (IUMI) provided a list of marine insurance premiums paid to insurance companies in each country for Hull Transport/Cargo, Marine Liability Offshore Energy. In addition, premiums for P&I clubs are included. National values are then allocated to cities based on their corresponding maritime financial and insurance activity/importance. Each city's share of the national values is computed by multiplying the national values with a ratio measuring each city's relative financial and insurance importance, which we measure as the amount of non-life insurance premiums in each city relative to aggregate national non-life insurance premiums. A critical assumption is that all the firms included in computing the ratio are delegated to cities after the location of their headquarter.

DEALOGIC, BLOOMBERG AND LOAN PRICING CORPORATION

We use data from Dealogic, Bloomberg and Loan Pricing Corporation to gather information about maritime mandated syndicate loans issued from bookrunner/MLA in 2020. Values were allocated to cities based on headquarter location of each bookrunner/MLA.

PETROFIN RESEARCH

Petrofin Research provided a list of the existing shipping portfolio of the top 40 shipping banks in the world. We used Petrofin's publication from 2021 to allocate the corresponding values to cities according to banks' maritime headquarter. The data covers full year 2020.

BUREAU VAN DIJK – ORBIS DATABASE

We used Bureau van Dijk's Orbis database to obtain the number of listed maritime companies in each cities' stock exchange. We identified maritime companies as companies that have NACE rev.2 codes: 5010, 5020, 5030, 5040, 3011, 3012, 3315, 5222, 5224 and 7734. We used Orbis database also to obtain the market capitalization of listed maritime companies with the same NACE codes and allocated these to cities based on the location of each stock exchanges.

CLARKSONS DATABASE

To evaluate the trade level on stock exchange in each selected city, we analyzed the data on the number of listed companies retrieved from the Clarksons Research Capital Markets (Shipping Intelligence Network). Furthermore, on each city's stock exchange the team also analyzed the trading volume of bonds, IPO and Follow Ons for the years of 2021 (up to November 2021). The number of listed companies measures the relative importance of each city as a maritime finance hub, while the trading volume tells us something about the volume of financial activity in each city. These two data sources combined give us a good measure of each city's relative importance as a maritime finance hub. All companies that own, operate, design, build or deliver equipment or specialized services to all kinds of ships and other floating units were considered.

MARITIME TECHNOLOGY

CLARKSON DATABASE

The Clarkson Database was also used to measure the size of fleet (CGT) built later than 2018 by active shipyards and their orderbook. The fleet size per yard was aggregated and then distributed to the different cities based on the location of the shipyards. The database was also used to identify the environmentally friendly fleet that has been built after 2018, where we utilized information about GT, vessels engine and fuel type to assess carbon intensity in accordance with DNV's Alternative Fuel Insights. The data were analyzed by Menon Economics.

Using total CGT of each ship retrieved from the Clarksons Research World Fleet Register, we determined the size of each classification society's classified fleet (measured as CGT) that is allocated to cities by using the location of classification societies' respective headquarter.

Finally, we used the Clarksons Database to compute the purchasing price of ships sold in the years of 2019-2021. These purchasing prices are allocated to cities based on where the corresponding builder shipyards are located.

BUREAU VAN DIJK – ORBIS DATABASE

We use Bureau van Dijk's Orbis database to obtain operational revenue (turnover) of companies in the maritime technology industry which we define as companies with NACE rev. 2 codes: 3011, 3012, 3315. Turnover values were then aggregated for each city based on companies' location.

The Orbis database was also used to collect information about number of active maritime patents owned by companies registered, which was later allocated to cities based on the location of the headquarter of the owner company. Maritime patents are defined as patents with the following IPC codes: B63B, B63C, B63G, B63G, B63H, B63J.

WORLD SHIPPING REGISTER (WORLD-SHIPS.COM)

Data from World Shipping Register was used to collect information about the number of maritime schools located in the different cities.

PORTS AND LOGISTICS

LLOYD'S LIST TOP 100 PORTS 2021

Lloyd's List rates the top 100 ports in the world based on TEU throughput. We use the 2021 report which contains data from 2020. Values were allocated to cities based on the location of the port.

DREWRY

Drewry provides a list with the top 21 port operators in the world yearly, based on TEU throughput. We used their list for 2019 and allocated values to cities based on the location of company headquarters.

UNCTAD

We used Liner Shipping Connectivity Index from UNCTAD to measure port performance. The index is based on 6 components that measure both connectivity and capacity of ports. We then allocate the LSCI index to cities based on the location of the ports.

ALTERNATIVE FUEL INSIGHTS, DNV

DNV Alternative Fuel Insights was used to gather information about ports with available LNG bunkering facilities. Ports were ranked based on the aggregate tank capacity of LNG bunker vessels who use the port for bunkering. Then the values for ports were allocated to cities they are located at.

ATTRACTIVENESS AND COMPETITIVENESS

THE WORLD BANK

We have used the Ease of Doing Business Index and the Burden of Customs Procedure Index provided by the World Bank. These indexes are on the national level, but since laws, rules and regulations often are identical across cities within a country, we argue that the indexes are representative on the city level.

TRANSPARENCY INTERNATIONAL

The Corruption Perceptions Index, which measures the perceived level of public sector corruption, is based on data from Transparency

International.

OECD

The OECD Services Trade Restrictiveness Index (STRI) provides up-to-date information on regulatory changes that affect trade in services in 46 countries across 22 sectors. We use the STRI index on maritime transport sector to measure restrictiveness in countries.

CHANGES IN METHODOLOGY AND INDICATORS FROM THE 2019 EDITION

- Modification of the weightage (and importance) of the pillar "Attractiveness & Competitiveness" during both the **initial ranking** (i.e., objective assessment of 15,000 cities to identify the initial top 50 cities), and the **final ranking** (i.e., objective and subjective assessment of cities to get the final ranking of the top 50 cities). This was done because the data for the objective indicators in this pillar are at a country-level, as opposed to being city-level, which gives an unfair boost (during the *initial ranking*) to cities that did not perform well on the other four maritime pillars, but which will suddenly perform well overall due to high national values (typical situation for small cities in Denmark, Norway, and New Zealand). Hence the weightage used for the pillar "Attractiveness & Competitiveness" was:
    - **Initial ranking:** weightage of 0% to overlook the importance of national values which may not apply to all cities within the same country but to instead emphasize that the initial identification of top 50 cities consists only of cities that perform well on the other four maritime pillars.
    - **Final ranking:** weightage of 20% to bring back the importance of attractiveness and competitiveness in the final and global benchmarking of the top 50 cities.

- Modification of some pillar-specific indicators to ensure that each of the 4 maritime-related pillars has a "green" indicator to reflect the decarbonization trend of the maritime industry. The changes for the indicators are:
    - Pillar "Shipping": addition of 2 new objective indicators (operational revenue of shipping companies; share of the fleet with low carbon-intensive fuel types), and removal of 1 subjective indicator on preferred relocation of company's HQ which was previously a duplication under Pillar "Attractiveness & Competitiveness".
    - Pillar "Maritime Technology": addition of 2 new objective indicators (size of fleet delivered by shipyards which are low carbon-intensive fueled ships; operational turnover of companies in the maritime technology industry). Furthermore, the patents indicator is now based on the number of maritime patents owned by any company, while the previous edition contained information about number of any type of patents owned by maritime companies.
    - Pillar "Ports & Logistics": removal of 2 objective indicators regarding the cargo tonnage volume handled in ports (since updated reliable data could not be sourced), and the quality of port infrastructure (which is provided by the World Bank but measured subjectively based on business executives' perception of their country's ports facilities). Addition of 2 new objective indicators on liner shipping connectivity index and ports with available LNG bunkering facilities.
    - Pillar "Attractiveness & Competitiveness": modification of 1 objective indicator from the burden of customs procedure to a more detailed indicator about discriminatory measures – restrictions on foreign entry, movement of people, barriers to competition, regulatory transparency – for maritime transport and logistics cargo handling which is sourced from OECD's Services Trade Restrictiveness Index.

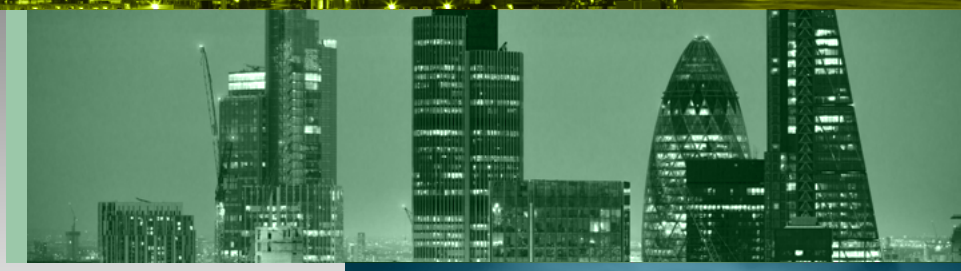
- Modification of some data sources across all pillars, to ensure the latest reliable information is used. We have put more work into quality check of raw data and aggregation of cities to encompass with the 2-hour drive rule.

- In this year's ranking, we have included the subjective city assessment for all cities in the top 50 city pool. Hence, the final ranking of the top 50 cities utilizes information on both objective and subjective data for all cities across all five pillars. In the previous editions of the report, the subjective assessment has only been applied for the top 15 cities within the pool of top 50 cities.

- We have also changed the way we normalize data across indicators to make up the pillar rankings and thus the overall rankings. We have now adopted a classical machine learning technique to normalize values for each indicator value by subtracting the indicator mean and dividing by the standard deviation of the series. In this manner, each indicator is standard normalized with a mean of zero and a standard deviation of 1. Because some of the indicators contains high levels of kurtosis (skewness), we divided all normalized indicators by its maximum value. Hence, extreme values are still present within each indicator, but between indicators the skewness will not alter the pillar scores. For those cities that have missing values reported on indicators, we have enforced a small penalty to avoid that missing values are treated like performing average. In this way, all the indicators are directly comparable.







MENON ECONOMICS

DNV