STARTUP WHARF

ENABLING STARTUP-DRIVEN
MARITIME INNOVATION
AND TRANSFORMATION

TRADE 2.0
– JAPAN –

Maritime
Startup and Innovation
Ecosystem Report

A QUIET REVOLUTION

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STARTUP-DRIVEN INNOVATION IS THE NEW DRIVER OF MARITIME TRANSFORMATION FOR AN ETHICAL, SUSTAINABLE AND PROFITABLE MARITIME BUSINESS

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CONTENT

Foreword

We are delighted to be the key sponsor of this report, which is the first of a series of in-depth profiles into maritime technology and start-ups in a specific country and builds on the excellent global Trade 2.0 report that we jointly launched with the authors in 2019.

STARTUP WHARF

Inmarsat's connections in Japan run long and deep with a Land Earth Station run by our partner KDDI having been operational since we formed in 1979. We have since continued to hold a number of longstanding and vital partnerships with other key partners in the country such as JSAT Mobile, JDC, AT Communications and Japan Radio Company (JRC), along with counting many of the leading shipowners as long-standing and valued clients.

In 2016 we purposely expanded our Tokyo office to enhance the support we offered the Japanese shipping community as the digital revolution in the maritime industry started to take off, with Japanese owners at the heart of the drive for automation, operational efficiencies and greener and safer shipping.

Owners such as K Line, MOL and NYK that have installed Fleet Xpress are now involved in ground-breaking projects in operational data sharing, manned autonomous ships, and decarbonisation.

And, we can't forget that we are also relying on Japan to deliver the first slice of our future with Mitsubishi Heavy Industries launching our first I-6 satellite in 2021.

Working together in partnerships (a theme that is continuously highlighted in this report) with companies both large and small will always bring the most benefits and it's for that reason that we continue to enter partnerships with innovative Japanese companies such as the one we entered this year with Ship Data Centre (ShipDC), the data integration company set up by classification society ClassNK and those covered in this report.

The introduction of Fleet Xpress four years ago, has helped drive levels of connectivity that have never been experienced before bringing the age of the connected ship.

When we first announced our vision of Fleet Xpress, our revolutionary, high capacity, global broadband network, nine years ago, many considered it a shot in the dark. At the time, satellite communications were considered to be something of a niche industry operating at the periphery of the mainstream, terrestrial telecommunications sector.

But today we are living in a very different world, one in which satellite communications have become an essential enabler of the emerging global digital society. Satellite connectivity offers unique, mission-critical capabilities – reliability, resilience and, above all, the power to deliver applications, such as those covered in the following pages, in real-time and via an established ecosystem.

With our five Global Xpress satellites, and a further seven satellites planned by 2023 we are adding additional capacity to the network, as well as in-orbit redundancy that further upgrades the reliability and resilience of our services. This kind of augmentation will be a consistent feature in the years to come, as we maintain the Fleet Xpress platform at the cutting edge of innovation in collaboration with our partners, and continue to enable digital transformation in the shipping industry.

Ronald Spithout

President, Inmarsat Maritime

inmarsat

Executive Summary

JAPAN's maritime industry has been at the forefront of innovation for a century and a half. Through the second half of the 20th century, when Japan became one of the world's great exporters of consumer technology, the country also cemented its position as a leading maritime nation. Today, Japan is the world's third largest economy, the third largest shipbuilding nation, and the second largest ship owning nation in the world.

Japan's innovation philosophy stems from the nation's culture of high context, where relationships are given as much importance as individual elements in a system. This has led to Japanese engineers being particularly adept at fusing seemingly unrelated technology disciplines to create entirely new paradigms. This methodology gave the world modern day robotics, autopilot, anti-lock braking systems, and the Nintendo Gameboy.

In the maritime industry, as the traditionally analogue shipping fleet becomes increasingly digital, the need to understand the relationships between physical and cyber technologies has never been more important. This puts Japan at a natural advantage over other countries where much of the innovation of the last 30 years has been in software alone.

Japanese shipping companies continue to make innovation a high priority. Unlike in much of Europe and North America, where innovation is driven by startups and entrepreneurs, it is large corporate enterprises that are pushing the technological envelope. In the last five years all of the major carriers have trialled and implemented new technology initiatives including computer assisted and augmented reality navigation, a payments app for seafarers, and AI driven collision avoidance systems.

Thanks in part to the keiretsu system of business groupings, much of Japanese innovation is driven by partnerships. Today, those partnerships extend horizontally, outside the vertical keiretsu system and across competitive lines, including the E5 Lab, the Ship Data Centre, and the now shuttered Maritime Innovation Japan Corporation.

Recognising that corporate innovation can only go so far, the Japanese maritime industry is now also partnering with startups to explore new technology development. Japan has only a very small startup ecosystem and so the industry is instead looking out to international startups to help them solve big problems. Large corporations with interests in the industry including NYK Group, Weathernews Inc, and Mitsui Group have all established joint ventures outside Japan, either to develop specific technologies or to engage and build relationships with local startups.

The Japanese government is attempting to grow the local startup ecosystem too, putting together programmes to help them trade internationally, and making it easier for foreign entrepreneurs to launch businesses in Japan. Along with government support for startups, there is an opportunity for shipping companies and shipyards to invest in them. We know from other maritime startup hubs around the world that "smart money", where investors have an innate understanding of the industry, is crucial to helping startups break into maritime. Internal projects are also a hugely critical part of the innovation ecosystem, particularly when it comes to addressing strategically important problems that need to be solved at scale.

Looking ahead, it is estimated that Japan's maritime technology market, which is worth $8.8 billion today, will grow to be worth $15.8billion by 2030. A much faster growth rate than the maritime industry as a whole or the wider economy. Very few other maritime nations have both the technological expertise and the industrial scale of Japan. This gives the country huge potential to develop and implement technology that can enact real change; especially in operational data sharing, manned autonomous ships, and decarbonisation.

Japan's lack of startups has not held the maritime industry back to date. But it is important to realise that much of the net job creation in Japan over the last few decades has come from entrepreneurs or foreign enterprises. While Japan has an enviable position as a leading maritime nation, one of the keys to unlocking the growth potential of the technology sector is to better support local entrepreneurs and innovators. Combining support for entrepreneurs creating new ideas, with the scale of Japan's current shipbuilding and ship operating industries could create a force for innovation that is unmatched in the world.

Introduction

IN 1878, a steel hull ship was launched from a UK shipyard. The Hideyoshi Maru was ordered by a fledgeling Japanese shipping line. The ship was at the cutting edge of technology. It was the first ship in the world to be fitted with a three cylinder compound steam engine and had been commissioned to carry coal between Fukuoka Prefecture and Nagasaki Prefecture. Six years later, in 1884, a partnership was formed between 55 small shipowners, including the owner of the Hideyoshi Maru, to pool their resources and investments, creating Osaka Shosen Kaisha (OSK) Line, the forerunner to Mitsui OSK Lines.[1]

In 1893 the Hiroshima Maru, operated by the newly formed NYK Line, arrived at the port of Bombay, India for the first time.[2] It was the first international liner service operated by a Japanese company and marked the beginning of a rapid and successful expansion of Japan's international maritime industry.

Three years later, in 1896, entrepreneur and industrialist Kawasaki Shōzō founded Kawasaki Dockyard Co. Ltd, by merging the operations of two dockyards he had built in the previous decades. In 1919, the shipyards built more ships than market demand would allow for. Kojiro Matsukata, the president of Kawasaki Dockyard at the time, decided to use the excess ships to start the shipping line that eventually became known as K Line.[3]

Though there have been several mergers and changes over the decades, K Line, Mitsui OSK Lines and NYK Line have been at the frontier of Japan's maritime industry since they were founded. Two themes run throughout their respective histories; the first is an appreciation and understanding of new technology and the second is the ability to adapt to a rapidly changing world.

Today, more than 140 years after the Hideyoshi Maru first set sail, as the shipping industry faces an unprecedented pace of change, Japan's maritime sector continues to adapt, making the most of the cutting edge technology in the process. At a time when most developed economies are obsessing over the role startups can play in creating positive change across the shipping industry, it is Japan's large corporate enterprises that are breaking new boundaries in everything from electric vessels and autonomous shipping, to data sharing and crew welfare.

Japanese innovation philosophy, that revolutionised consumer technology throughout the twentieth century, permeates every manufacturer, shipyard, and shipping line in the country today. In the coming chapters, we will discuss just a few examples of the role innovation plays in keeping Japan at the forefront of the global shipping industry, and how the Japanese innovation ecosystem, which is unique in the world, continues to push the boundaries of what's possible across digital, mechanical, and electrical engineering.

TWO THEMES RUN THROUGHOUT JAPANESE MARITIME HISTORY: THE FIRST IS AN APPRECIATION AND UNDERSTANDING OF NEW TECHNOLOGY AND THE SECOND IS THE ABILITY TO ADAPT TO A RAPIDLY CHANGING WORLD

Japan's Unique Maritime Advantage

JAPAN is uniquely positioned in the world as a maritime economy and an innovator. A powerhouse in global shipbuilding and heavy manufacturing, and home to some of the greatest innovations of the 20th century, modern day Japan is at the forefront of global trade. From the 1950s to the 1990s, Japan's economy grew at breakneck speed, and the island nation became one of the world's great exporters of consumer technology and the second largest economy after the United States. Today, Japan is the third largest economy in the world, the third largest shipbuilding nation, and the second largest ship owning nation in the world.[4] As we progress through the 21st Century, and the maritime industry increasingly seeks out new technology to address challenges such as decarbonisation, safety, security, and efficiency, what unique advantage does Japan have over other maritime nations and how should it best capitalise on its position in the world?

Understanding Japan's innovation philosophy

Answering this question requires an exploration that runs deeper than just economic output indicators or trade statistics. Japanese culture lends itself to a different approach to work, business, trade, and innovation. In a study conducted by researchers at the University of Michigan, Japanese and American test subjects were shown animated underwater scenes and asked to describe them. The majority of the American participants described the large fish swimming in the foreground, but the majority of the Japanese participants described contextual elements of the animation, such as the fact that it was underwater, or the rocks and seaweed in the background. Overall, Japanese participants made 70% more observations about background elements of the environment, and 100% more observations about relationships between background elements.[5]

Japanese society is one of high context, where relationships between elements often matter as much as the elements themselves. This gives Japanese companies a unique advantage when it comes to innovation. In Europe and America, innovation is often viewed through the lens of creating breakthrough moments in individual, cutting edge technologies. In Japan, however, innovation more often involves combining established technologies or disciplines to create entirely new categories or use cases.[6]

In 1969, Tetsuro Mori, a senior electrical engineer for Yaskawa Corporation, was attempting to build an electronic control system to run a mechanical production line. At the time, combining the two disciplines of electronic and mechanical engineering was groundbreaking, and as his work progressed, Mori coined the phrase "mechatronics", to describe this new discipline.[7] Today, mechatronics is a discipline at the nexus between mechanical engineering, electrical engineering, and computer science. The discipline of mechatronics underpinned the development of robotics, computer aided design, and autonomous systems. Without it, we wouldn't have industrial robots working in our factories, autopilot systems in planes, or anti-lock braking systems in cars.

Similarly in the 1980s, despite US researchers leading the development of the use of glass fibres for optical communication, it was Japanese researchers who pioneered the marriage of optical engineering with electrical engineering, giving birth to the field of optoelectronics.[8] Today, the world's internet traffic is carried along subsea cables to your home using fibre optics that would not have existed without the merging of these two separate disciplines.

Lateral thinking with withered technology

Perhaps the best known example of Japanese innovation culture is the story of Nintendo. In the 1960's Nintendo was a struggling playing cards manufacturer. Recognising the decline of the playing cards business, Nintendo attempted to diversify into everything from a taxi service to "love hotels", each with limited success. Gunpei Yokoi, an electrical engineer hired to maintain the card printing machines, created an extendable arm as a toy for his own amusement using spare parts from the factory. After spotting the arm on a visit to the factory, Nintendo President Hiroshi Yamauchi asked Yokoi if he would be willing to develop it into a product. The "Ultra Hand" was a roaring success, and Nintendo became a toy manufacturer, with Yokoi leading the design of new toys.

During his time as a Nintendo designer, Yokoi developed an innovation philosophy he called "lateral thinking with withered technology". Instead of working at the cutting edge of technology, Yokoi preferred instead to use old technology that was reliable, cheap, and easy to work with, in radically different ways. When most toy manufacturers were building expensive remote control cars with multiple radio channels, Nintendo built one with only a single radio channel even though it meant the car could only turn left. Lefty RX was a breakout hit, in part because of its simplicity, but mostly because it could be produced and sold at a fraction of the cost of its competitors.

Yokoi and his team's biggest hit, and arguably their biggest contribution to modern technology, was the Gameboy. The Nintendo Gameboy was released, in 1989, at roughly the same time as a number of similar handheld devices, from rival game developers. The Gameboy's screen was only 2.6" wide and capable of producing just four shades of grey. It had no backlight and it had just 4kb of memory.[9] Its American competitor was released in the same year, the Atari Lynx, had a 3.5" full colour screen, a backlight, and a massive 64kb of memory.

But the Lynx's superiority proved to be its downfall. The cutting edge chipsets used were difficult to source, meaning the console was beset with production problems. Its colour backlit screen meant the console could only be played for around three hours before needing new AA batteries. The massive memory and advanced graphics made it expensive for game developers to release new titles. Lastly, the cutting edge machine retailed at $179. By contrast, the Game Boy retailed at a manageable $80 with a game, was easy to manufacture, had a 30 hour battery life, and was so simple that developers quickly churned out hundreds of titles. The Atari Lynx was discontinued in 1992 after having sold a modest 3 million units.[10] The Nintendo Game Boy, thanks to its simplicity, dominated the handheld market for a decade. It is estimated that the Game Boy line sold 118 million units worldwide during its 14 year life in production.[11]

INSTEAD OF WORKING AT THE CUTTING EDGE OF TECHNOLOGY, YOKOI PREFERRED INSTEAD TO USE OLD TECHNOLOGY THAT WAS RELIABLE, CHEAP, AND EASY TO WORK WITH, IN RADICALLY DIFFERENT WAYS

Bringing Japanese innovation to maritime

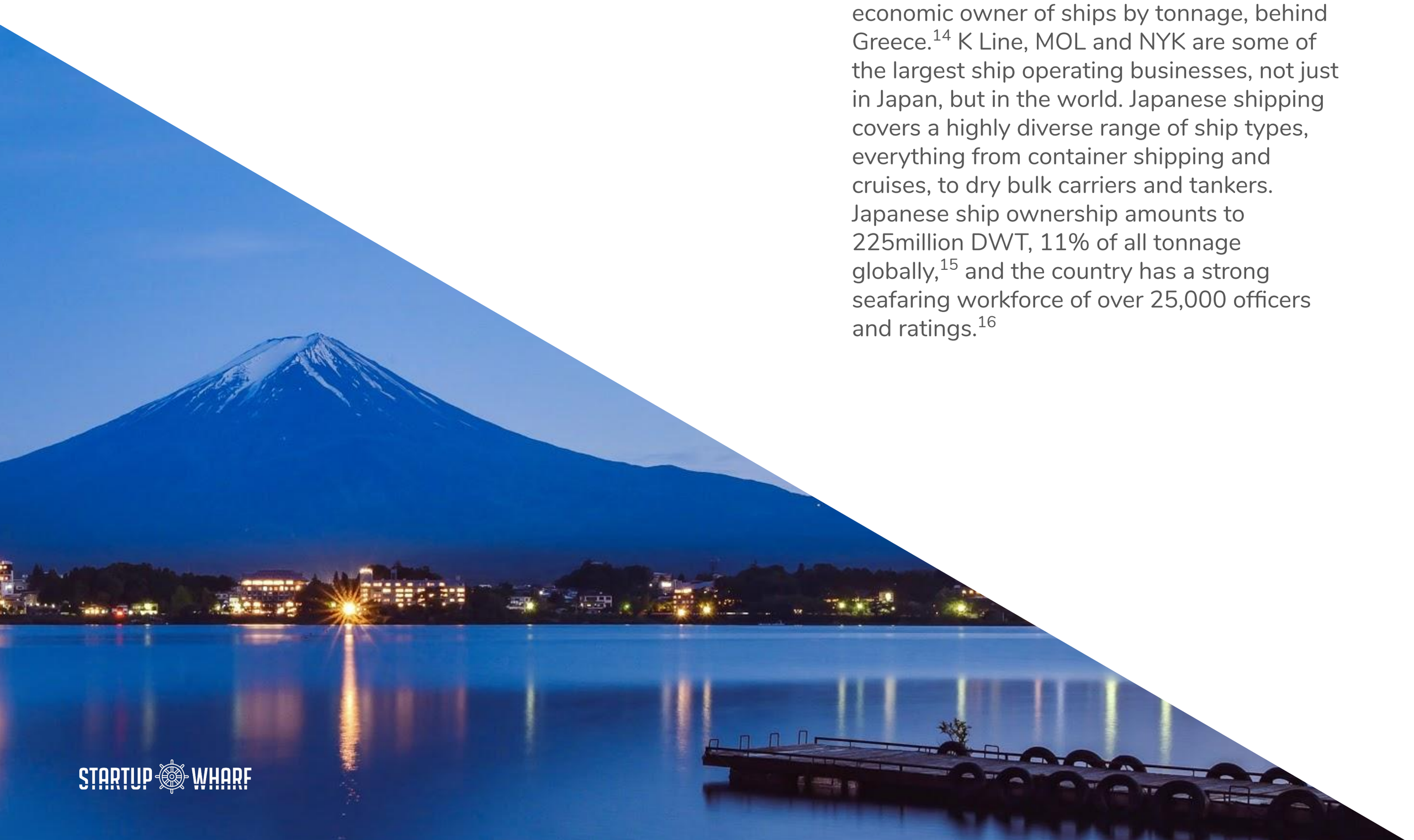
Nowhere is the innovation philosophy that brought us robots, fibre optic broadband and the Game Boy more appropriate than in the maritime industry. As the traditionally analogue shipping fleet becomes increasingly digital, there is a growing need to understand the relationships between the physical world and the cyber world, rather than each in isolation. Unlike other industries like banking, where startups have become great disruptors, software alone cannot solve the shipping industry's problems or fundamentally change its operating model. Moving the world's shipping fleet into the next phase of technological maturity requires a fusion of disciplines that puts Japan at a natural advantage. Further, at sea, where reliability in extreme conditions and an ability to source parts anywhere in the world are coupled with constant cost pressures, lateral thinking with withered technology is not just an advantage but an imperative.

Japan has a long and proud maritime history. The shipbuilding and sailing tradition in Japan stretches back centuries. Vast coastal fleets of up to 1,000 warships were deployed as early as the 12th Century. But it was not until the mid-19th century, when the threat of invasion from America forced the end of 200 years of isolationist foreign policy, that Japan started building an ocean going Navy for defence and trade.

Throughout much of the 20th century, Japan was at the forefront of the shipbuilding industry and the leading producer of tonnage around the world. Today, Japan has lost its position as the largest shipbuilding nation to tough competition from China and South Korea. But the island nation still produced 25% of global tonnage output in 2018 and has a reputation for building ships of outstanding quality.[12] Major shipbuilding companies including Tsuneishi Holdings, Oshima Shipbuilding, and Imabari Shipbuilding to name a few, operate more than 20 major shipyards across the country, producing 14million DWT of newbuild ships each year.[13]

> JAPAN IS A MAJOR SHIPBUILDING NATION AND A KEY PLAYER IN OWNERSHIP AND OPERATIONS OF THE WORLD'S FLEET

As well as building ships, Japan is also a key player in the ownership and operation of the world's fleet. Japan is the second largest economic owner of ships by tonnage, behind Greece.[14] K Line, MOL and NYK are some of the largest ship operating businesses, not just in Japan, but in the world. Japanese shipping covers a highly diverse range of ship types, everything from container shipping and cruises, to dry bulk carriers and tankers. Japanese ship ownership amounts to 225million DWT, 11% of all tonnage globally,[15] and the country has a strong seafaring workforce of over 25,000 officers and ratings.[16]



But Japan's shipping industry is not resting on its dominant position on the world's maritime stage. Like much of Japanese industry, innovation in maritime is mainly driven by corporate entities. Further, unlike in North America and Europe, where innovation appears to be driven by technology suppliers and startups, it is the ship operators themselves that are pushing the envelope. Through a combination of R&D, corporate venturing, and internal transformation teams, Japanese ship operators are creating a quiet revolution in the industry.

In the last five years, all of the major carriers have trailed and implemented new technology initiatives; from autonomous operations, to mixed reality training, to unified data management. Throughout 2018, in collaboration with Japan's National Maritime Research Institute, Mitsui OSK Lines ran a feasibility study to investigate the use of computer assisted collision avoidance tools. By developing an algorithm that creates a collision risk profile for other vessels in the vicinity, the research team were able to alert mariners in a simulator of potentially dangerous traffic situations before they developed fully.

After the conclusion of the feasibility study, MOL began rolling out an augmented reality navigation support system to 21 of its fleet of VLCCs. The technology, developed with Furuno Electric Co, was tested throughout 2018 on two of its newbuild ships; a car carrier and a crude oil tanker. Data from AIS, Radar, ECDIS, and video systems are combined and overlaid onto a digital display. The system combines independent technologies that were developed throughout the last century into a new interface intended to improve situational awareness on board and make it easier for officers to match the traffic they can see out of the window to what the navigation equipment has detected.

MOL's long term strategy is to improve navigational safety and efficiency by creating data driven, automated processes. But they are not alone in this endeavour.
K Line has been working with Japanese shipyard Kawasaki Heavy Industries to develop a vessel performance optimisation platform for their fleet. The system integrates data from a range of sources from the engine room and navigation equipment. It is used to monitor vessel performance, manage biofouling, optimise trim, and reduce the workload of the ship's crew.

MarCoPay

Mobile banking has become a default standard for many of us. Smartphones can send and receive money over the internet in a matter of seconds. But what happens if there is no phone signal or wifi? How can seafarers send and receive money, or pay for goods electronically while they are in the middle of the Pacific ocean or at a foreign port? The answer lies in the lateral use of an old technology. QR codes have existed since the early 1990s. They were originally developed by Japanese auto manufacturers to track inventory at factories, and today are more often used to add friends on Snapchat than anything else.

Maritime fintech startup MarcoPay, however, has developed a way to use QR codes to facilitate electronic payments without internet access. Founded as a joint venture between NYK Line and Philippine ship management and crewing conglomerate Transnational Diversified Group, MarcoPay is a digital currency for seafarers. It is pegged to the US dollar and allows NYK to pay their international seafarer salaries directly to their phones. Once paid, crew members can use the money to buy goods on board their ship, send remittance home, or withdraw cash from ATMs around the world.

When a seafarer wants to buy goods from the ship's bonded store, send money home, or send money to other crew members on board, they scan a QR code with their phone which securely registers the transaction on the ship's system. Transactions are synced via satellite to cloud based financial infrastructure that is underpinned by Citi. By using a reliable technology that is a quarter of a century old, MarcoPay is enabling seafarers to easily access their pay and better support their families at home from the middle of the ocean with their own phones.

sensetime

Sensetime, which started as an academic project in Beijing and is now being hailed as the world's most valuable artificial intelligence startup, provides several technologies including face, image, object, and text recognition as a SaaS platform. Despite being less than 5 years old, they have over 700 clients worldwide and $750m in annual revenue. Sensetime opened their Japan office last year and have been working with Mitsui OSK Lines on the development of a computer vision powered collision avoidance system.

The system, which is being tested on board MOL operated cruise ship Nippon Maru, uses ultra high definition cameras to recognise and track vessels of any size. This includes those vessels that are too small to require AIS, like fishing boats, and those that reflect radar signals poorly like wooden boats and yachts. The recorded video and collected data is fed into the system to train an algorithm that, like a human, continually improves over time.

The system can operate independently of AIS and radar. Though it has not yet been deployed commercially, its introduction builds on MOL's strategy to improve navigational safety through the use of augmented reality and automation by plugging an important gap in the capability of the system that exists today.[18]

Additionally, a built-in set of KPIs can trigger alerts when any safety or efficiency parameter falls outside of a set range. The system, having begun life as a merger of two systems in 2016, has completed phase two of its development and been rolled out to 170 ships. It is now capable of analysing up to 2,000 operational data points on each ship every 30 minutes.[17]

The examples above just scratch the surface of the depths of innovation going on in Japan. Like much of Japanese industry, while there is a role to play for entrepreneurs in the innovation ecosystem, there is a genuine drive from leaders in the corporate world to keep Japan at the forefront of shipping technology. Technology at the bleeding edge is being deployed to Japanese ships every day, and the commitment extends beyond research and development all the way through to full scale implementations. Beyond the economic and geographic position of the country, Japan's unique innovation advantage is built on that corporate drive to constantly improve. But it is a culture of trust, partnerships, and the ability to combine technologies across lateral disciplines that really make Japan stand out as a centre of excellence for maritime innovation.

The Maritime Innovation Ecosystem in Japan

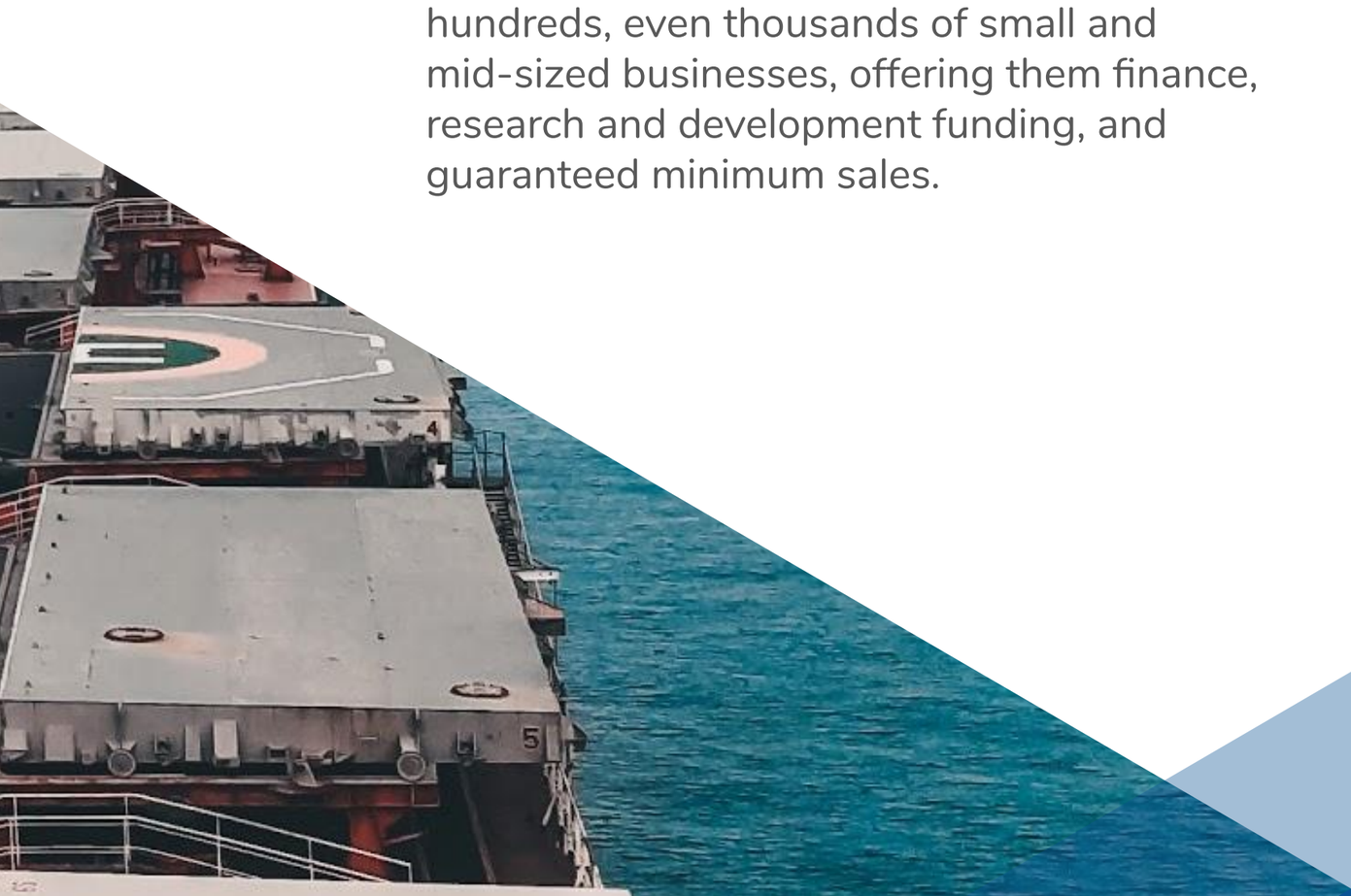
FOR much of the last century innovation in the Japanese maritime industry was driven by large corporate trading houses, shipping lines, and shipyards but often fulfilled by small and medium enterprises. Today, innovation is still driven by large enterprises, but in the face of the overwhelming international pace of change, the techniques and methodologies of startup driven innovation are increasingly being adopted. Further, playing to the natural strengths of Japanese industry, government and large corporations are now looking out to the world to bring in startups to help transform everything from the design and build, to the successful operation of the commercial fleet.

Through the latter half of the twentieth century, Japan's economy was driven by informal corporate groupings called keiretsu. These groups, which still exist today, are linked by interlocking shareholdings, directorates, and historical ties. There are six major keiretsu and a large number of smaller ones operating across Japan. Traditionally, each group had its own bank, real estate developer, heavy industries manufacturer, and trading company. The major shipping lines in Japan are all keiretsu members: K Line is a member of the Sumitomo group, Mitsui OSK Lines is a member of the Mitsui group, and NYK Line is a member of the Mitsubishi group. Keiretsu operate so that each member supports the ecosystem they are part of, and direct competitors within the same group are avoided. Until the late 1990s, the major corporate entities within a keiretsu supported hundreds, even thousands of small and mid-sized businesses, offering them finance, research and development funding, and guaranteed minimum sales.

As the joint pressures of globalisation and technological progress forced manufacturing overseas, the keiretsu system began to break down. Without the support of large industry players, many small innovators did not survive the changing dynamic.

Innovation driven by partnerships

Today, though it is far less prominent than it used to be, the keiretsu system still plays an important role in facilitating the trusted partnerships needed to enable innovation. Partnerships also now extend beyond the traditional keiretsu, with competitors often coming together to help move new ideas from concept to implementation. One such example of this is the Maritime Innovation Japan Corporation (MIJAC). Founded in 2013 as a joint venture, with an initial investment of $100,000 USD by partners including Oshima Shipbuilding, Shin Kurushima Dockyard, Tsuneishi Shipbuilding, ClassNK, Sanoyas Shipbuilding, and NYK Line.[19] MIJAC was a research and development organisation aimed at enhancing Japanese shipbuilding, shipping, and ocean technologies, and promote them worldwide.[20] The joint venture was shuttered in 2017, but in that time it conducted research on everything from autonomous shipping and LNG as a fuel, to computer-vision aided cargo handling and air lubricated vessels. During its time in operation, MIJAC ranked joint first in the number of maritime related patent applications filed in Japan, alongside the National Maritime Research Centre and Furuno Electric Co.[21]



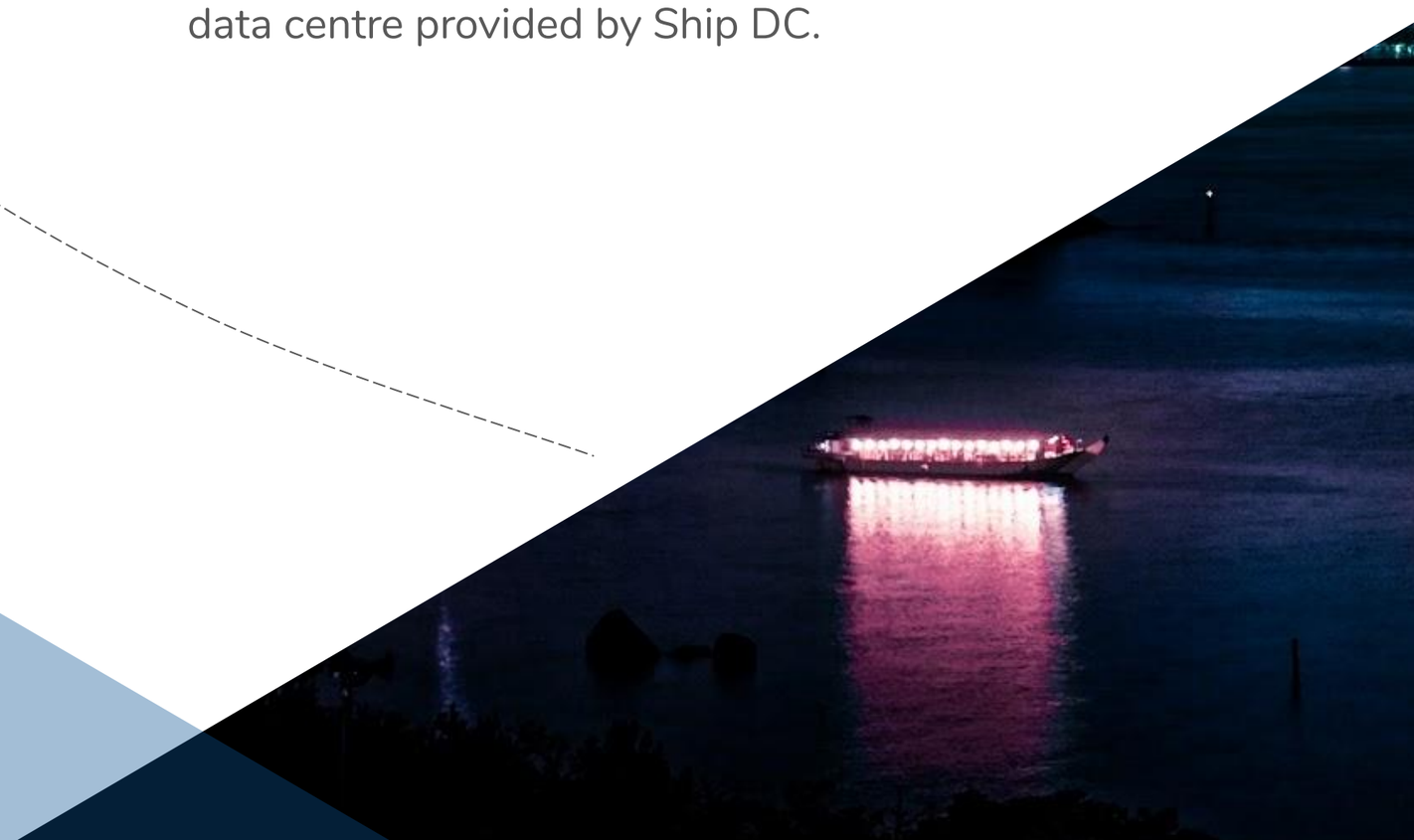
Global marine engine manufacturer Yanmar is developing automatic mooring technology through a partnership with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). As part of a research project, Yanmar designed and built a 4.5m long unmanned autonomous surface vessel for JAMSTEC to provide continuous environmental monitoring at sea.

To make the project viable, Yanmar had to develop an automatic docking system that can bring a boat alongside in a pontoon or quay without human intervention. The system uses high definition differential satellite navigation alongside a system of cameras, radar, inertial sensors, and an acoustic transceiver on the quayside to guide the boat safely alongside without hitting any obstacles on the way.

Though it has only been used on experimental craft to date, Yanmar plans to develop and test the technology further to make it viable for use on commercial ships and fishing boats, as well as a system to aid yachts and amateur sailors.[24]

One of the biggest challenges facing the shipping industry today is developing viable solutions to decarbonisation. Again, it is a partnership that reaches across competitive divides that is working on solving the problem. E5 Lab Inc, a joint venture partnership between Mitsui OSK Lines, Mitsubishi Corporation, Asahi Tanker Co, and Exeno Yamamizu Corporation was established to deliver value to the industry across electrification, environment, economics, and evolution. E5 is working towards the ambitious target of designing and launching Japan's first fully electric bunker tanker by 2021. The tanker, which will be powered by electric battery packs and charged by renewable energy, will have two azipods and a thruster, making it highly manoeuvrable. As well as being a zero emission vessel, the electric propulsion system will create almost no noise and vibration, improving the welfare of crew on board. 90% of crew injuries happen during mooring.[22] As well as improving welfare, E5 plans to improve safety with an automatic mooring system, keeping crew off the deck during the most dangerous part of the ship's operation. An electric tanker is not E5's only ambition, they are also experimenting with electric tug designs, using next generation satellites for broadband at sea, and a zero emission electric hydrogen hybrid car carrier.[23]

One of the main challenges that come with forging technology partnerships across large businesses is the use of common standards and frameworks for sharing data. When K Line, MOL and NYK merged their container divisions to form Ocean Network Express in 2017, each respective company was handling and managing data in different ways. This made sharing data across ships that were now part of the same fleet practically impossible. Understanding the increasing importance of data integration, ClassNK, Japan's largest classification society, established the Ship Data Centre (Ship DC) in 2015. To address the challenge of data integration across multiple ship operators, the spinoff venture established the Internet of Ships Open Platform (IoS-OP). The platform is built around a common set of data standards and definitions, and an onshore data centre provided by Ship DC.



By bringing operational data from multiple fleets into a single open platform, it is possible to create value that would otherwise have been too difficult or expensive to unlock. In 2019, ONE began using the IoS-OP to share data with K Line, MOL and NYK respectively, across all of the ONE container fleet, significantly increasing the volume of data available and improving the accuracy of analysis, reporting, and performance monitoring across the entire fleet. As well as helping unify data across shipping lines, IoS-OP also makes it easier to create partnerships with solution providers and to build new revenue streams by selling data back to manufacturers and shipyards. In May 2019, Finnish data analysis provider NAPA became the first solution provider to join the platform, providing ship performance analytics and voyage optimisation services to ship operators.[25] By integrating through IoS-OP, NAPA can offer their services to ship operators with less integration time and cost than before. By creating a unified standard that can be used by all stakeholders, Ship DC is fuelling new partnerships that were previously impossible. The Internet of Ships Open Platform consortium has over 50 members, representing a range of interests including ship operators, shipyards, and digital solution providers.[26]

NAPA is far from the only international technology business successfully partnering with the Japanese carriers. NYK Line recently announced a new partnership with Norwegian maritime digital solutions developer Dualog. The agreement, which is supported financially by Innovation Norway, gives Dualog research and development access to a fleet of 50 ships, and will allow both companies to improve their capabilities across IoT, big data management, and cyber security.[27]

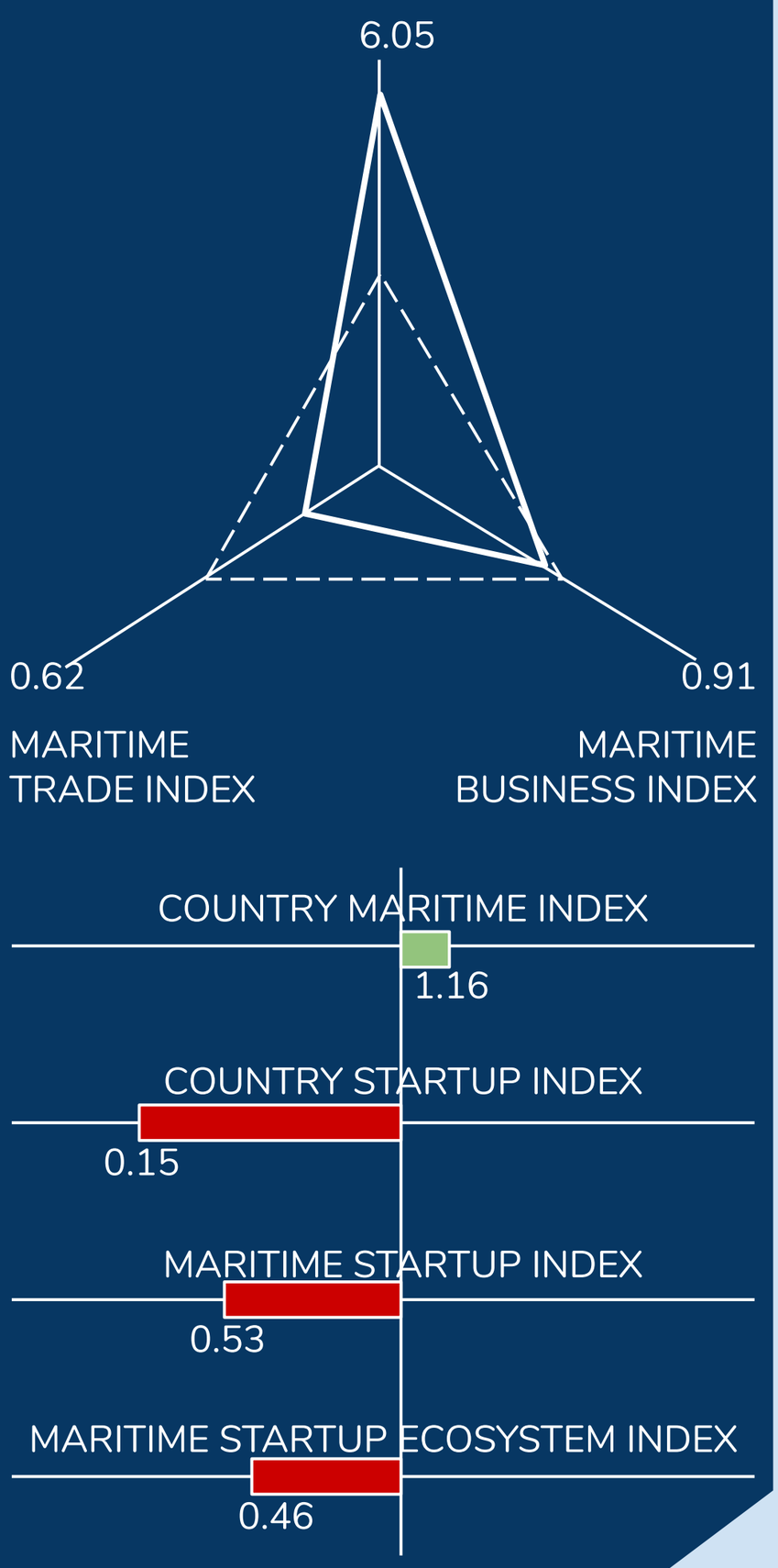
Startups wanted

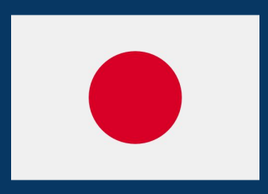
The partnership dynamic that fuels innovation across Japan extends into the startup world too. Though Japan is not often considered a startup nation, it is important to remember that one of the world's most prolific investors in startups is Japanese. Since it was founded in 2017, Softbank's Vision Fund has taken part in $71billion of equity funding across nearly 100 startups and scaleups.[28] Corporate venture capital is one of the most common forms of investment in Japan, making up the majority of money invested in startups across the country.[29] The startup movement in Japan is still small, and a fraction of the size of its American or European counterparts.

THE PARTNERSHIP DYNAMICS THAT FUELS INNOVATION ACROSS JAPAN EXTENDS INTO THE STARTUP WORLD TOO

Maritime Startup & Innovation

MARITIME
MANUFACTURING INDEX





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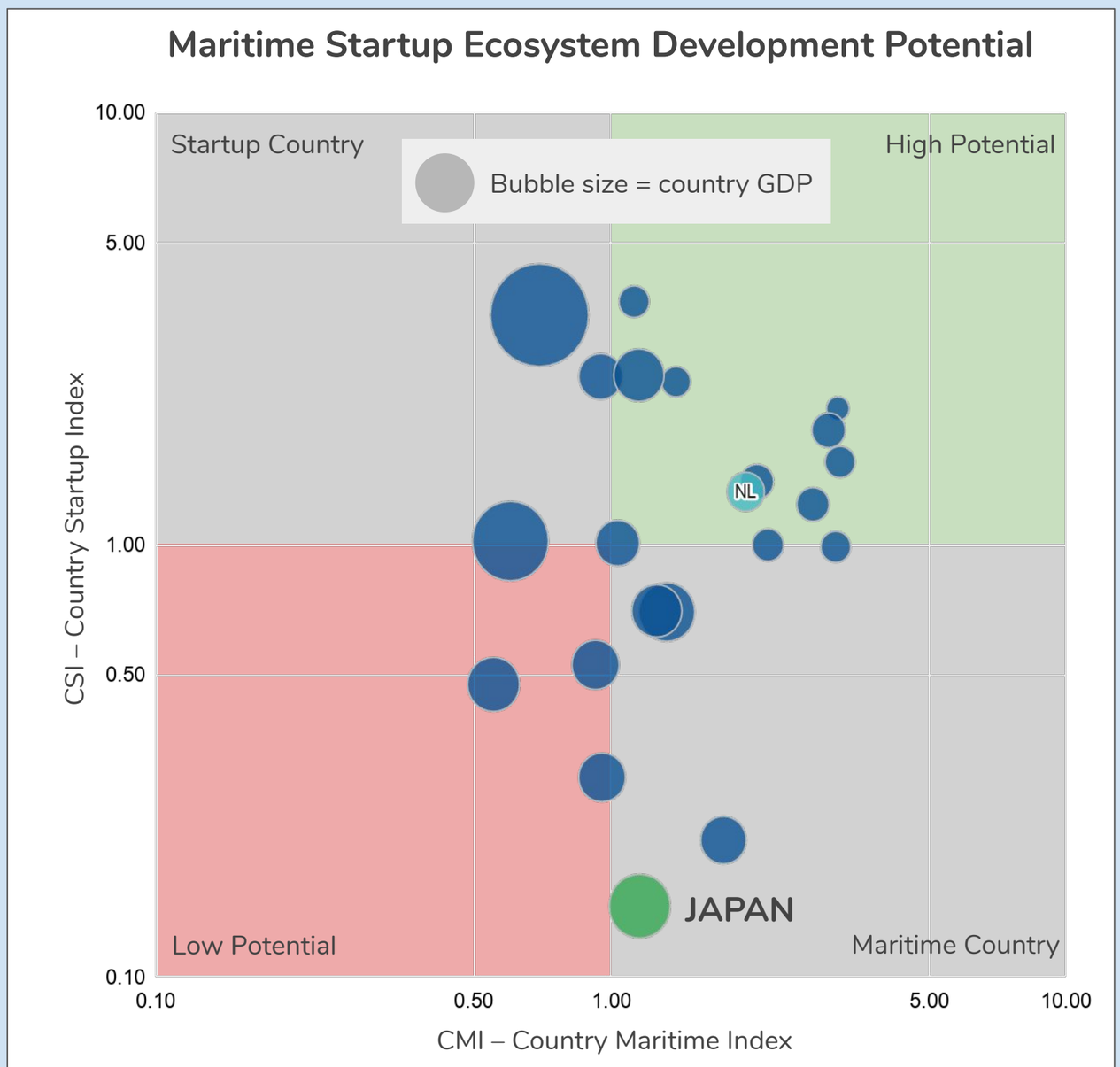
Growth forecast analysis

The Japanese Ship Tech sector is expected to turn over $8.8 billion in 2020. This represents all information technology spending in the industry including research and development, digital products and services, hardware, communications, and related services across ship ownership, management, operations, building, and marine manufacturing.

The Ship Tech sector is expected to achieve a CAGR of 6.1% over the next 10 years, growing four times faster than the maritime industry as a whole, and be worth $15.8 billion by 2030.

The maritime industry in Japan as a whole is expected to turn over $83.4 billion in 2020, growing to $95.7 billion in 2030.

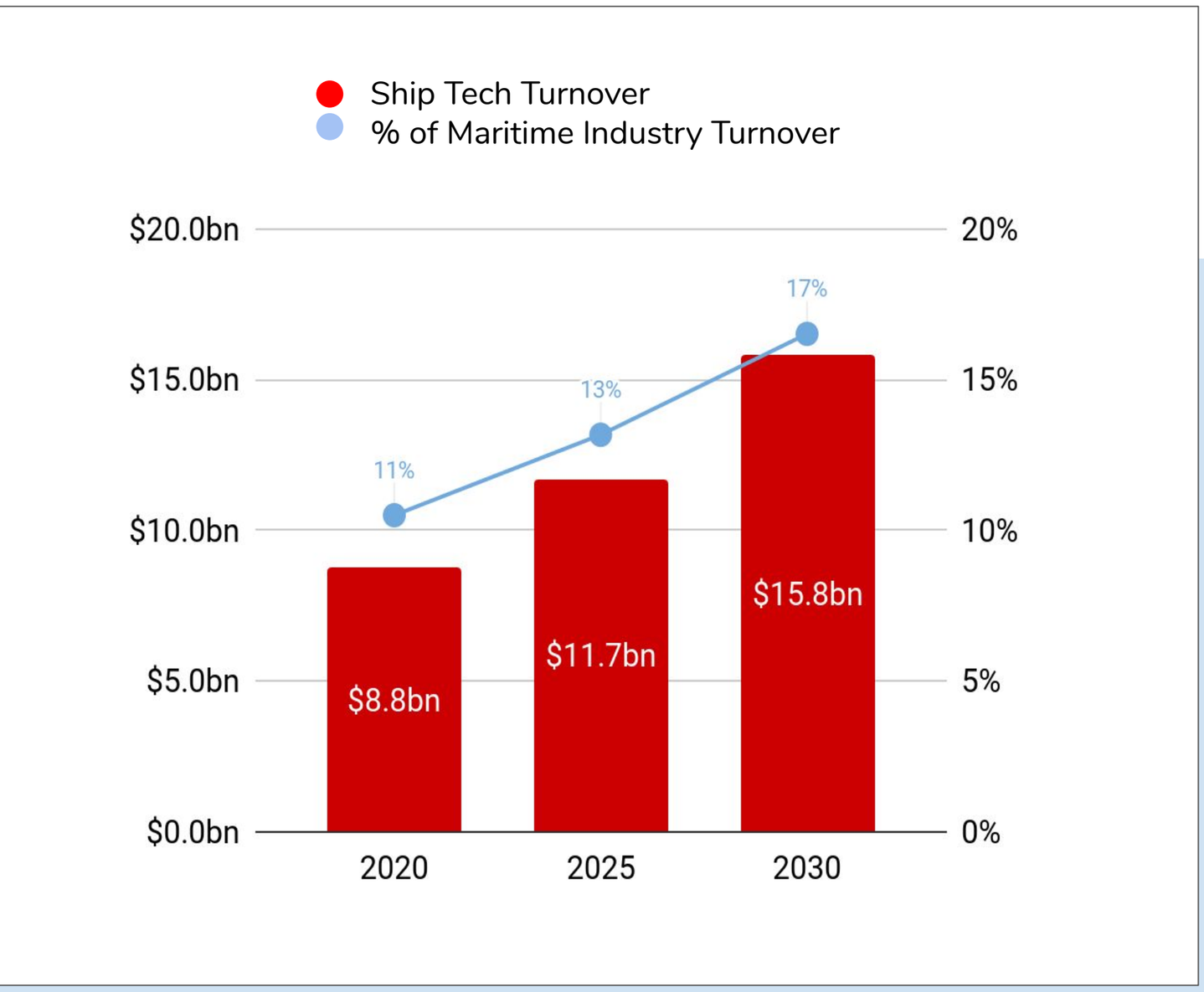


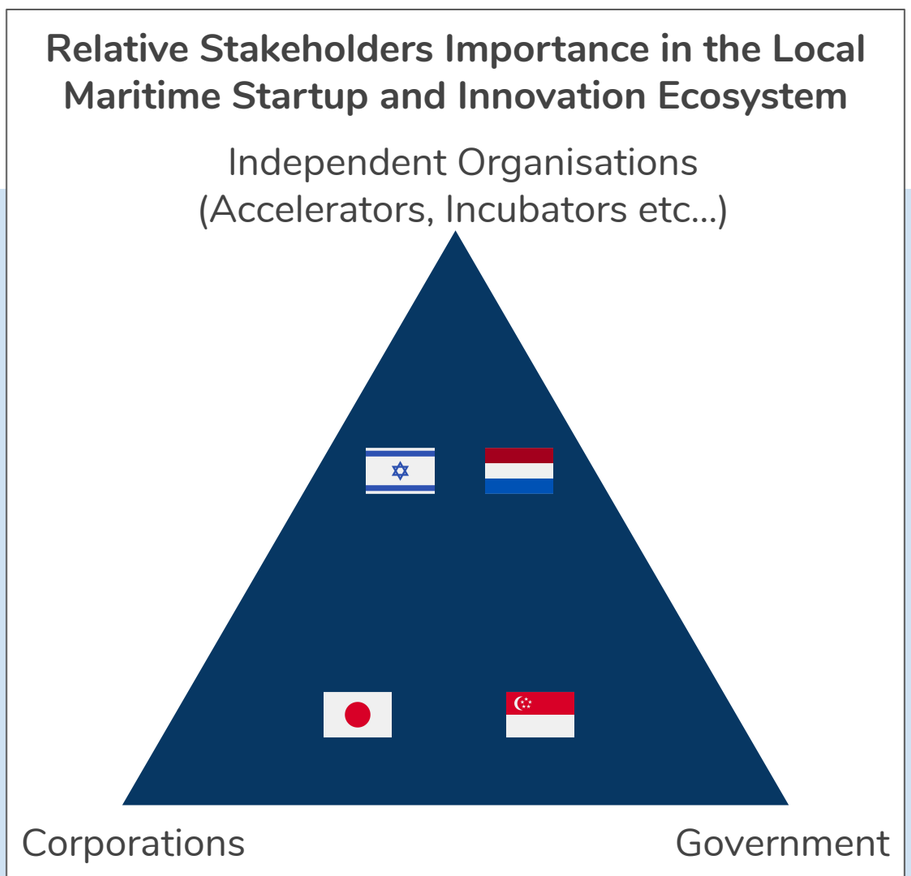
The graph above displays a country's potential to develop a maritime startup ecosystem in relation to their entrepreneurial attitude (CSI) and importance of the local maritime industry (CMI). NL is a useful benchmark as a leader in startup driven innovation, first to launch a maritime startup accelerator.

Japan has a very low entrepreneurial index and the development of a hub for startup driven innovation in maritime will require heavy investment in entrepreneurs and the continued support of government and industry.

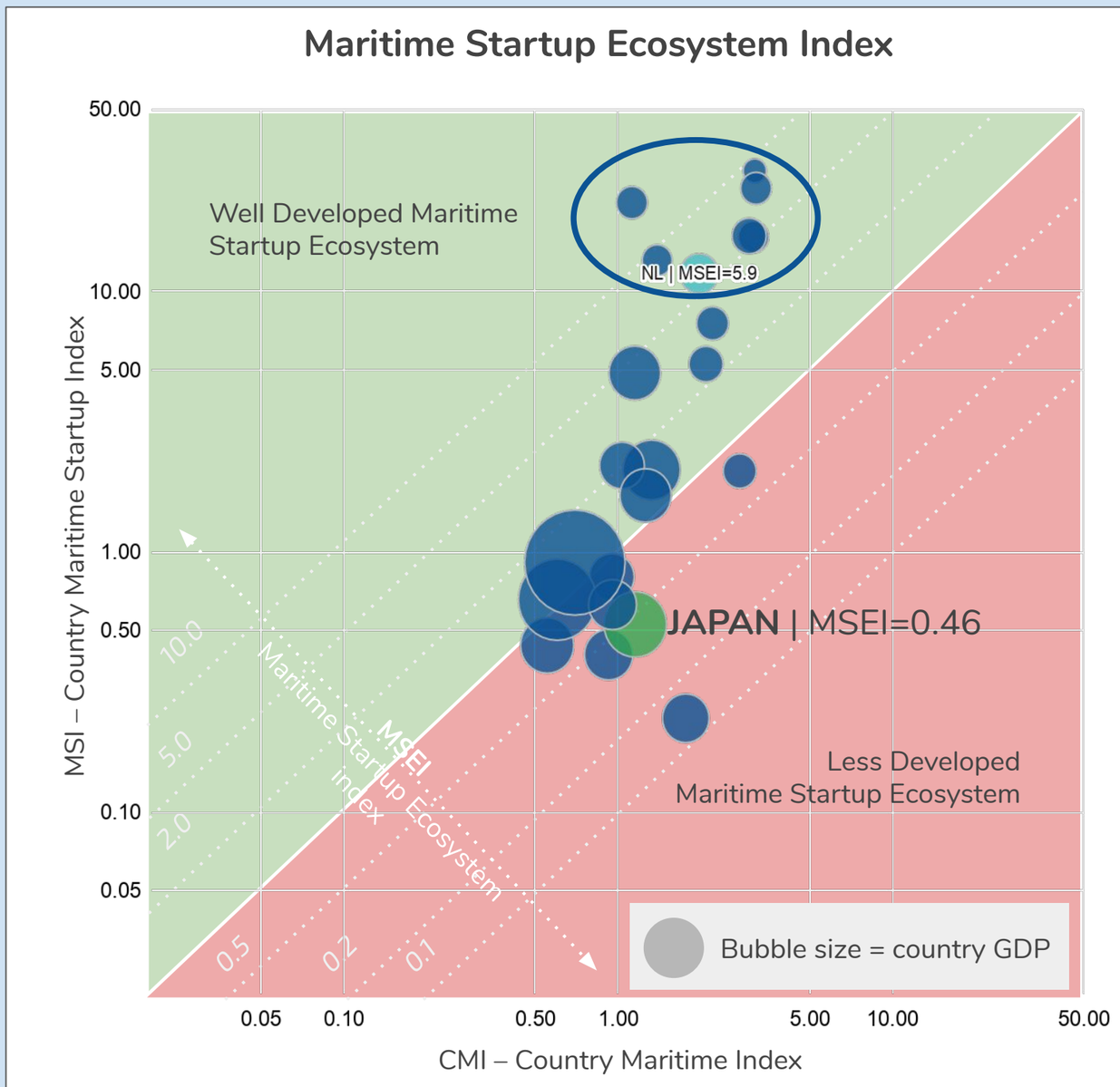
Ecosystem Overview

inmarsat Research Programme





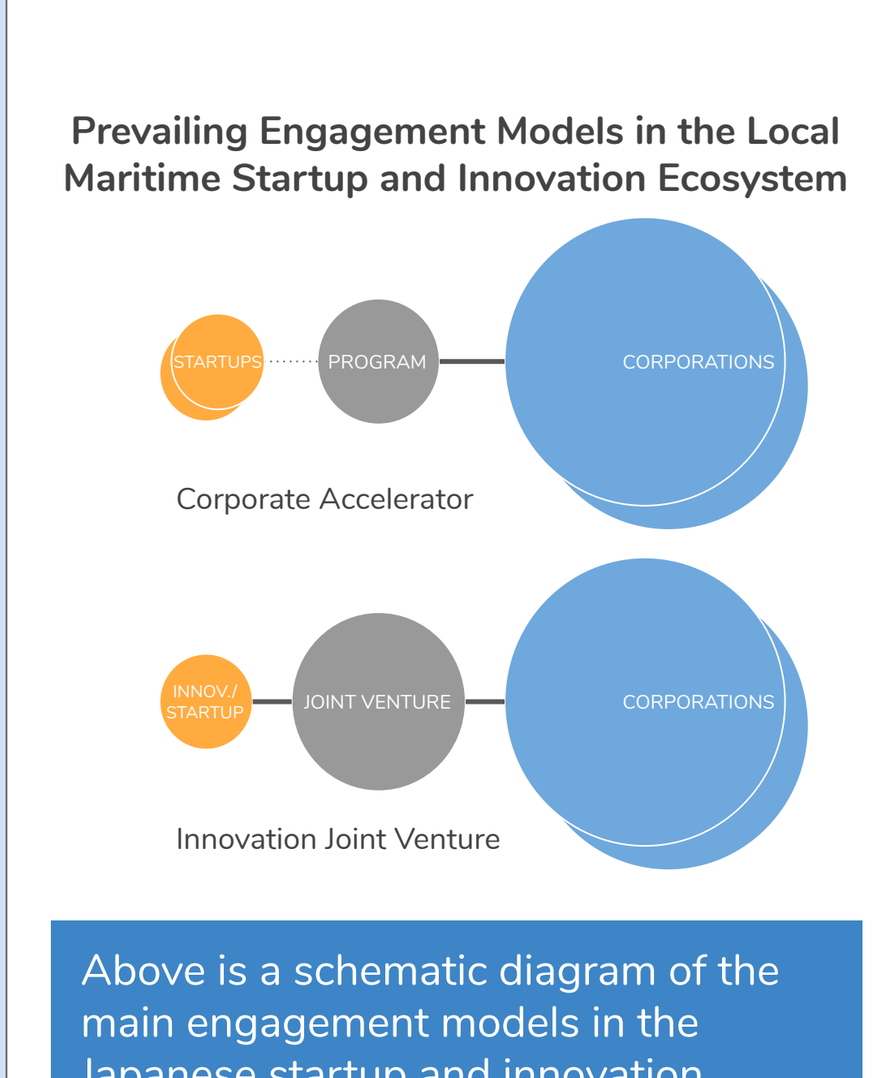
Above is a purely qualitative analysis of the drivers of the local maritime innovation ecosystem, comparing Japan to Israel, Singapore, and the Netherlands. Japan's ecosystem is predominantly driven by corporations with some government intervention.



This graph displays the importance of the maritime industry to an economy (CMI) against the development of its maritime startup (MSI).

To the top right of the graph are relatively small, entrepreneurial maritime nations with a comparatively highly developed maritime startup ecosystem (MSEI). Closer to the center are larger countries with diversified industrial interests.

Japan's low MSEI confirms the predominant attitude of corporate innovation in Japan.



Above is a schematic diagram of the main engagement models in the Japanese startup and innovation ecosystem. Thick lines mean ownership, dotted lines mean relationship.

STARTUP WHARF

North America is considered the cultural home of the startup movement, so when Mitsui Group and Weathernews wanted to create their own startup focused on digitalising shipbroking, they chose to found the company not in Japan but in the USA.

Marufreight is a digital platform facilitating transactions between charterers and carriers in the tramp freight market. The platform allows charterers to list open cargo and carriers to bid on moving it. The platform facilitates an entirely digital broking process, from pre-fixture right through to cargo discharge and digitalise the documents and contracts required. As well as the business processes, Marufreight offers carriers a suite of voyage planning tools that combine real time weather and vessel information data to help improve decision making. The platform, which launched in 2019, is free to sign up to with a fee of 1% charged on invoices that are processed through the platform.

In the future, Marufreight plans to open up the platform to brokers, offering them access to vessel data, cargo tracking, and delay risk analysis to support negotiations and reduce workload. Their long term goal is to expand from dry bulk into wet cargoes and better enable all commodities trading.

It is smaller still in the maritime industry, with only a handful of new companies operating in the space. Recognising the value of startup driven innovation, both the Japanese government and some shipping lines have begun building partnerships with overseas startups, to bring their vision, technology, and expertise to bear in the maritime industry.

Singapore is fast becoming Asia's hub for maritime startups. It has a much more developed startup ecosystem than Japan and is a centre of excellence both for the shipping industry and for cutting edge technology development. To capitalise on Singapore's success, Japanese corporates NYK Group, Weathernews Inc, and Kozo Keikaku Engineering Inc set up Symphony Creative Solutions (SCS); a joint venture focused on making the most of the local innovation ecosystem by developing its own products and applications, and helping Singapore startups engage with the Japanese maritime industry. SCS has developed a number of applications to improve port and vessel operations including port call collaboration software, a cargo monitoring mobile app, and a voyage optimisation platform.[30]

SCS doesn't just build its own innovative products and platforms. In collaboration with National University of Singapore's NUS Enterprise, and sister company Ocean Network Express, SCS run the Ocean of Opportunities (O3) challenge, aimed at helping innovative startups refine, pitch, and implement new ideas that will enhance the maritime industry. The challenge, which runs annually, invites startups to pitch solutions to specific problems the industry faces that have been identified by the team at ONE. In 2019, startups from 15 countries submitted proposals for problems including container tracking, ship connectivity, training technology, underwater inspections, smart contracts, and fuel price analytics. Shortlisted startups were given access to design workshops to refine their ideas, office space, mentors, an industry bootcamp, and the chance to exhibit their offering to ship operators.

The key to the success of SCS is the fact that it is detached from the core NYK Group business, both commercially and geographically. With none of the legacy systems and processes that come with being part of a 150 year old shipping giant, SCS can move like a startup, fail fast, and establish what works and what doesn't while at the same time having access to the resources, ships, and expertise of a large ship operator. This approach allows NYK Group to discover, evaluate, and implement new technologies faster and cheaper than developing in-house solutions or buying in external solutions from large suppliers.

The O3 challenge has led to some successful proofs of concept for startups on ONE ships. It is often difficult to set up IoT networks in engine rooms. Steel bulkheads, decks, and heavy machinery can block radio signals, meaning sensors need to be wired into a network or rely on high powered radio systems.

Brightree, the O3 runner up in 2018, has successfully tested a system that uses radio frequency modules to pass IoT signals from the bottom of the engine room up four decks to the engine control room. With no complicated network, the entire test took only 90 minutes to set up, and was able to pass data across two fire proof steel doors. Future iterations of the system will reduce the radio modules to the size of a credit card with minimal power requirements.[31]

As well as Brightree, ONE has run a successful proof of concept with Singapore startup Portcast through the Ocean of Opportunities Programme. It is often difficult for sales teams to get a picture of available space on board a container ship, this often leads to underutilisation of the vessel and lost revenue. Using Portcast's artificial intelligence engine, the sales team at ONE were able to access previously unknown insight into vessel availability, giving the sales team the tools to better utilise all of the available space on board ONE ships and improve revenue per sailing.

Though not part of the J-Startup portfolio of businesses, one maritime startup aims to drastically improve the way crews handle collision avoidance and navigation. Aidea Inc, a Tokyo based technology startup founded in 2017 has built a navigation system for ships that combines the best of consumer user experience design, with industrial navigation equipment. The system is primarily used on leisure craft and yachts, but was installed on its first full sized commercial ship in October 2019.

Aidea's navigation support system is available as a smartphone or tablet app and combines AIS, radar, and chart data to help navigators gain a better situational overview from a single screen. As well as giving the navigator a situational overview, the system can be programmed to alert the bridge watch keeping team of potential collision risks from other vessels, shoal water, or obstructions. The app also logs data which can be sent to a cloud server ashore and integrated into fleet management, emergency services, or client software using a set of APIs.

Supporting homegrown innovation

As well as looking internationally for startup driven innovation, the Japanese government and industry players are attempting to foster homegrown innovation. J-Startup, an accelerator established by the Japanese Ministry of Economy, Trade, and Industry takes an active role in building the local startup and SME community, and helping it export across the world.

Such is the pedigree of Japanese technology SMEs, that when buyers at Apple, who are known for aggressively seeking the best suppliers, were looking for component manufacturers for the iPhone 6, they signed contracts with 139 Japanese suppliers. The only country who contributed more to the phone's manufacture was China, where the device was assembled.[32] Japanese startups and SMEs often struggle to compete internationally. This is partly because English is not widely spoken in Japan[33] and partly because historically, the keiretsu system meant that small businesses had little need for skills such as sales, marketing, and international business. To combat this, J-Startup's programme for Japanese entrepreneurs connects technology startups and SMEs to venture funding, large corporations, and global accelerators to help them win international contracts.

As well as helping entrepreneurs in Japan, J-Startup also has a programme to attract international innovators to set up in the country. Visa rules have now been relaxed for startup founders in several cities, making it possible to stay for 12 months to launch a new business as opposed to the usual six. Startup founders who want to expand into Japan can access J-Startup's team who can facilitate market surveys and offer business planning support.[34] The work of J-startup is beginning to take effect. In 2019, the Japan External Trade Organisation took a delegation of 29 startups to the Consumer Electronics Show in Las Vegas. Further, more than 140 Japanese startups have joined their portfolio, building everything from autonomous vehicles to vertical farms.

While startups and partnerships are hugely important when it comes to driving innovation forward, internal projects are also a critical piece of the puzzle. At Mitsui OSK Lines an in-house team employed a startup methodology to develop their Lighthouse information platform. The application was created through a process of customer discovery, iteration, and continuous improvement and now gives stakeholders in the bulk sector, such as shippers and port terminals, the ability to share vessel, weather, cargo, and contract data securely in real time.

Internal innovation is also useful when it comes to addressing difficult, strategically important problems that a startup may struggle to solve at scale. NYK Group has repeatedly identified a shortage of crew members as a key future risk to their business.[35] To combat this, they have been working towards using technology to enable their manned ships to sail autonomously. By combining autonomous navigation and engineering technology, with improved communications and cyber security capabilities, NYK plans to enable their fleet to sail with small highly trained crews that are supported from ashore.

The Iris Leader is a 71,000 grt car carrier. It trades all over the Pacific, delivering cars from Japanese factories to the USA and China. In 2019 it became the first full size ship to conduct an autonomous voyage test using the IMOs new guidelines. A team from NYK Line's wholly owned subsidiary Japan Marine Research developed the "Sherpa System" for autonomous navigation which uses various sensors to model both the collision risk from nearby vessels and the best course and speed manoeuvre to reduce the risk of collision. During the trial, the Iris Leader safely sailed in autonomous mode for a total of five days during the ocean passages of two voyages, from Xinsha, China to Nagoya, Japan, and then from Nagoya to Yokohama.

The Japanese ecosystem is unique, fast paced, and operates at a level of scale not seen elsewhere in the world. In Europe and the USA, startups are a necessary part of the maritime innovation ecosystem. In Japan, however, the industry's ability to forge trusted partnerships, both within the country, and around the world, make it possible to stay at the cutting edge. Whether it is partnerships unlocking value from data, international startups quickly solving corporate problems, or internal teams creating the vessel of the future, innovation sits at the heart of the industry and permeates every level, from the newly emerging startups, right to the top of the major corporations.

THE JAPANESE ECOSYSTEM IS UNIQUE, FAST PACED, AND OPERATES AT A LEVEL OF SCALE NOT SEEN ELSEWHERE IN THE WORLD

Innovation Outlook

BY many metrics, Japan is clearly a leader in the development of maritime technology. But the country's position is threatened by the ongoing growth of China and the rise of startup driven innovation around the world, which is an increasingly important driver of new technology. There are a number of strategic opportunities that could be a catalyst for the growth of Japan's maritime technology sector including realising the potential of shared data, the pursuit of manned autonomous vessels, and of course decarbonisation.

Japan's maritime technology market

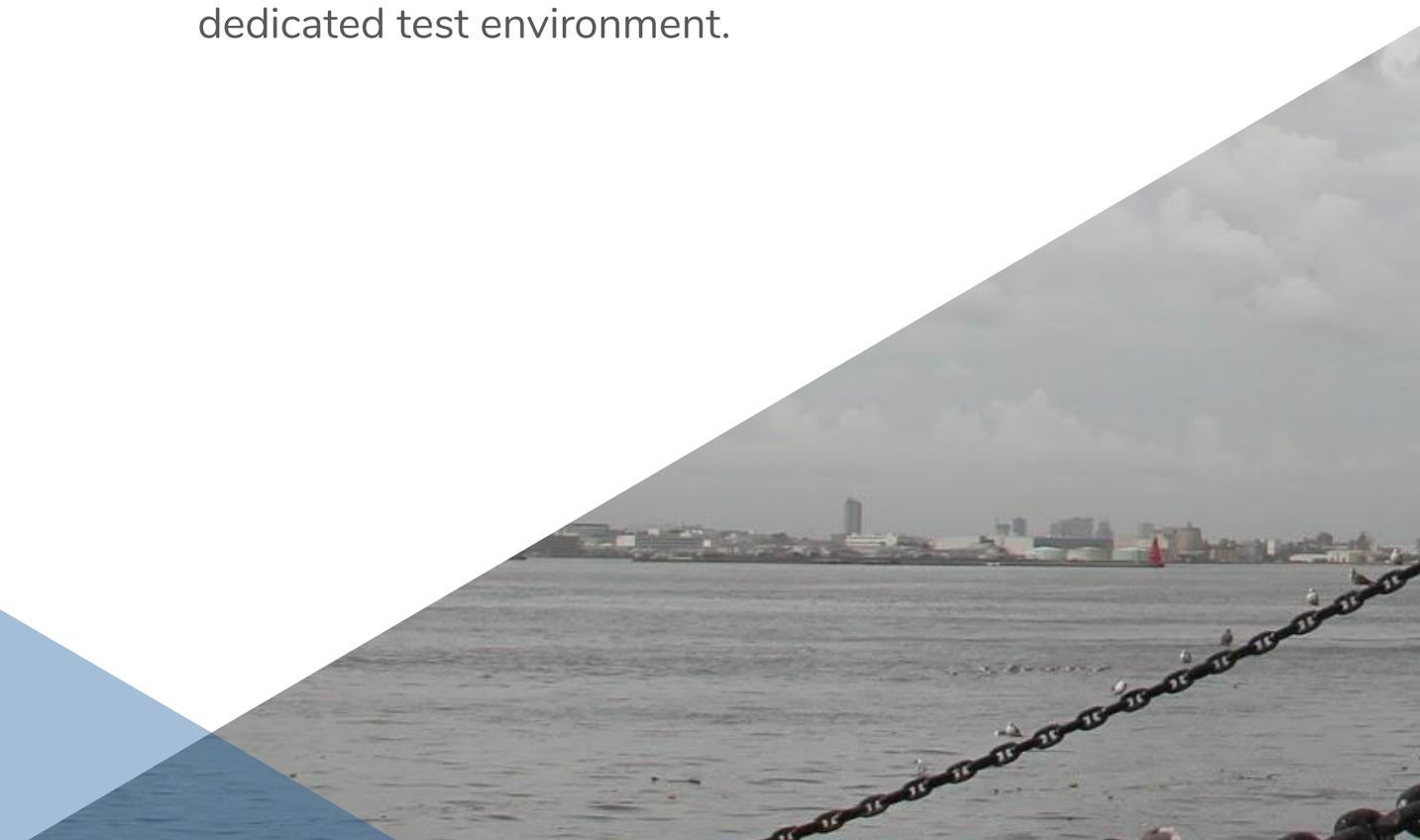
Japan's maritime information technology market is forecasted to turn over $8.8 billion USD in 2020. Information technology spend includes software, hardware, communication equipment, and related services across ship ownership and management, shipbuilding, and ship machinery manufacture.

Maritime technology has high growth potential in an industry and economy that is otherwise not expected to grow particularly fast. By 2030 it is estimated that the maritime technology market will be worth $15.8 billion per year. A forecasted CAGR of 6.1% as opposed to 1.4% for the industry as a whole over the same period.

Strategic opportunities for the industry

The culture of partnerships that extends across Japanese industry has already led to the development of an open data sharing platform that has achieved tangible results and attracted international interest. Data sharing is proving to be an important but difficult challenge for the industry. Many projects around the world have made far less progress than the likes of the Ship Data Centre. Additionally, Japan's reputation as a hardware and electronics hub puts the country in a strong position to capitalise on the rising demand for connected sensors that can be deployed to the maritime environment.

Different schools of thought exist on the future extent of autonomy in the maritime environment. Though there are several technologists and manufacturers attempting to build fully autonomous unmanned ships, there is an equal number who believe that ocean going ships will always have people on board. It is clear, however, that the strategy of the major Japanese carriers is to pursue manned autonomous ships, combining the best of technology with excellence in seafaring skill. As well as protecting the strategic long term interests of the carriers themselves, this technology could become an important revenue stream in its own right. The successful blending of machine and human control systems in a safety critical environment is a challenging and potentially dangerous pursuit. Successfully achieving this will take the best in design thinking, systems engineering, and a dedicated test environment.



There are very few industry players around the world who have publicly stated the ambition to build and use these systems and also have the scale and depth of expertise to deliver on them. Despite this, there are several startups and small technology providers who are working on solving the problem. USA based Shone and Sea Machines Robotics are working on building similar technology, as is Israel based Orca. All of these companies have raised millions of dollars in funding each, and Shone and Sea Machines have already signed partnerships with CMA CGM and Maersk respectively.[36] But none of these startups will have the ability to scale their technology in the same way that the Japanese carriers and shipyards can.

Despite its many natural advantages, Japan does have an Achilles heel when it comes to maritime innovation. Startup driven innovation has evolved to take a central position in the development of new shipping technologies around the world. The dearth of startups in Japan as a whole, but particularly in the shipping industry is a serious weakness in the sector. It does not matter how much they prioritise innovation, it is impossible for any large corporations to compete with startups when it comes to speed, cost, and agility.

Efforts to work with startups outside Japan are having an impact, but they come with their own set of challenges. It is often expensive, both for the startup and corporate partner to meaningfully engage with each other across international borders. As well as cultural and language barriers, it can be difficult to establish a common legal framework for agreements, with one partner, usually the startup, having to work in a jurisdiction they are not familiar with. Further, after a successful proof of concept, it is often difficult for a startup with limited resources to scale a solution for a fleet of ships without a permanent presence in the customer's country. For a startup, choosing to expand into a new territory is an important strategic decision which requires careful consideration. It is therefore likely that corporates who only engage internationally will not have the first-mover advantage that comes with engaging with local startups.

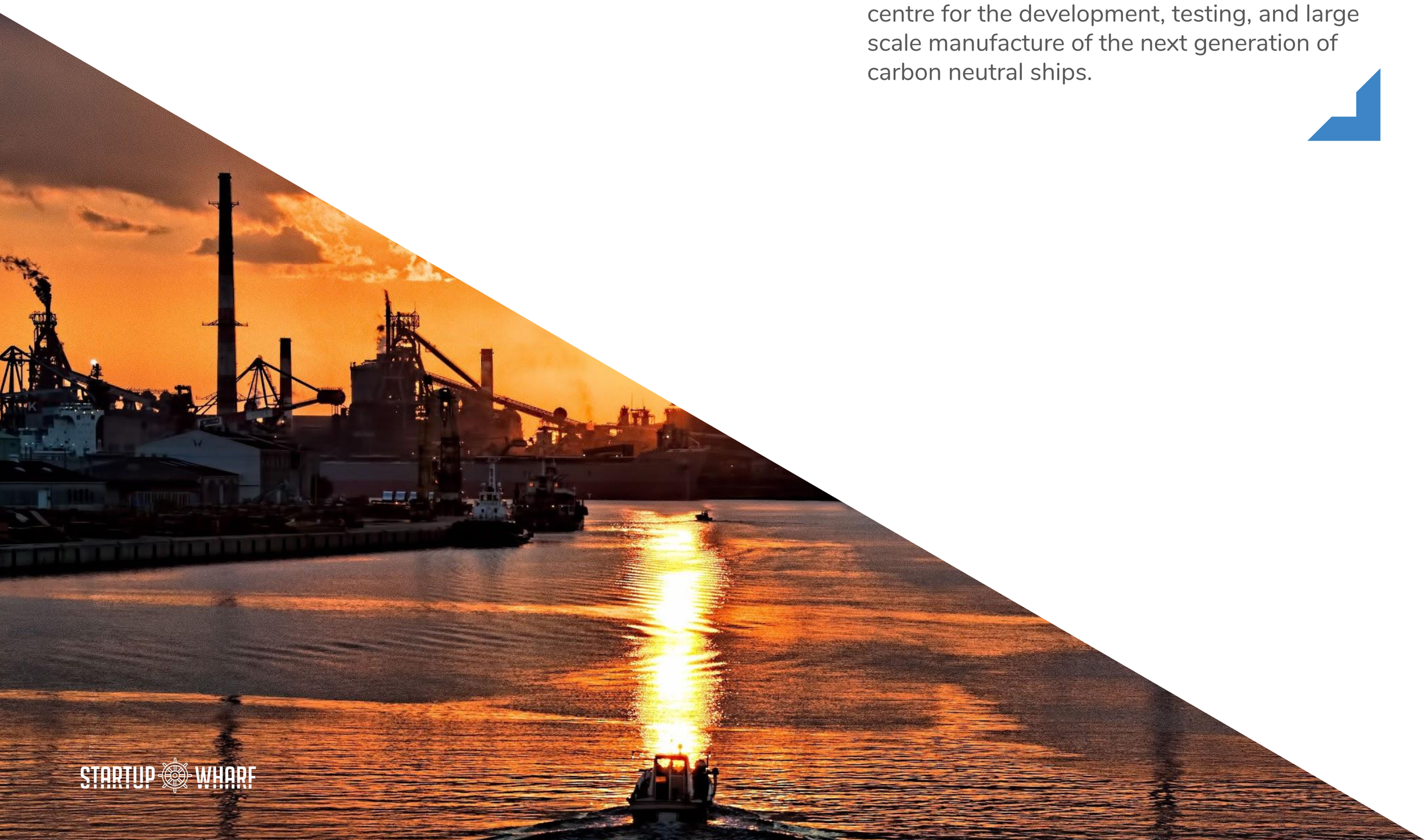
The international engagement strategy simply cannot compete with countries like Israel, Singapore, and the Netherlands that have pursued a very deliberate path of building a local startup ecosystem to drive innovation. The long term benefits of a local system are clear too. As startups mature and exit, those early entrepreneurs often reinvest their wealth and experience into new startups to drive the ecosystem. It is a flywheel effect that cannot be replicated from a distance.

With the technological expertise that exists across Japan's corporations and SMEs Japanese startups should be in a great position to take on the world's tough problems. That said, cultural pressure on young people to join large corporations, coupled with a lack of easily available venture funding has made Japan a challenging environment to would-be entrepreneurs.[37] But the picture is slowly changing, with efforts such as the government's J-Startup programme and rising interest from local and international venture investors beginning to turn the tide.

As the number of startups in Japan continues to rise, the opportunity for the large carriers and shipyards to start dedicated venture funds rises too. We know from other maritime startup hubs around the world that funding alone is not enough for a startup to be successful in this space. "Smart money", where investors have an innate understanding of the industry a startup is attempting to break into is crucial for success in maritime. The combination of capital, expertise, and exposure that could be offered to local startups from large ship operators could help Japan to rapidly establish itself as a hub for startup driven innovation in Asia.

Perhaps the biggest opportunity for Japan's maritime technology sector comes with the global industry's ambition to end its reliance on fossil fuels. From the IMO targets, to the getting to zero coalition, to the Poseidon Principles; 2019 saw decarbonisation become a top priority for the industry. While there are already many industry stakeholders working on this global challenge, there are few that could match Japan's expertise across heavy industry manufacturing, ship operations, and technology.

Achieving decarbonisation requires the combination of many different techniques and technologies, from the development of battery powered electric propulsion, to the use of AI and machine learning in energy management and voyage optimisation. It is unlikely that Japan will ever overtake South Korea and China in shipbuilding output by tonnage, but Japan could become a global centre for the development, testing, and large scale manufacture of the next generation of carbon neutral ships.



Conclusion

THROUGHOUT this report, we have seen countless examples of the Japanese maritime industry's ability to push the technological envelope. In many ways, Japan's unique economic make up gives it a massive advantage over the rest of the world when it comes to industry driven innovation. The large corporations that make up the shipping industry, whether they are ship operators, shipyards, or service providers, are pioneering new ideas across navigation, engineering, seafarer welfare, and maritime business.

The Japanese innovation philosophy of technological fusion and lateral thinking perfectly suits an industry that still depends on technology that is hundreds of years old. The ability to embrace cutting edge technology like machine learning, computer vision, and the cloud, while respecting the role mariners have played in safely navigating the world's oceans for hundreds of years is key in helping Japan's ship operators to maintain a leading position on the world stage in a time of turbulent change and disruption in the industry as a whole.

One of the key strengths of the Japanese shipping industry is its ability to forge partnerships, both vertically within its own supply chain, but also horizontally across competitive lines. These partnerships have given the industry the ability to share operational data in new ways, develop all electric vessels, and implement new ideas from the international startup community.

The economic make up that gives so much to corporate innovation in Japan also means that entrepreneurial innovators are held back. Where there is a perception in Europe and America that the startup community is pushing the corporate industry into the 21st century, this is not the case in Japan.

The strength of corporate innovation across the country means that entrepreneurs don't have access to the same resources and opportunities as their peers in other countries. During Japan's so-called "lost decades", when stagnant demand led to a prolonged decline in GDP, nearly all net job creation came from foreign enterprises, small businesses, and entrepreneurs.[38] Embracing entrepreneurship is an imperative not just for the shipping industry, but for the economy as a whole.

This is a $8.8 billion market, with growth potential that outstrips both the maritime industry and the economy as a whole. With a leading position in data management, autonomous vessel operations, and the right infrastructure in place to capitalise on a burgeoning green shipping market, Japan's maritime technology industry is in an incredibly strong position. But fully capitalising on this position does require change. Learning not just to embrace international entrepreneurship, but to foster it locally is perhaps the biggest growth opportunity for the Japanese shipping industry.

THIS IS A $8.8bn MARKET, WITH GROWTH POTENTIAL THAT OUTSTRIPS BOTH THE MARITIME INDUSTRY AND THE ECONOMY AS A WHOLE

Supporting the ecosystems that allow entrepreneurs to test and build new ideas and combining those ideas with the infrastructure, scale, and depth of expertise that already exists would be a catalyst for massive growth, supercharging this quiet technological revolution. By combining technology fusion, lateral thinking, trusted partnerships, and entrepreneurship the Japanese maritime industry could create a force for innovation so powerful that it is unmatched in the world.

Methodology

THIS report is based on a combination of primary research, including telephone interviews, surveys, and financial modelling, and secondary research from various sources including Startup Wharf's database of startup driven innovation, the Thetius maritime innovation intelligence platform, and a wide range of books, publications, journals, and media outlets. The aim of this report was to create the most comprehensive and accurate overview of maritime innovation in Japan to-date, but it is by no means complete. The maritime sector is fractured, it suffers from a lack of visibility at all levels and it is also fast moving and ever changing. Despite the work of a number of organisations to improve technology visibility across the industry and the resources put into this research project, the analysis cannot cover the full scope of innovation going on in Japan's maritime industry. While it would be impossible to showcase every innovation across the country, the aim of the authors was to capture the key themes and trends that are impacting the industry in Japan and around the world.

The market sizing and forecast was calculated using a proprietary financial modelling method that takes into account Japan's current and historic GDP, forecasted GDP growth, economic output from shipbuilding, maritime manufacturing, ship owning, ship operating, trade in export services, and trade in goods. This is combined with the country's innovation efficiency index and startup ecosystem index.

Data sources for the market sizing and forecast include the World Bank, United Nations Conference on Trade and Development, the Global Innovation Index, Startup Wharf, Thetius, Crunchbase, Startupblink, Startup Ranking. The market sizing and forecast was cross-checked against forecasts from other reputable sources including Cebr, and the Japanese government's Ministry of Land, Infrastructure, Transport and Tourism.

All financial figures are in United States dollars unless otherwise specified.

Bibliography

1. Senpaku ISHIN, Mitsui OSK Lines, retrieved 2020
2. History, NYK Line, retrieved 2020
3. Corporate History, K Line, retrieved 2020
4. Handbook of Statistic, Merchant Fleet, UNCTAD, 2019
5. The geography of thought: How culture colors the way the mind work, Nesbitt, 2003
6. Japan's Growing Technological Capability, Implications for the U.S. Economy, National Research Council, Arrison et alia, 1992
7. Meet the Steve Jobs of Mechatronics, East Coast Polytechnic Institute, retrieved 2020
8. Japan's Growing Technological Capability, Implications for the U.S. Economy, National Research Council, Arrison et alia, 1992
9. Nintendo Game Boy, Centre for Computing History, retrieved 2020
10. Atari Lynx, Centre for Computing History, retrieved 2020
11. The Game Boy Turns 25: How a ‘Grey Brick” Took Over the World of Portable Gaming, Independent, Vincent, 2014
12. 2019 Handbook of Statistics, Merchant Fleet, UNCTAD, 2019
13. Ships built by country of building, annual Table summary, UNCTAD STAT, 2019
14. 2019 Handbook of Statistics, Merchant Fleet, UNCTAD, 2019
15. Merchant fleet by country of beneficial ownership, annual, UNCTAD STAT, 2019
16. Seafarer supply, quinquennial, UNCTAD STAT, 2015
17. 2020 New Year Message from the President, K Line, Myochin, 2020
18. MOL Starts Demonstration Test of Vessel Image Recognition System Using AI Technology on Nippon Maru, Mistui OSK Lines, 2019
19. Maritime technology R&D venture in Japan, The Digital Ship, 2013
20. The Challenge for Today’s Shipbuilding Companies, MAJIC, Shibata, 2014
21. Analysis by Thetius, data provided by the European Patent Office, retrieved 2020
22. World's new fully electric bunker tanker, E5 Lab Inc, 2019
23. E5 Lab, E5 Lab Inc, 2019
24. Yanmar Develops Basic Technology with JAMSTEC for Auto-navigation Robotic Boat and Auto-docking System, Yanmar Co Ltd, 2019
25. NAPA announced as first service provider for Ship Data Center’s IoS Open Platform, NAPA, 2019
26. IoS OP, Ship DC, 2018
27. NYK to operate 50-vessel tech R&D testbed in partnership with Dualog, Smart Maritime Network, O’Dwyer, 2019
28. Data provided by Crunchbase, retrieved 2020
29. There's a Fad for Corporate VCs in Japan. That's a Good Thing, Aleyev, Bloomberg, 2019
30. Products, Symphony Creative Solutions, 2019
31. Successful Proof of Concept, Symphony Creative Solutions, 2018
32. How & Where iPhone Is Made: Comparison Of Apple’s Manufacturing Process, CompareCamp, 2014
33. Why do Japanese have trouble learning English? Tsuboya-Newell, Japan Times, 2017
34. J-Startup, Ministry of Economy, Trade, and Industry, 2018
35. Nippon Yusen Kabushiki Kaisham, Financial, Social and Environmental Performance, 2015, 2016
36. Funding analysis by Thetius. CMA CGM teams up with Shone to develop AI onboard ships, Splash 24/7, Jiang 2018. AI Powered Situational Awareness for Maersk, Marine Log, 2018
37. Why Tokyo’s start-ups are drawing the crowds, Financial Times, Inagaki, 2018
38. The Entrepreneurship Vacuum in Japan: Why It Matters and How to Address It, Karlin, Wharton School of Business, University of Pennsylvania, 2013

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Leonardo is a MSc Naval Architect and MBA with 4 generations of seafaring tradition. He designed and built RoRo, LNG and other cargo ships, and participated in the design, acquisition, conversion of container terminals, ranging from small regional to multi million TEU greenfield projects like Hutchison Ports' BEST in Barcelona.

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STARTUP WHARF

Startup Wharf is the independent, global network of maritime startups, with the mission to enable startup-driven maritime innovation and transformation.

Startup Wharf supports startups and entrepreneurs develop their business in maritime, while helping the industry and investors find and engage with maritime startups.

Startup Wharf publishes reference content for the maritime innovation ecosystem such as the quarterly Maritime Startup Ecosystem map and the Trade 2.0 series of market research reports on global startup and innovation ecosystems.

Thetius

Thetius is a source of intelligence, analysis, and research on emerging technologies within the supply chain, helping industry leaders to understand and prepare for the future.

We combine proprietary and public data with industry expertise to predict future innovation and help senior executives within shipping to make better strategic technology decisions.

Thetius research is used to inform the strategies of FTSE 100 companies, oil majors, venture investors, policy makers and NGOs to name a few.

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We will not be liable to you in respect of any losses arising out of any event or events beyond our reasonable control. We will not be liable to you in respect of any business losses, including without limitation, loss of or damage to profits, income, revenue, use, production, anticipated savings, business, contracts, commercial opportunities or goodwill. We will not be liable to you in respect of any loss or corruption of any data, database or software. We will not be liable to you in respect of any special, indirect or consequential loss or damage.

(6) Exceptions
Nothing in this disclaimer shall: limit or exclude our liability for death or personal injury resulting from negligence; limit or exclude our liability for fraud or fraudulent misrepresentation; limit any of our liabilities in any way that is not permitted under applicable law; or exclude any of our liabilities that may not be excluded under applicable law.

(7) Severability
If a section of this disclaimer is determined by any court or other competent authority to be unlawful and/or unenforceable, the other sections of this disclaimer continue in effect.
If any unlawful and/or unenforceable section would be lawful or enforceable if part of it were deleted, that part will be deemed to be deleted, and the rest of the section will continue in effect.

(8) Law and jurisdiction
This disclaimer will be governed by and construed in accordance with English law, and any disputes relating to this disclaimer will be subject to the exclusive jurisdiction of the courts of England and Wales.

(9) Our details
In this disclaimer, 'we' means (and 'us' and 'our' refer to) Startup Wharf Ltd., a company registered in England and Wales under registration number 11065390.

STARTUP WHARF

MOVING THE WORLD'S SHIPPING FLEET INTO THE NEXT PHASE OF TECHNOLOGICAL MATURITY REQUIRES A FUSION OF DISCIPLINES THAT PUTS JAPAN AT A NATURAL ADVANTAGE

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