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# A CHANGED WORLD

The state of digital transformation in a post COVID-19 maritime industry

Nic Gardner, Matthew Kenney & Nick Chubb

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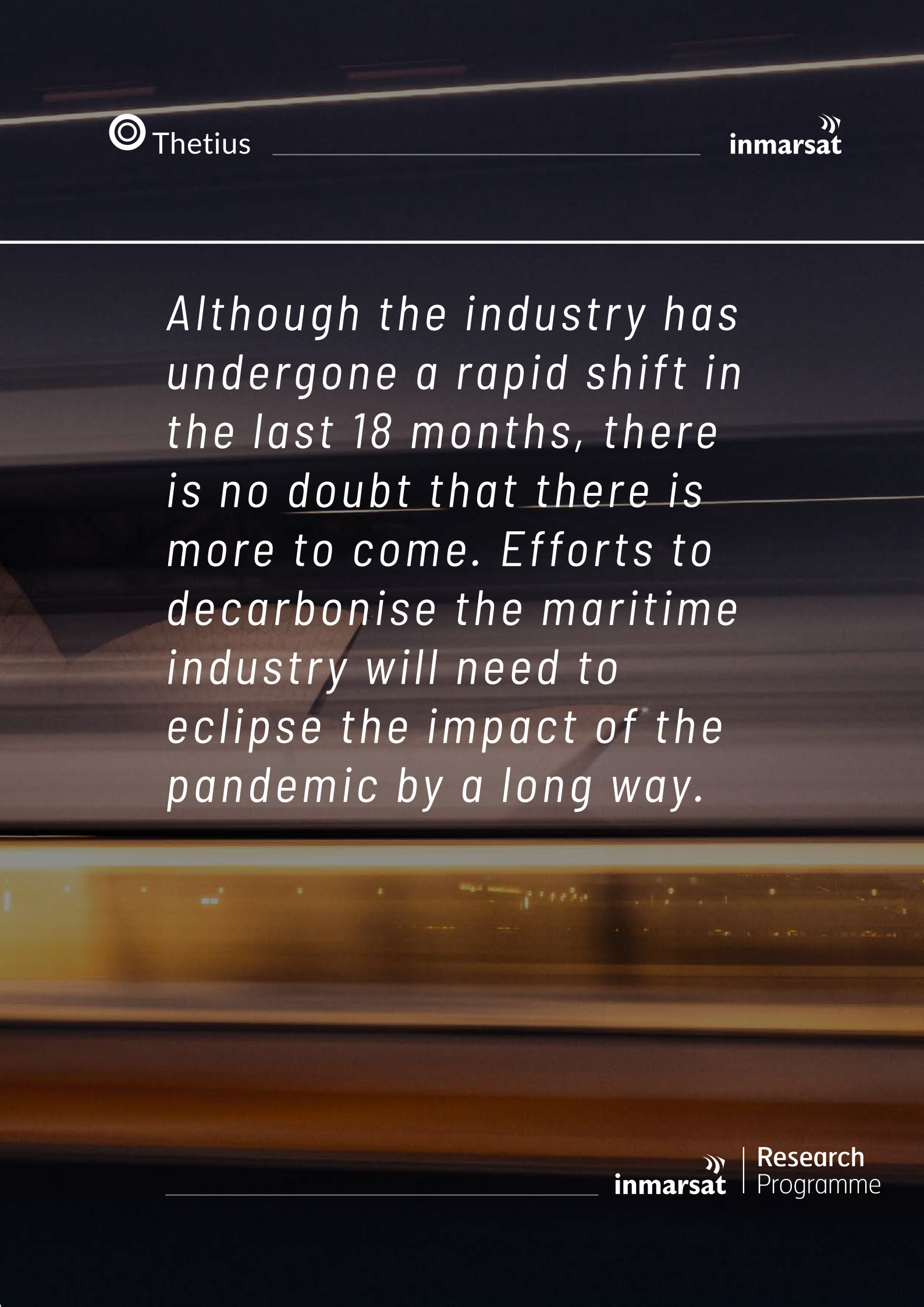
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Although the industry has undergone a rapid shift in the last 18 months, there is no doubt that there is more to come. Efforts to decarbonise the maritime industry will need to eclipse the impact of the pandemic by a long way.
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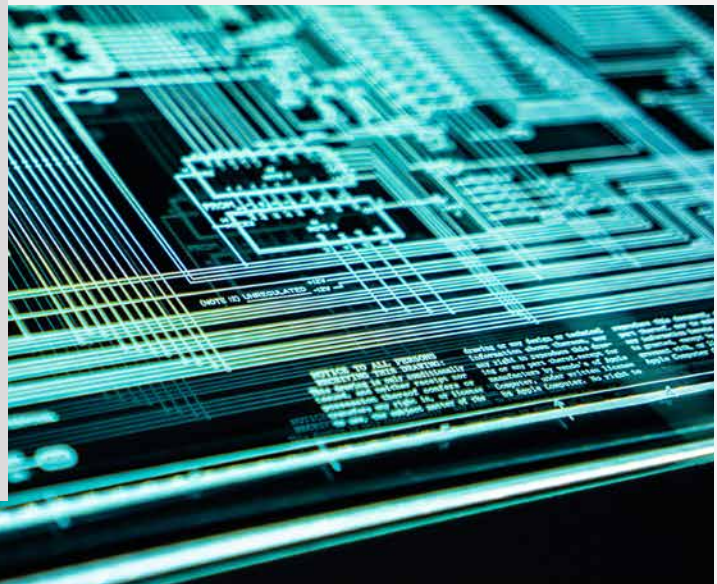
# FOREWORD

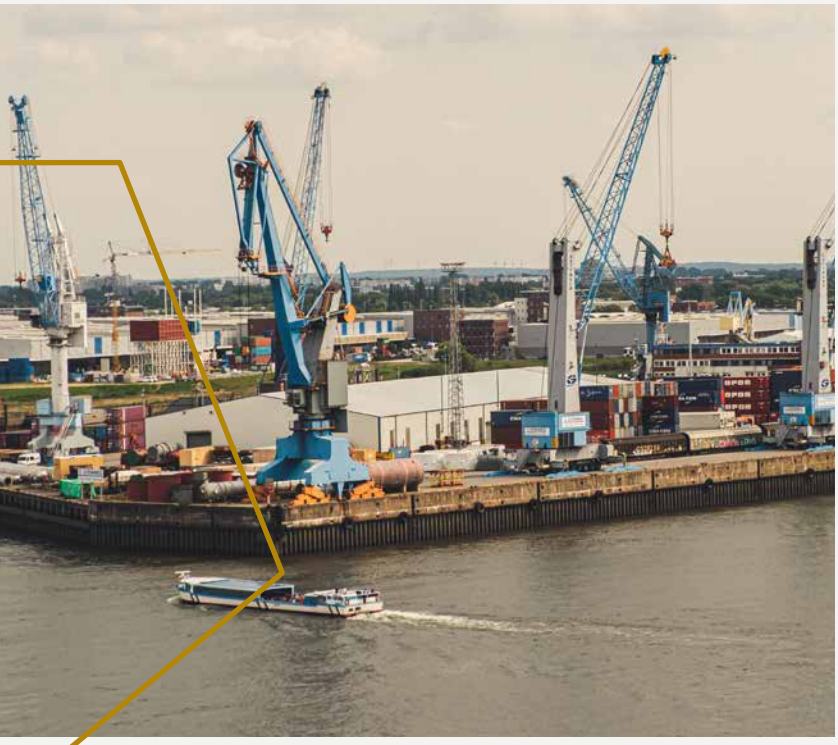

By Stefano Poli,
VP Business Development - Maritime


Global businesses have changed profoundly since November 2019, and few industries have been so altered by COVID-19 as our own.

As elsewhere, the virtual meeting is now a shipping industry staple, but the fact is that players all along the supply chain have looked to digital technologies to respond to the restrictions brought by the pandemic. Accelerated maritime digitalisation has been experienced in everything from the wider acceptance of the e-bill of lading and online training, to broader crew connectivity and remote ship surveying.

But shipping as a whole can benefit from knowing not only how, but how far, our industry has been impacted over this period of upheaval by digital technologies. For this reason, I am delighted to offer this foreword to 'A changed world: The state of digital transformation in a post COVID-19 maritime industry', a new report from consultancy Thetius sponsored by the Inmarsat Research Programme.





*since 2008, the UK has produced the highest number of maritime technology businesses in the G7 connected to ship operations and management*

As the report notes, Inmarsat's own data covering commercial shipping during the pandemic period shows that average daily data consumption per vessel increased nearly tripled, from 3.4 to 9.8 gigabytes between January 2020 and March 2021. In an equally significant shift, authors suggest that the global maritime digital products and services market in 2021 is 18% bigger than previous forecasts predicted, and that growth is running three years ahead of pre-pandemic forecasts.

Many will be familiar with the ways data analytics can help shipping meet its decarbonisation goals, and with moves for automation to play a greater role in ship operations. The following report has much to say on these matters but its abiding theme is the vast scope of previously promising digital opportunities whose maritime moment has come.

Crew training and officers examinations have become fully online for the first time ever in some jurisdictions. Maritime pilots are delivering pilotage services via video link. Telemedicine services for seafarers are finally becoming a reality. Such has been the progress made in the acceptance of remote ship surveys, meanwhile, that Inmarsat and Lloyd's Register are joining forces to provide dedicated connectivity for surveys to be live streamed while a vessel is at sea. All this and abundant additional opportunities exist to improve both the physical and mental health of crew through increased connectivity.

As part of the world leader in global, mobile satellite communications, headquartered in London, I would also like to highlight the report's focus on the UK as a host nation for technology and innovation. Data from the Thetius intelligence platform showing that, since 2008, the UK has produced the highest number of maritime technology businesses in the G7 connected to ship operations and management. It is also second only to the United States as the most abundant source of cloud computing, data analytics, and artificial intelligence (AI) technologies for the maritime sector.

In closing, I would like to extend my warm congratulations to the authors of this report – Nic Gardner, Matthew Kenney and Nick Chubb – for providing their unique insights into maritime digitalisation during a period of turmoil in global economies. We are proud to present this latest in a series of Thetius reports supported by Inmarsat.

# EXECUTIVE SUMMARY

There is no doubt that the global maritime industry is operating in a changed world. But many of these changes were already on the horizon before the COVID-19 pandemic. That said, for a number of digital use cases, what was thought impossible in 2019, or deemed too risky to attempt in the near term, has now been tried and tested.

*By 2030, we estimate the industry will be worth $345bn, up from a previous forecast of $279bn.*

The COVID-19 pandemic has led to a large increase in the adoption of digital tools across the industry. But there is more to digital transformation than adopting digital tools; genuine transformation is still some years away. There is zero doubt that COVID-19 has accelerated the process, average daily data consumption per vessel increased from 3.4 to 9.8 gigabytes between January 2020 and March 2021.

The impact of COVID-19 on ship operations is evidenced by a massive increase in the use of remote services such as pilotage and surveying. Similarly, crew training and officers examinations went fully online for the first time ever in some jurisdictions.

More broadly, global trade facilitation saw an explosion in the use of digital tools including massive growth in consumer demand for e-commerce and the use of online booking platforms for shipping freight.

2020 saw a small dip in spending growth on digital tools developed specifically for the maritime industry. However, overall there was significant investment in general IT infrastructure. Before the pandemic, global spending on digital products and services in the maritime sector was forecast to be $124bn in 2020. We estimate that the actual spend was $2bn lower, at $122bn. Pre-pandemic forecasts estimated that the digital maritime industry would be worth $135bn in 2021. But we estimate that the global maritime digital products and services market will turn over $159bn this year; An increase of $24bn or 18% on previous forecasts.

Based on this new data, we are forecasting that by 2022, industry turnover will be three years ahead of pre-pandemic growth forecasts.

*Although the industry has undergone a rapid shift in the last 18 months, there is no doubt that there is more to come. Efforts to decarbonise the maritime industry will need to eclipse the impact of the pandemic by a long way.*

By 2030, we estimate the industry will be worth $345bn, up from a previous forecast of $279bn. Similar patterns are seen at a local level in the UK, with 2020 seeing spend reduced by c. £100m ($135m) and 2021 seeing a c. £1.0bn ($1.3bn) lift on pre-pandemic spending forecasts.

Venture investment patterns saw a similar, but more extreme, dip followed by a rapid recovery. Investment values dropped from $1.4bn in 2019 to just $345m in 2020. We estimate that by the end of 2021 a total of $2.5bn will have been invested with total deal flow up by 85% on 2020 levels, bringing the level back to pre-pandemic forecasts.

The UK maritime technology sector has weathered the pandemic well. The UK has produced more maritime technology businesses in the ship operations and management sector than any other G7 nation since 2008 and the government has recently announced several measures to boost maritime innovation. The UK is progressing well against the short-term measures of the government's Maritime 2050 strategy, particularly in areas such as technology, people, and trade. But the government lags behind its own targets on areas including the environment, infrastructure, and security.

Looking ahead, decarbonisation is the biggest long term issue facing the industry. Changing fuel infrastructure is a complex and lengthy process, as evidenced by the 97-year journey to remove tetraethyl lead as an additive in the petrol supply chain. But digital tools can play a strong role in the immediate future of the industry's decarbonisation journey. For example, there is evidence of fleet-wide fuel savings of up to 20% just from changing the handling behaviour of a ship's bridge team.

Although the industry has undergone a rapid shift in the last 18 months, there is no doubt that there is more to come. Efforts to decarbonise the maritime industry will need to eclipse the impact of the pandemic by a long way. To facilitate this change, the authors recommend that industry stakeholders create a long term transformation plan, that government boosts non-financial support for innovation in the sector, and that innovators take the time to fully understand the various levels of market maturity before creating and launching new technology products.

# INTRODUCTION

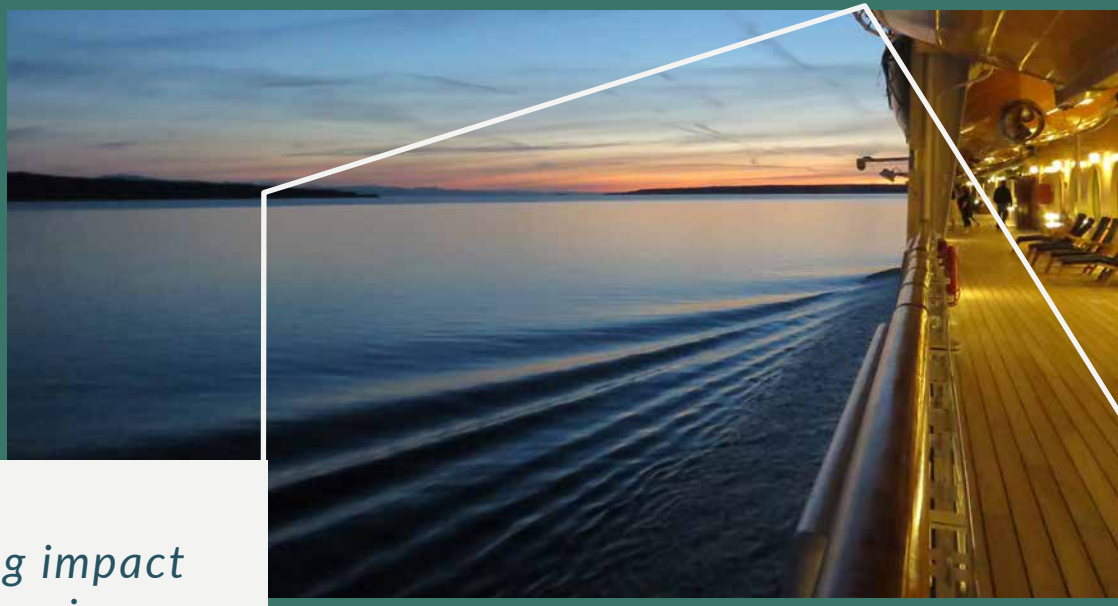
In November 2019 the global maritime industry was bracing for major technological change. Just four months prior to the closure of the International Maritime Organization (IMO) Headquarters due to the outbreak of COVID-19, the IMO Secretary General Kitack Lim reflected on maritime digitalisation in his opening address to the 31st General Assembly. He said,

> *"The IMO is showing strong commitment to addressing the rise of digitalization and automation in the maritime industry, to enhance the efficiency and sustainability of shipping."*

Just days before, some of the biggest names across the global shipping ecosystem had signed a pact to cooperate on the challenges of digitalisation and decarbonisation. The 'Global Shipping Industry Chain Cooperation Initiative', spearheaded by China's shipping giant Cosco, was formed in the belief that collective action was required to progress digital transformation in the supply chain. During a panel discussion at a Hong Kong industry innovation forum the same month, prominent ship managers Fleet Management Limited, observed that, "One of the major challenges with any digital transformation is getting change adopted. This involves convincing people who were used to doing things a certain way to do things differently, by making use of the new systems that are being put in place."

*The atmosphere was one of cautious expectancy. Digital transformation was approaching, but legacy issues, skills gaps, and market instability were conspiring to make most businesses reluctant to move.*

The atmosphere was one of cautious expectancy. Digital transformation was approaching, but legacy issues, skills gaps, and market instability were conspiring to make most businesses reluctant to move. In 2019, the idea of migrating entire shoreside infrastructures to a remote working environment within just a few weeks, would have been met with almost universal derision. The perception, it is reasonable to assume, would have been one of absolute impossibility.



*The devastating impact of COVID-19 has in many ways introduced a new global paradigm in maritime commerce.*

The devastating impact of COVID-19 has in many ways introduced a new global paradigm in maritime commerce. For a number of digital use cases, what was once thought impossible, or deemed too risky to attempt in the near term, has now been tried and tested. The procurement of digital capabilities, once believed to be subordinate to core operations, became top priority and digital tools took their place at the very heart of maritime industrial operations. The response to government lockdowns was unprecedented within our times. Within days, office staff across the world started working remotely. Nautical colleges moved their lectures online, and maritime administrations began conducting officer examinations, surveys, and inspections remotely. Even maritime pilots began delivering their pilotage services via video link.

The industry of November 2019 believed all of this was possible, but found great difficulty in putting timescales on the rate of change. With feet readied at the edge of the diving board, stepping off into uncertainty was still a step too far for many businesses. Back in London, Kitack Lim finished his opening address by saying, 'Shipping will be an enabling factor for good. We have before us an opportunity to revolutionize an industry that is truly indispensable to the world, its economy and its people. Let us continue to seize that opportunity.'

In this report, we will explore the impact of COVID-19 as a universal disruptor and catalyst for digital transformation. We draw upon an extensive and detailed analysis of the evidence of the past two years to seize the macro picture and ask, what is the post-pandemic state of digital transformation in the global and UK maritime industries and what progress has been made by the public and private sectors towards a digitally enabled future?

# THE PANDEMIC EFFECT: HOW HAS COVID-19 IMPACTED THE DIGITAL TRANSFORMATION OF THE MARITIME INDUSTRY?

IN light of evidence from across commerce and industry, it is impossible to dispute that COVID-19 has increased the use of digital tools. Even in the maritime industry, which some had argued was lagging behind aerospace and road transport in its efforts to digitalise prior to the pandemic, digital transformation gathered pace in many areas.

Digital tools, which had previously been considered low priority, suddenly required immediate implementation in response to 'work from home' mandates.

On the demand side, the retail sector flocked to the internet to substitute closures to their physical stores with online sales. Businesses which had previously relied on customers coming to them, had to switch to e-commerce models and as a result, demand for supply chain visibility increased. At the height of the pandemic in 2020, e-commerce's share of global retail sales jumped by 3 percentage points, which in monetary terms placed an additional $675bn of trade online within weeks.[1] The drivers for the shipping industry to be digitally-enabled and visible to the e-commerce supply chain became obvious and pressing almost overnight.

*there's more to "digital transformation" than using digital tools to continue doing jobs in much the same way.*

However, there's more to 'digital transformation' than using digital tools to continue doing jobs in much the same way. Emailing a scanned bill of lading rather than putting it in an envelope and handing it to a courier is 'digitalisation', but it's not 'digital *transformation*'.

1 UNCTAD. (2021, March 15). How COVID-19 triggered the digital and e-commerce turning point | UNCTAD. Retrieved from https://unctad.org/news/how-covid-19-triggered-digital-and-e-commerce-turning-point

The United Nations Conference on Trade and Development (UNCTAD) defines three stages of digitalisation in maritime transport:

1. **Optimisation** – maximizing efficiency and reliability in existing processes to reduce the costs of trading.
2. **Extension** – moving beyond efficiency to produce opportunities for new services and businesses.
3. **Transformation** – reinventing logistics, trade and business models, based on data-driven revenue[2]

Talking to *Ship Technology* magazine in November 2020,[3] GAC CIO, Martin Wallgren, explained, "This journey has also forced on us a lot of small digital solutions, [but] you have to do both the small and the big [part]...[Now], every port, every country, has their own rules, their own regulation, their standards...[As an industry] we have to fix some fundamental objectives before we can say 'let's go digital all over the world'."

One of those fundamental objectives is standardisation, which requires motivation, cooperation, and trust. While COVID-19 has increased companies' and governments' motivation to digitalise quickly, and even increased adoption of market-ready digital technologies, it hasn't led to digital transformation.

Before COVID-19, communications provider Dualog listed: a cost-savings mindset, perceived risk, limited bandwidth, lack of standardised infrastructure, opposition to data sharing, regulatory compliance, and cybersecurity, as barriers to digitalisation.[4] Lloyds List, in partnership with Inmarsat, has since conducted a more detailed study that included the canvassing of shipping companies, and which ranks challenges to digitalisation by industry perceptions of impact. A poll of 186 ship owners and managers cited the threat of cyber attack, lack of standardisation, lack of training, and disjointed data and systems among the top barriers to digitalisation, but placed the lack of evidence on cost savings as the most important factor.[5]

Writing in 2021, Tijan et al. identified similar barriers including, "...high implementation costs, low quality of offshore internet connections, aging decision-makers, overly technology-oriented culture, the lack of investment initiatives, the low level of modern digital technology...diffusion through the supply chain, and risk aversion."[6]

> *"...[Now], every port, every country, has their own rules, their own regulation, their standards...[As an industry] we have to fix some fundamental objectives before we can say 'let's go digital all over the world'."*
>
> GAC CIO, Martin Wallgren

2 UNCTAD. (2019, June). Digitalization in Maritime Transport: Ensuring Opportunities for Development. Retrieved 6 August 2021, from https://unctad.org/webflyer/digitalization-maritime-transport-ensuring-opportunities-development

3 Macola, I. G. (2020, November 19). Q&A: digitalisation and the future of shipping with Martin Wallgren. Retrieved 4 August 2021, from https://www.ship-technology.com/features/qa-digitalisation-future-shipping-martin-wallgren/

4 dualog. (2020, January). The 6 biggest barriers to going digital in the maritime sector. Retrieved 4 August 2021, from https://www.dualog.com/blog/the-6-biggest-barriers-to-going-digital-in-the-maritime-sector

5 Lloyds List, Inmarsat (2020, June). Digitalisation Uncovered: What's Next for Shipping? Retrieved 26 August 2021, from https://www.inmarsat.com/en/insights/maritime/2020/digitalisation-uncovered.html.

6 Tijan, E., Jović, M., Aksentijević, S., & Pucihar, A. (2021). Digital transformation in the maritime transport sector. Technological Forecasting and Social Change, 170, 120879. https://doi.org/10.1016/j.techfore.2021.120879

In a survey by Shipping and Freight Resource and Ocean Insights, 42% of respondents planned to change their shipping and supply chain strategy, and 67.6% indicated an intention to invest in technology as a result of COVID-19.[7]

COVID-19 lowered many of the legal and motivational barriers, as companies, governments, and regulatory bodies were forced to pivot to remote working. It's hard for an organisation to argue that something is impossible once they've done it—or their competitor has.

*Many shipping companies responded to the COVID-19 crew change crisis by improving crew internet access, and providing online training for both shore-based and seagoing staff.*

*...average daily data consumption per vessel increased from 3.4 to 9.8 gigabytes between January 2020 and March 2021.*

## DIGITALISATION DURING COVID-19

The rise in data consumption and the use of internet services is a useful proxy for digital engagement. For example, in the UK, broadband consumption more than doubled from 22,000 petabytes in 2019, to 50,000 petabytes in 2020.[8] Considering the same metric at sea is more challenging; however, according to Inmarsat, average daily data consumption per vessel increased from 3.4 to 9.8 gigabytes between January 2020 and March 2021.[9]

Though it is impossible to generalise, there are many examples of digitalisation that have been driven by the COVID-19 pandemic across ship operations, ship management, port operations, and trade. Here we will take a closer look at each of these.

7 Shipping and Freight Resources. (2020, August 22). 42% will change supply chain strategies post COVID-19 – Impact Survey. Retrieved 9 August 2021, from https://www.shippingandfreightresource.com/supply-chain-strategies-post COVID-19-impact-survey/

8 2020, December 30, UK internet use doubles in 2020 due to pandemic, BBC News, https://www.bbc.co.uk/news/technology-55486157

9 Internal analysis by Inmarsat, August 2021

## SHIP OPERATIONS

Many shipping companies responded to the COVID-19 crew change crisis by improving crew internet access, and providing online training for both shore-based and seagoing staff. V-Group's 'Life After Lockdown – The acceleration of digital engagement' report[10] explains the success of this approach, with seafarers fleetwide receiving access to resilience training, and 3,000 shore-based personnel participating in ongoing cyber safety training.

As colleges and universities worldwide shifted to remote learning, nautical colleges followed suit.[11,12] After proving the system during the COVID-19 lockdown, South Shields Marine School will be continuing to offer a wide range of courses by remote learning, increasing their reach and allowing the flexibility that the maritime industry needs.[13]

The UK Maritime and Coastguard Agency (MCA) has also moved to remote operations, putting oral examinations online in June 2020. Having proven that it worked during the pandemic, this could provide UK seafarers worldwide with easy access to training and examinations.[14]

*Though many aspects of a ship's operation can now be conducted remotely, they still need people on board to operate safely.*

Like everything that requires physical attendance to a vessel, COVID-19 disrupted ship survey and inspection. Although remote surveys have been under development for years, COVID-19 increased focus and accelerated adoption.[15] In July 2020, the MCA formally approved the "Use of alternative measures for the completion of surveys on internationally trading UK registered ships,"[16] along with many other States[17] and Classification Societies.[18 19]

This has created opportunities for manufacturers of drones[20] and other remote surveying tools, which have boomed as a result of these approvals. Such is the progress being made that satellite operator Inmarsat and classification society Lloyd's Register

10 V.Group. (2020). Life After Lockdown - The acceleration of digital engagement. Retrieved 4 August 2021, from https://vgrouplimited.com/life-after-lockdown-2-download-the-paper

11 South Tyneside College. (2020, December). Navigating through the COVID-19 pandemic. Retrieved 5 August 2021, from https://www.stc.ac.uk/news/2020-12/navigating-through-covid-19-pandemic

12 ICS & IAMU. (2020, October). MSC 102/INF.25 The impact of COVID-19 on maritime education and training. IMO MSC. Retrieved 5 August 2021, from https://www.ics-shipping.org/wp-content/uploads/2021/03/MSC-102-INF.25-The-impact-of-COVID-19-on-maritime-education-and-training-ICS-and-IAMU.pdf

13 South Tyneside College. (n.d.). Courses | South Tyneside College. Retrieved 5 August 2021, from https://www.stc.ac.uk/courses-by-interest/129

14 Maritime and Coastguard Agency (MCA). (2020, June). MIN 620 (M) Update on online oral exams and future issue of Notice of Eligibilities during the COVID-19 lockdown period. Retrieved 5 August 2021, from https://www.gov.uk/government/publications/min-620-m-update-on-online-oral-exams-and-future-issue-of-notice-of-eligibilities-during-the-covid-19-lockdown-period

15 International Association of Classification Societies (IACS). (2021, February). IACS Information Paper on Remote Survey for Interested Stakeholders. Retrieved 4 August 2021, from https://iacs.org.uk/media/7738/iacs-remote-surveys-information-paper.pdf

16 Maritime and Coastguard Agency (MCA). (2020, June). MIN 622 (M+F) COVID-19 - Use of alternative measures for the completion of surveys on internationally trading UK registered ships. Retrieved 5 August 2021, from https://www.gov.uk/government/publications/min-622-mf-coronavirus-covid-19-use-of-alternative-measures-for-the-completion-of-surveys-on-internationally-trading-uk-registered-ships

17 Lloyd's Register. (n.d.). Latest Flag State instructions on COVID-19 (Coronavirus). Retrieved 4 August 2021, from https://www.lr.org/en-gb/who-we-are/coronavirus/flag-and-port-state-instructions/

18 DNV GL. (2019, March 11). DNV GL rolls out remote surveys for all vessels. Retrieved 4 August 2021, from https://www.dnv.com/news/dnv-gl-rolls-out-remote-surveys-for-all-vessels-142769

19 Bureau Veritas (BV). (n.d.). Remote and Augmented Surveys. Retrieved 5 August 2021, from https://marine-offshore.bureauveritas.com/digital-classification/remote-augmented-surveys

20 Gardner, N. (2021, July 28). Deep Dive: Aerial Drones in the Maritime Industry. Retrieved 5 August 2021, from https://thetius.com/deep-dive-aerial-drones-in-the-maritime-industry/

*While we're unlikely to see fully autonomous ships take over in the near future, COVID-19 has highlighted the advantages.*

recently announced the launch of a new remote survey service. This makes it possible for surveys to be live-streamed while a vessel is at sea, instead of during port stays when the crew's workload is usually very high.[21]

Though many aspects of a ship's operation can now be conducted remotely, operators still need people on board to work safely. Ship automation is a contentious issue. But with crew changes difficult or impossible, shore-leave non-existent, ships being detained for having crew on board past the end of their contract, and half of seafarers considering leaving the industry, shipowners are increasingly turning to automation as a potential resilience measure.[22] [23]

Even without automation, remote pilotage has expanded as a result of the pandemic. Sending pilots onto a ship known—or suspected—to have COVID-19 on board presents a risk to the pilots, and to other vessels they may subsequently board. If pilots are self-isolating, there may not be enough pilots available, resulting in delays at the port. During the pandemic, even the Suez Canal Authority resorted to remote pilotage,[24] while smaller ports like Peterhead[25] used it for selected ships.

While the shipping industry is unlikely to see fully autonomous ships take over in the near future, COVID-19 has highlighted the advantages.

For those living and working onboard, access to traditional medical care ashore has become all but impossible, and remains so even today. Despite obvious advantages for seafarers, uptake of digital telemedicine prior to COVID-19 was slow. COVID-19 changed this by expanding telemedicine adoption ashore, which may have had a normalising effect on those at sea. The number of calls to Centro Internazionale Radio Medico doubled in the first six months of 2020 compared to the same period in previous years.[26] As with many changes discussed, this in itself is neither digitalisation nor a digital transformation; however, given the technical and regulatory burdens that have held telemedicine back in the past,[27] wide adoption and improved connectivity at sea as a result of the pandemic will reduce these barriers and improve seafarers' access to care.


21 Lloyd's Register and Inmarsat form industry-first collaboration to develop a remote survey solution, Inmarsat 2021

22 Saul, J., & Khasawneh, R. (2021, July 20). SOS: Stranded and shattered seafarers threaten global supply lines. Retrieved 5 August 2021, from https://www.euronews.com/2021/07/20/us-shipping-seafarers-insight

23 Maritime Executive. (2021, February 16). Semi-Autonomous Sailings Start Aboard Shortsea Vessel in Belgium. Retrieved 5 August 2021, from https://www.maritime-executive.com/article/semi-autonomous-sailings-start-aboard-shortsea-vessel-in-belgium

24 Suez Canal Authority. (2020, March). In the context of the precautionary and preventive measures to counter the novel Coronavirus. Retrieved 5 August 2021, from https://www.suezcanal.gov.eg/English/MediaCenter/News/Pages/navigation_23-03-2020.aspx

25 Peterhead Port Authority. (2020, April 2). Remote pilotage among Covid-19 measures introduced. Retrieved 5 August 2021, from https://www.peterheadport.co.uk/news/remote-pilotage-among-covid-19-measures-introduced

26 Sagaro, G. G., Battineni, G., Chintalapudi, N., di Canio, M., & Amenta, F. (2020). Telemedical assistance at sea in the time of COVID-19 pandemic. International Maritime Health, 71(4), 229–236. https://doi.org/10.5603/imh.2020.0041

27 Peine, A., Paffenholz, P., Martin, L., Dohmen, S., Marx, G., & Loosen, S. H. (2020). Telemedicine in Germany During the COVID-19 Pandemic: Multi-Professional National Survey. Journal of Medical Internet Research, 22(8), e19745. https://doi.org/10.2196/19745

*Now that digital tools have been proven to work during COVID-19, it makes no sense to go back to "the old ways."*

## SHIP MANAGEMENT

COVID-19 forced ship management companies, like most other companies, into remote working. V-Group's experience will be familiar to most office workers:[28]

"With physical contact limited, new working practices were implemented quickly and a greater reliance on digital tools was essential. Video conferencing facilities... became much more frequent when face to face meetings came to a halt..."

But not all companies would have laid the groundwork before COVID-19 hit:

"Significant [pre-pandemic] investment into technology...meant organising for the whole team to work from home could happen overnight because everyone was working on one system".

Like other businesses across the globe, ship management companies work across time zones and oceans. Now that digital tools have been proven to work during the COVID-19 pandemic, it makes no sense to go back to pre-digital working practices.


## PORT OPERATIONS

Even before COVID-19, there were considerable operational disparities between ports worldwide: only 49 of the 174 UN Member States had functioning Port Community Systems.[29] Despite ports being designated as "essential services" during COVID-19 lockdowns, "worker bubbles" and other safety measures slowed operations, and COVID-19 infections led to worker shortages.[30] However, by May 2021, 41% of ports were going ahead with planned investments, and 5% of ports had even sped up their investment timeline.[31]

While these investments don't necessarily involve digitalisation, the challenges of the pandemic have motivated stakeholders to consider targeted future investments to mitigate the issues highlighted by COVID-19.[32] [33]

28 V.Group. (2020). Life After Lockdown - The acceleration of digital engagement. Retrieved from https://vgrouplimited.com/life-after-lockdown-2-download-the-paper

29 IAPH, BIMCO, ICHCA, ICS, IHMA, IMPA, . . . PROTECT. (2020, June). Accelerating Digitalisation of Maritime Trade and Logistics - A Call to Action. Retrieved from https://www.bimco.org/-/media/bimco/news-and-trends/news/maritime-digitalisation/maritime-industry-policy-statement-acceleration-digitalisation.ashx

30 Statista. (2021, February 24). Worker shortages due to coronavirus at ports worldwide by service 2020. Retrieved 5 August 2021, from https://www.statista.com/statistics/1114355/worker-shortages-at-ports-covid-19/

31 Notteboom, T., & Pallis, T. (2021, May). IAPH-WPSP Port Economic Impact Barometer One Year Report. Sustainable World Ports. Retrieved 5 August 2021, from https://sustainableworldports.org/wp-content/uploads/IAPH-WPSP-Port-Economic-Impact-Barometer-20-21-View.pdf

32 ESCAP & UNCTAD. (2020, September). COVID-19 and its impact on shipping and port sector in Asia and the Pacific. UNESCAP. Retrieved 5 August 2021 from https://www.unescap.org/sites/default/d8files/knowledge-products/ShippingPoliyBrief-16Oct2020-FINAL.pdf

33 UNCTAD. (2020, November). Review of Maritime Transport 2020. Retrieved 5 August 2021, from https://unctad.org/webflyer/review-maritime-transport-2020

*Because no aspect of the supply chain functions alone, the industry needs to collaborate towards effective digital transformation.*

Ports that had already invested in digital systems before the COVID-19 pandemic, have reaped the rewards. The Port of Gothenburg's existing automatic gates and digital contractor permit system cut down on face-to-face contact and simplified their transition to "the new normal" brought about by COVID-19.[34] They are planning to launch their artificial i ntelligence (AI) enabled digital platform in the second half of 2021, and expect to, "..enhance freight flow transparency and have a direct impact on productivity, lead times, and delivery capacity." [35]

Because no aspect of the supply chain functions alone, the industry needs to collaborate towards effective digital transformation.[36] From Just-In-Time arrivals to Single-Window systems, ports, shipping companies, and regulators must work together.[37] COVID-19 has highlighted the sticking points in existing systems. The technology exists; the standards exist; and a general consensus exists that it's a good idea. The next great question is one of willingness to pursue genuine transformation.

## TRADE FACILITATION

While individual countries and companies can make independent progress on ship and port operations and management, trade facilitation is different. By its nature, it requires multi-party cooperation from governments, banks, insurers, companies, customers, and more.

The World Trade Organization Trade Facilitation Agreement (WTO TFA) includes trade portals and digital tools for customs data exchange. Full implementation would reduce trade costs by an average of 14.3%, but, as always, there are challenges. Many of the developing and least-developed nations need support and assistance to implement the TFA. By demonstrating the advantages of widespread implementation, COVID-19 has increased motivation for countries to cooperate. At the October 2020 meeting, several countries presented trade facilitation measures taken in response to COVID-19 and called for expedited TFA implementation.[38, 39]

In February 2020, the World Economic Forum proposed an ambitious "Logistic Internet" where anyone can connect once, then share with everyone.[40] This would set neutral common standards for:

- **Global Trade Identity;**
- **Shared Visibility;**
- **Port Call Optimisation;**
- **Financial Flow; and**
- **Customs Cross Border Interoperability.**

34 ST Engineering Antycip. (2021, March 5). Covid-19 and the Digitalisation of Ports and Shipping. Retrieved 5 August 2021, from https://steantycip.com/blog/covid-19-digitalisation-ports-shipping/

35 Port of Gothenburg. (2020, October). Digital transformation set to produce Port of Gothenburg 2.0. Retrieved 5 August 2021, from https://www.portofgothenburg.com/news-room/press-releases/digital-transformation-set-to-produce-port-of-gothenburg-2.0/

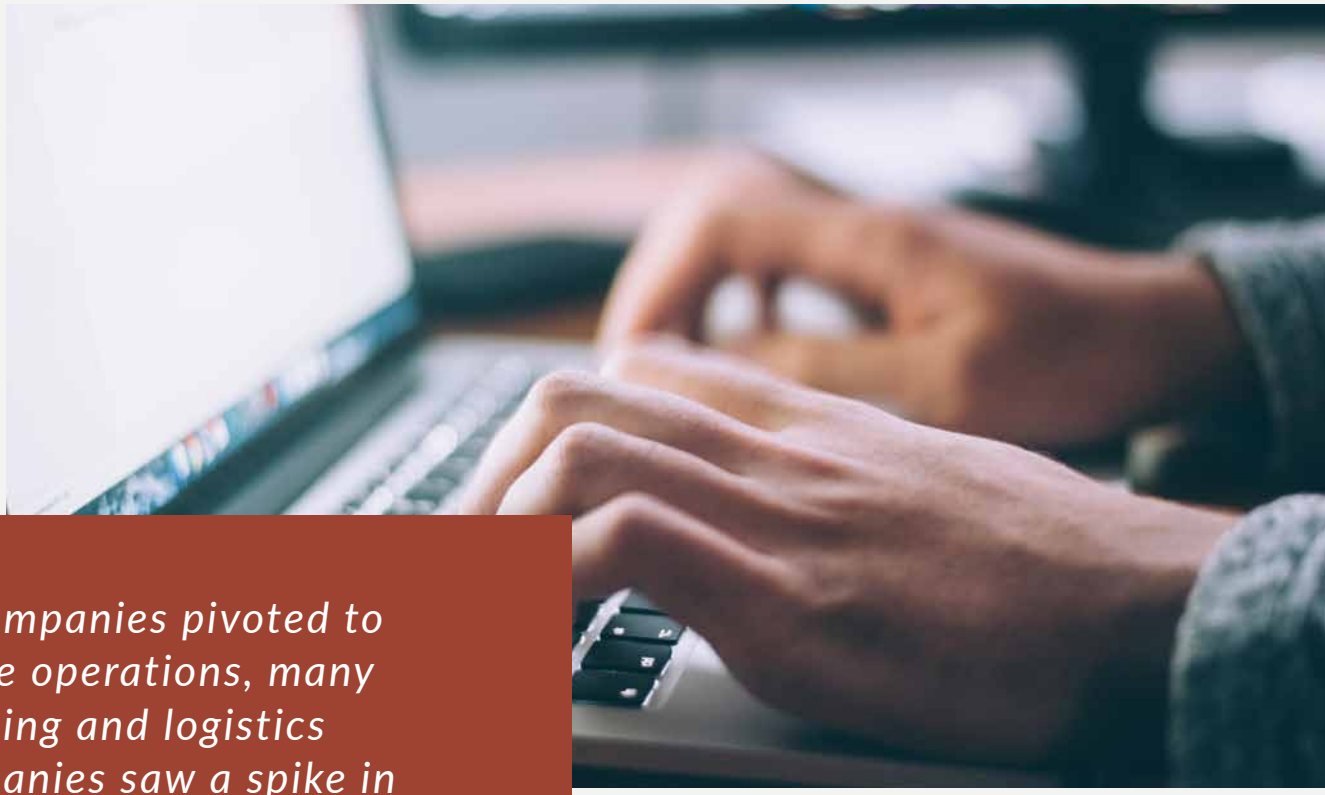
36 Port Technology International Team. (2020, April 9). COVID-19 could accelerate digitalization for shipping industry. Retrieved 5 August 2021, from https://www.porttechnology.org/news/covid-19-could-accelerate-digitalization-for-shipping-industry/

37 GEF-UNDP-IMO GloMEEP Project and members of the GIA. (2020). Just In Time Arrival Guide - Barriers and Potential Solutions. Retrieved from https://wwwcdn.imo.org/localresources/en/OurWork/PartnershipsProjects/Documents/GIA-just-in-time-hires.pdf

38 World Trade Organization (WTO). (2020, October). Members cite role of trade facilitation in ensuring access to goods to tackle COVID-19. Retrieved 6 August 2021, from https://www.wto.org/english/news_e/news20_e/fac_22oct20_e.htm

39 Australia; Brazil; Canada; Colombia; Ecuador; the European Union; Iceland; Japan; Republic of Korea; Mexico; Montenegro; New Zealand; North Macedonia; Norway; Singapore; Switzerland; the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu; Thailand; Turkey; the United Kingdom; the United States; and Uruguay. (2021, June). Supporting the timely and efficient release of global goods through accelerated implementation of the WTO Trade Facilitation Agreement. World Trade Organization (WTO). Retrieved from https://tinyurl.com/22jb8vts

40 Jensen, H. (2020, February 17). Digitisation of logistics can increase trade and reduce poverty. Retrieved 9 August 2021, from https://www.weforum.org/agenda/2020/02/how-the-global-logistics-industry-can-collaborate-to-increase-trade-and-reduce-poverty/



*As companies pivoted to online operations, many shipping and logistics companies saw a spike in uptake of their online services.*

The EU's Project ALICE has made a similar proposal,[41] by proposing to tackle the process in "generations" from the bottom up, with government support. Generation 1 was in progress before COVID-19; however, COVID-19 has certainly encouraged Generations 2 and 3: demonstrating seamless sectoral and regional progress, and large-scale industry-led demonstrations.

As companies pivoted to online operations, many shipping and logistics companies saw a spike in uptake of their online services. In the early days of COVID-19, Maersk saw a 90% increase in the use of their app for services like spot rates, quotes, booking, and online payment. Seeing this, they added extra functions in March 2021 to improve the customer experience.[42]

Electronic documents, including bills of lading (eBL), have been around for some time. Indeed, the International Air Transport Association (IATA) adopted e-Air Waybills in 2010, and they became the default contract of carriage for air cargo on enabled trade lanes in January 2019.[43] Unfortunately, lack of motivation, legal questions,[44] regulatory barriers, and the absence of standards have led to slow, siloed uptake in maritime.[45] The

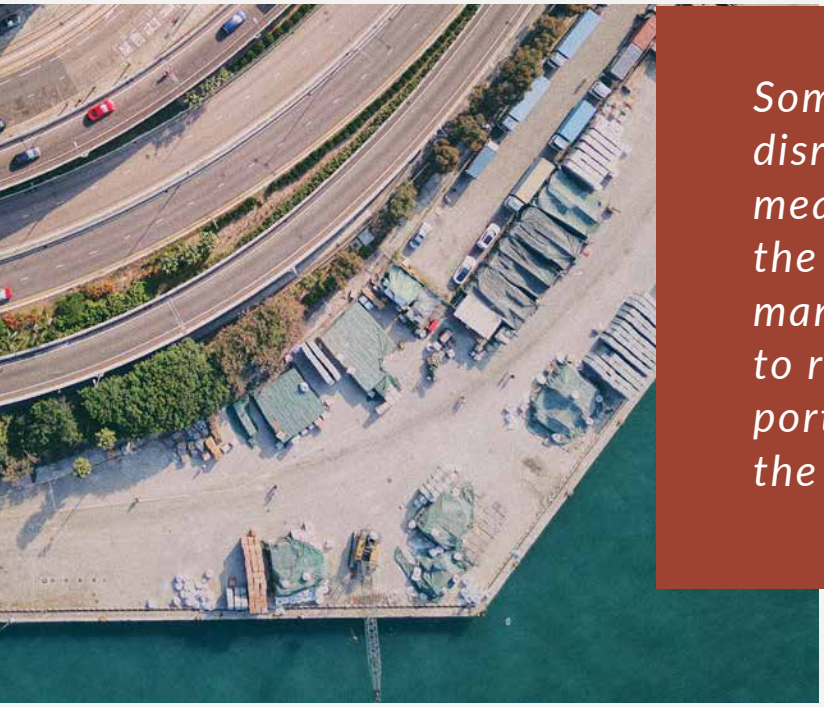
41 ALICE. (2020, November). Final Report on Physical Internet Development Monitoring. European Commission. Retrieved from https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5d6711b5c&appId=PPGMS

42 Maersk. (2020, May 6). Maersk app sees record use amid COVID-19. Retrieved 4 August 2021, from https://www.maersk.com/news/articles/2020/05/06/maersk-app-sees-record-use-amid-covid-19

43 International Air Transport Association. (n.d.). e-AWB. Retrieved 9 August 2021, from https://www.iata.org/en/programs/cargo/e/eawb/

44 International Chamber of Commerce. (2019, March 26). The legal status of electronic bills of lading. Retrieved 9 August 2021, from https://iccwbo.org/publication/legal-status-electronic-bills-lading/

45 Link-Wills, K. (2020, May 18). Shipping group promotes standardized e-bill of lading. Retrieved 9 August 2021, from https://www.freightwaves.com/news/shipping-group-promotes-standardized-e-bill-of-lading



*Some courier services were disrupted due to lockdown measures in the beginning of the COVID-19 pandemic and many importers were not able to release their cargoes from ports as they could not get the printed bills of ladings.*

problems with physical document transfer during COVID-19 created a spike in interest in eBLs,[46] with adoption of existing eBL solutions increasing[47] [48] and the Digital Container Shipping Association calling for 50% adoption of eBLs by 2030.[49]

Some courier services were disrupted due to lockdown measures in the beginning of the COVID-19 pandemic and many importers were not able to release their cargoes from ports as they could not get the printed bills of lading. For non-negotiable bills of lading, electronic sea waybills allowed shippers to avoid this disruption and continue their logistics operations. Similarly, online bookings helped shippers to sustain and carry out shipments smoothly. In line with this, several container lines have reported that their online booking tools have been used significantly more than in the pre-pandemic period.

Digital transformation depends on digitalisation. While many of the digitalisation measures introduced as a result of COVID-19 are neither universally adopted, or intended as permanent, having proven that something is possible as a result of force majeure means industry can no longer claim that it cannot be done. In future, companies that maintain and improve on the “temporary” measures will be more resilient to future shocks, and have a competitive advantage over those who revert back to outmoded working practices.

46 MECO Group. (2020, March 30). E-Bills of Lading. Retrieved 9 August 2021, from https://www.themecogroup.co.uk/charterers-liability-insurance/publication/e-bills-of-lading/

47 MSC. (2020, September 9). MSC Partners with WAVE for Wide Adoption of its e-Bill of Lading in India. Retrieved 9 August 2021, from https://www.msc.com/sur/news/2020-september/msc-partners-with-wave-for-wide-adoption-of-its-e?lang=en-gb

48 Ocean Network Express. (2020, April 2). ONE Issues its First Electronic BL and Selects essDOCS to Power its Global BL Digitization Initiative. Retrieved 9 August 2021, from https://www.one-line.com/en/news/one-issues-its-first-electronic-bl-and-selects-essdocs-power-its-global-bl-digitization

49 Digital Container Shipping Association. (2020, May). DCSA takes on eBL standardisation, calls for collaboration. Retrieved from https://dcsa.org/wp-content/uploads/2020/05/20200519-DCSA-taking-on-eBL.pdf

Many existing digital solutions, such as electronic bills of lading, are not yet ready for universal adoption in international trade because there is no singularly agreed standard legal framework.[50] Maritime trade organisations, including those relating to ports,[51] policy,[52] trade facilitation,[53] and government and research,[54] called for cooperation to improve digitalisation during COVID-19.

Individual companies and sectors can digitalise their own operations, but true digital transformation of an industry requires sustained cooperation in regulation, standardisation, and data sharing.[55] [56] In the future, we may find that COVID-19's true impact on digital transformation was in highlighting the need for stakeholders and competitors to work together for the benefit of all.

*Individual companies and sectors can digitalise their own operations, but true digital transformation of an industry requires cooperation in regulation, standardisation, and data sharing.*

50 International Association of Ports and Harbors (IAPH). (2021, January). IAPH global ports survey on the implementation of electronic data exchange to conform with the IMO Convention on Facilitation of International Maritime Traffic (FAL). Retrieved 4 August 2021 from https://sustainableworldports.org/wp-content/uploads/IAPH-FAL-Survey-Report-Jan-2021.pdf

51 IAPH, BIMCO, ICHCA, ICS, IHMA, IMPA, . . . PROTECT. (2020, June). Accelerating Digitalisation of Maritime Trade and Logistics - A Call to Action. Retrieved 5 August 2021, from https://www.bimco.org/-/media/bimco/news-and-trends/news/maritime-digitalisation/maritime-industry-policy-statement-acceleration-digitalisation.ashx

52 UNCTAD. (2019, June). Digitalization in Maritime Transport: Ensuring Opportunities for Development. Retrieved 6 August 2021, from https://unctad.org/system/files/official-document/presspb2019d4_en.pdf

53 World Customs Organization (WCO). (2020, April). COVID-19: WCO and ICC issue joint statement and call for increased action on Customs and trade facilitation. Retrieved 6 August 2021, from http://www.wcoomd.org/en/media/newsroom/2020/april/covid_19-wco-and-icc-issue-joint-statement.aspx

54 MPA Singapore. (2020, November). 11 Joint Industry Projects Awarded S$1.625 million to Drive Maritime Innovation. Retrieved 6 August 2021, from https://www.sgpc.gov.sg/media_releases/mpa/press_release/P-20201117-1

55 OECD (2019). Going Digital: Shaping Policies, Improving Lives. OECD Publishing, Paris, https://doi.org/10.1787/9789264312012-en.

56 International Association of Ports and Harbors (IAPH). (2020, June). Joint Industry Call – World Port Sustainability Program. Retrieved 4 August 2021, from https://sustainableworldports.org/joint-industry-call

# QUANTIFYING THE IMPACT: HOW HAS COVID-19 AFFECTED THE MARKET?

2020 saw the world go through the largest economic and societal shock it has ever encountered. The impact of that shock was felt throughout the maritime world, forcing whole swathes of the industry to pivot to using the tools that enable remote working and collaboration.

2020 saw a small dip in the growth of spending on digital tools that are developed specifically for the maritime industry. However, there was significant investment across the industry in the general IT infrastructure required to enable remote working.

Though the long term working patterns for the shoreside industry are as yet unknown, the infrastructure investments made during 2020 have led to explosive growth in the adoption of digital tools specifically for the maritime sector in 2021 so far.

*The infrastructure investments made during 2020 have led to explosive growth in the adoption of digital tools specifically for the maritime sector in 2021 so far*

## A SLUMP THEN A BUMP

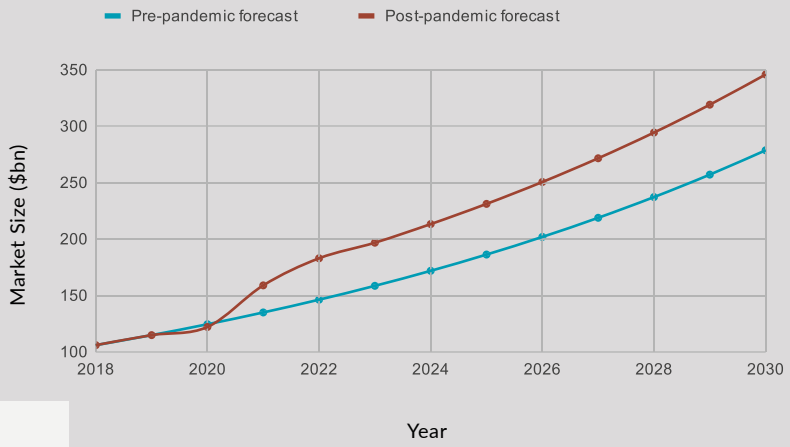
Previous forecasts, undertaken by Thetius, Startup Wharf and PUBLIC estimated that global spend on digital products and services in the maritime sector would be $124bn in 2020.[57] [58] We estimate that the actual spend was $2bn lower, at $122bn.[59]

57 Chubb, N., Zangrando, L. (2018). Frictionless Trade: How New Technology will Power International Trade. PUBLIC. Retrieved from https://www.public.io/insight/research/frictionless-trade/

58 Chubb, N., & Zangrando, L. (2019). Trade 2.0 - How Startups are Driving the Next Generation of Maritime Trade. PUBLIC. Retrieved from https://www.public.io/insight/research/trade-2-0/

59 Estimate based on data gathered through the Thetius Intelligence platform from January 2019- August 2021. This includes the details of 859 market announcements including contract awards, partnerships, and product launches. Equity investments are specifically excluded.

PRE-PANDEMIC VS. POST-PANDEMIC MARKET SIZE FORECAST




*Based on this new data, we are forecasting that by 2022 industry turnover will be three years ahead of pre-pandemic growth forecasts*

Pre-pandemic forecasts estimated that the digital maritime industry would be worth $135bn in 2021. But based on data gathered to the end of August this year, the pandemic has caused an explosion in growth. We estimate that in 2021, the global maritime digital products and services market will turn over $159bn. An increase of $24bn or 18% on previous forecasts.[60]

Based on this new data, we are forecasting that by 2022 industry turnover will be three years ahead of pre-pandemic growth forecasts. By 2030, we estimate the industry will be worth $345bn, up from a previous forecast of $279bn.

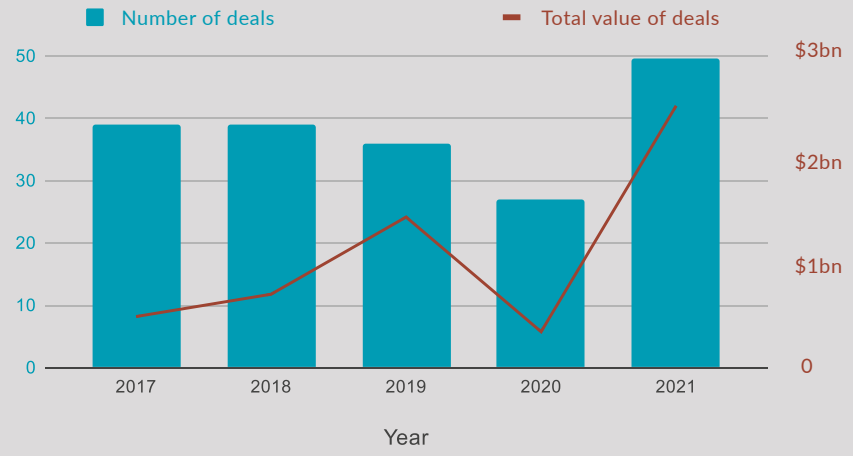
## STRONG GROWTH FORECAST IN THE UK

In the UK market, growth levels followed the same pattern of a small dip followed by a big jump, but the impact is even more pronounced. Pre-pandemic forecasts estimated spending on digital products and services in the UK maritime industry to be £4.6bn ($6.2bn) in 2020.[61] Similar to the global view, we estimate that the actual spend in 2020 was marginally lower, at £4.5bn ($6.06bn).

Pre-pandemic forecasts estimated that the UK digital maritime industry would turn over £5.1bn ($7.0bn) in 2021. But based on data collected to August this year, we estimate the industry will actually turn over £6.3bn ($8.6bn) in 2021, a £1.2bn ($1.6bn) or 23% increase on previous forecasts.[62]

60 Ibid
61 Ibid 57
62 Ibid 57

NUMBER OF INVESTMENTS AND INVESTMENT VALUE




## INVESTMENT PATTERNS RETURNING TO NORMAL

The pandemic did have a significant negative impact on venture investments in the maritime sector during 2020. In 2020, the volume of deal flow dropped by 25% versus 2019 levels, but the total value of investments dropped by a massive 76% from $1.4bn in 2019 to just $345m in 2020. This indicates that early stage venture investing was only marginally impacted, with smaller deals still able to go ahead.

In 2021 however, the picture has improved drastically, with both deal flow and investment value significantly up. In the year so far to August 2021, $1.7bn has been invested in maritime startups and scaleups. We estimate that by the end of 2021, a total of $2.5bn will have been invested with total deal flow up by 85% on 2020 levels. This brings investments into the maritime technology sector back into line with the growth trend previously seen from 2019 and before.[63]

*In 2021 however, the picture has improved drastically, with both deal flow and investment value significantly up*

63 Based on data gathered through the Thetius Intelligence platform from January 2019- August 2021. This includes the details of 96 market announcements of equity investments into maritime industry startups and scaleups.

# TAKING STOCK: HOW IS THE UK PROGRESSING TOWARDS THE GOVERNMENT'S MARITIME 2050 GOALS?

Despite recent political and economic uncertainty, the fundamentals of the UK as a world-class centre for innovation and technological development remain compelling.

Britain's exit from the European Union (EU) in January 2020 triggered broader domestic political challenges which compounded the impact of the COVID-19 pandemic in-country. But these events and others have also catalysed Britain into presenting more flexibility, adaptability, and guile in geopolitics and industrial strategy. Fuelled by increasing urgency, a political environment has formed that encourages innovation and change led by science and technology (S&T).

Central to the government's ambition to build a more adaptable British economy is maximising Britain's core economic strengths. By identifying areas of competitive advantage, the government has highlighted maritime trade and technology as primary growth areas. Facilitating success in these sectors is critical to the government meeting their immediate to longer-term strategic objectives.

*By identifying areas of competitive advantage, the government has highlighted maritime trade and technology as primary growth areas.*

Since publishing its Maritime 2050 strategy in January 2019, the United Kingdom's progress towards becoming a more competitive, more technologically-advanced, and more sustainable global maritime economy has not been without its setbacks. However, the last two years has seen the establishment of many new initiatives, sources of funding, and collaborative projects aimed at revitalising the UK maritime technological economy.

## OVERVIEW OF UK MARITIME INNOVATION

According to a recent government report,[64] current UK foreign policy 'rests on strong domestic foundations', with security, resilience, and economic strength forming pillars of political focus. The government has stated that the UK is keen to 'understand the precise nature and extent of British strengths and the integrated offer [they] bring in other parts of the world', placing political emphasis on Britain as an ambitious maritime trading nation.

Responding to geopolitical and geoeconomic shifts, such as a more assertive China, and the rising importance of the Indo-Pacific region, the UK has sought to position itself as a flexible agent of change.

*Responding to geopolitical and geoeconomic shifts, such as a more assertive China and the rising importance of the Indo-Pacific region, the UK has sought to position itself as a flexible agent of change.*

The concept of global Britain spurred the government into introducing a strategic framework spanning the period 2021-25, that places investment in science and technology as a top priority. Indeed, a consortium including the World Intellectual Property Organization (WIPO) placed the UK fourth in their 2020 Global Innovation Index,[65] with another respected poll - the Global Financial Centres Index (GFCI) - maintaining London as the second most influential financial centre in the world; albeit with Shanghai now only one point adrift in third place.[66] The UK remains a highly influential global power in maritime law, insurance, ship broking, and education and retains considerable market share in each.

Fostering a healthy and functional capital investment ecosystem is crucial to supporting UK ambitions to remain an influential maritime innovator and pioneer of emerging digital technologies. In contrast to record levels of venture capital (VC) funding prior to the pandemic, the first half of 2020 saw a sharp decline in VC funding across North America, Asia, and Europe - especially among early stage start-ups. Uncertainty factors predominated and financiers became concerned about their exit strategies as initial public offerings (IPOs) dwindled in the face of eroding investor confidence. However, recovery took hold in the second half, and 2020 overall saw funding for emerging technologies finish strongly, with UK-based tech companies receiving the highest amount of investment in Europe at around $15bn. In fact, only China and the United States received more VC capital inflows.[67] As a result, the UK tech startup and scaleup sector as a whole is estimated at $585bn today, supporting around 3 million jobs.[68]

The fundamentals of the UK as a host nation for technology and innovation remain attractive, despite the political and economic headwinds of recent years. Growing tech businesses in Britain have access to a range

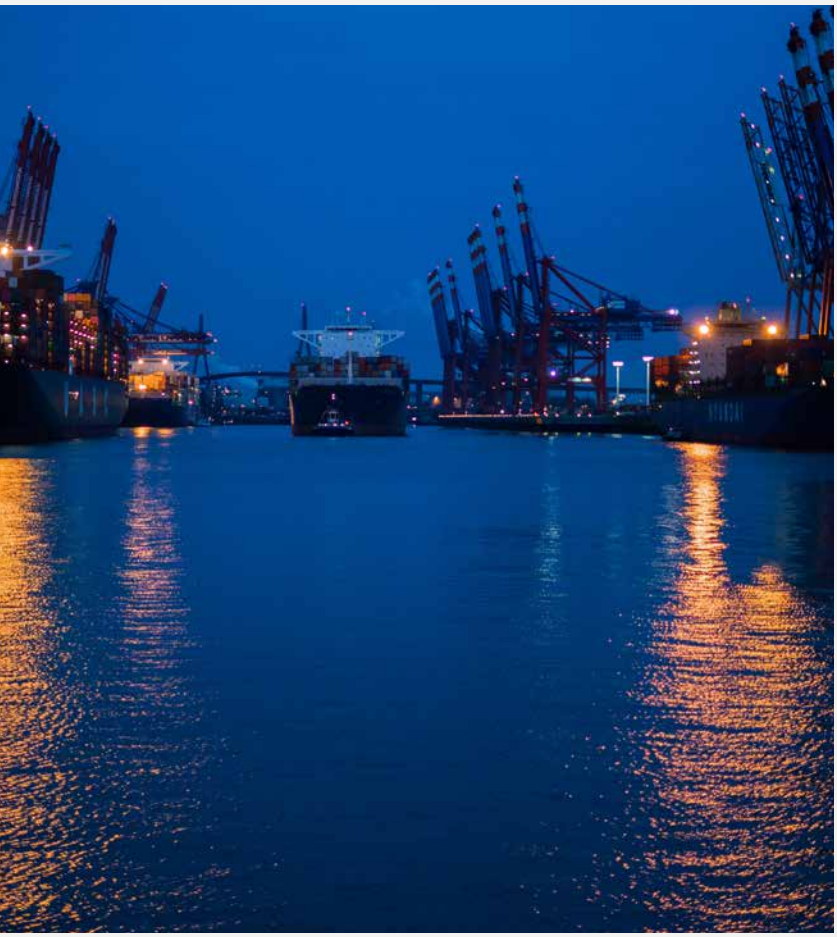
64 H.M. Government . (2021, March 1). Global Britain in a Competitive Age- the Integrated Review of Security, Defence, Development and Foreign Policy.

65 Cornell University, INSEAD, World Intellectual Property Organization. (2020). World Innovation Index 2020 - Who Will Finance Innovation?, 13th Edition.

66 (2021, March 1). GFCI 29 Rank - Long Finance. Retrieved from https://www.longfinance.net/programmes/financial-centre-futures/global-financial-centres-index/gfci-29-explore-data/gfci-29-rank/

67 ibid 65 xix

68 (2021, March 1). Tech Nation Report 2021 - The Future UK Tech Built. Retrieved from https://technation.io/report2021/



of support services including incubators, accelerators and grant funding initiatives. London in particular offers plentiful access to capital funding, a world class talent pool, and motivated political support for growth and foreign investment. The UK's capital city ranks ahead of all other cities in Europe for the number of higher qualified workers among the population.[69]

According to data from the Thetius intelligence platform, since 2008, the UK has produced the highest number of maritime technology businesses in the G7 that are connected to ship operations and management. This group, which represents about 41% of all UK maritime technology businesses, makes up just over 1/5th of businesses globally that operate within the vertical. The UK is also the second most abundant source of cloud computing, data and analytics, and artificial intelligence (AI) technologies for the maritime sector behind the United States of America.[70] These are also the most common areas of expertise for UK maritime technology sector businesses, making up about 58% of the UK maritime technology ecosystem, closely followed by process automation, robotics and hardware, and autonomous surface shipping, which collectively represent the next largest group at just over 39%.

Since 2019, opportunities for tech businesses operating in the UK maritime sector have increased, with the government announcing several initiatives designed to encourage investment and growth. In his 2021 spring budget, UK Chancellor of the Exchequer, Rishi Sunak, announced the formation of the UK's first 'infrastructure bank'. Based in Leeds, the bank, with close ties to the Treasury, invests in UK innovation and green technology infrastructure. Launched with £12bn ($16.6bn) of initial capital, the bank will leverage new sovereign green bonds over the coming years, bringing the estimated total investment to £40bn ($55.4bn). In addition, £7.9bn ($10.9bn) of direct investment in science and technology research has begun to roll out via the Department of Business, Energy and Industrial Strategy (BEIS).[71]

In the same budget announcement, Mr Sunak also declared 'freeport' status at eight of the UK's sea ports; Felixstowe, Harwich, Humber, Liverpool, Plymouth, Solent, Thames, and Teesside.[72]

69 Mayor of London. (2021). Local Skills Report 2021. Retrieved from https://www.london.gov.uk/sites/default/files/final_-_locals_skills_report_london_160321.pdf

70 Data Source: Thetius Intelligence Platform. Accessed 11 August 2021.

71 UK Government, Department for Business, Energy and Industrial Strategy (2021, May) BEIS Research and Development (R&D) Budget Allocations 2021 to 2022. Retrieved from https://www.gov.uk/government/publications/beis-research-and-development-rd-budget-allocations-2021-to-2022/beis-research-and-development-rd-budget-allocations-2021-to-2022

72 UK Parliament (2021), Financial Statement, Wednesday 3 March 2021, Hansard, Vol 690, Col. 261. Retrieved from https://hansard.parliament.uk/Commons/2021-03-03/debates/C8618796-C14D-4695-8DC0-20BC6C6DDED4/FinancialStatement?highlight=chancellor

*The aims of the maritime 2050 strategy are ambitious and form the basis for development across seven high level themes: UK competitive advantage, environment, infrastructure, people, security, technology, and trade.*

The UK freeport initiative is intended to boost redevelopment of the UK's coastal (and air) port infrastructure and promote regeneration and innovation on British soil. The government has pledged tax relief packages, simplified customs procedures, and streamlined planning procedures to establish freeports as national hubs for global trade and investment, promoting regeneration, job creation, and the establishing of hotbeds for innovation. The government announced the selected ports following a 12-week competitive bid process.

Remaining central to all UK state maritime ambitions is the 'Maritime 2050 Strategy', published by the government in January 2019.[73] The strategy aims to recognise the critical role that the UK maritime sector plays in the growth and development of the country, and build a fresh approach to harnessing the sector for the future. As the UK looks to 'reframe its relationship with the world', the government has placed its maritime asset base and skill set at the very heart of strategic government policy for the next three decades.

The aims of the Maritime 2050 Strategy are ambitious and form the basis for development across seven high level themes: UK competitive advantage, environment, infrastructure, people, security, technology, and trade. Now over two years in, what progress has the UK made towards setting the trajectory required to meet these aims?

## PROGRESS TOWARD MARITIME 2050

Inevitably, COVID-19 has impacted upon delivery of the Maritime 2050 strategic aims so far. For example, trade missions, exhibitions, and international engagements have been impossible throughout much of 2020-21, and government finance has met with levels of spending demand which are unprecedented in peace time. However, there are reasons for industry optimism, and the UK has made some progress towards a more integrated, more competitive, and more valuable UK maritime sector.

In preparing this report, Thetius conducted a detailed analysis of UK government progress towards the aims of its Maritime 2050 Strategy. The result of this study was that progress has been greatest in the following themes: trade (72% complete), technology (73%), people (70%), and UK competitive advantage (68%), with the least evidence of progress found under the themes of environment (53%), and infrastructure (50%). Security and resilience (57%) is a difficult theme to assess in terms of progress, due to restrictions on public information, but there is evidence of some progress in this area. See Fig.1.

73 Department for Transport (DfT). (2019). Maritime 2050: Navigating the Future. Retrieved from https://www.gov.uk/government/publications/maritime-2050-navigating-the-future

**FIG 1:** PROGRESSION TO DATE TOWARDS THE SHORT-TERM (1-5 YEAR) RECOMMENDATIONS OF THE 2019 MARITIME 2050 STRATEGY REPORT, GROUPED BY THEME.

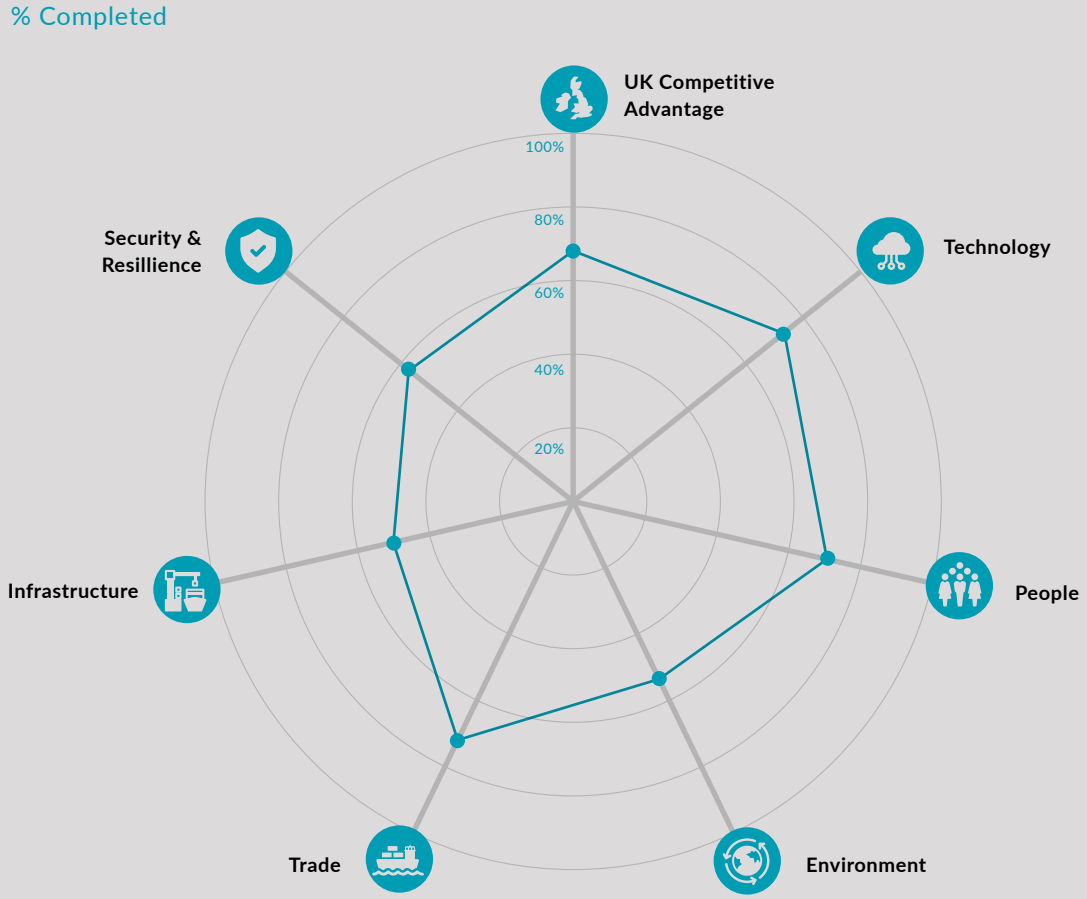



**Fig 1.** Progress Toward Completion of UK Government Stated Aims of The Maritime 2050 Strategy, Grouped by Theme. Method: Factor analysis using multimodal assessment criteria on a scale of 0-5: 0 = no progress, 1 = indication of at least one step taken, 2 = output identified with limited evidence of impact, 3 = Evidence of some impactful progress and/or continuing commitments met, 4 = Measurable and impactful progress achieved, 5 = Aim completed in full. Derived from multiple source materials.

*There are reasons for industry optimism, and the UK has made some progress towards a more integrated, more competitive, and more valuable UK maritime sector.*

Here we discuss key progress towards the seven core themes of the Maritime 2050 Strategy.

## COMPETITIVE ADVANTAGE

Activity to reinvigorate a competitive UK maritime sector has been underway domestically and internationally since 2019. Channels of communication between government and industry have remained open via a number of organisations such as Maritime UK, the Maritime Exports and Investments Group, the Clean Maritime Council, the Maritime Skills Commission, and other non-governmental organisations such as the Institute of Marine Engineering, Science, and Technology (IMarEST). The Department for Transport (DfT) maintained their leadership position during the height of the pandemic by (among other things) establishing the Restart and Recovery Steering Group, which involved maritime transport interests.

The UK was the first G7 economy to legislate for net zero carbon emissions as far back as 2008 with its Climate Change Bill. It subsequently published a clean maritime plan in 2019, setting out a number of short and medium term aims for improving the environmental outcomes of the UK maritime network (see Environment section on p.29).

In 2019, as a result of recommendations in the clean maritime plan, the UK established a new maritime research and innovation body called MarRI-UK. MarRI-UK is a 'collaborative innovation vehicle' bringing together industry and academia to tackle innovation and technology challenges in the UK. The body focuses on research and innovation projects with technological readiness levels (TRLs) of between 3 and 7; or from 'an experimental proof of concept' to 'system prototype demonstration in an operational environment'.[74] Their principal aim is to 'increase the global competitive position of the UK maritime sector'. MarRI-UK acts as a portal for central government funding via a series of sector or topic specific calls.

Internationally, the UK Ship Register remains a high quality option on the white list of Paris MOU flag state registries, having once more been awarded US QUALSHIP 21 status by the US Coast Guard (USCG) in July 2021. However, the UK flag has suffered a decline in fleet size in recent years, with the UK flag representing just 0.5% of the global trading fleet by deadweight tonnage at the end of 2019. Recognising the issues, the UK Maritime and Coastguard Agency (MCA) who operates the ship register, had already published recommendations designed to make the flag more competitive back in 2015,[75] including proposals to further distance the register from the UK maritime regulatory function. Rumoured changes to the UK Tonnage Tax regime following Britain's

74 For more information, see (n.d.). House of Commons - Technology and Innovation Centres - Science and Technology Committee. Retrieved from https://publications.parliament.uk/pa/cm201011/cmselect/cmsctech/619/61913.htm

75 Department for Transport (DfT). September 2015. Maritime Growth Study: Keeping the UK competitive in a global market. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876791/maritime-growth-study-keeping-UK-competitive.pdf

*Alongside the economic and strategic potential of the UK maritime sector, Maritime 2050 acknowledges the environmental impact of shipping and related supply chain activities.*

exit from the EU,[76] may also make the UK flag more commercially attractive to ship owners and increase interest from shipping companies to relocate to the UK, but the government is yet to announce official plans.

London has long been a leading centre for commercial, financial, and legal services to the shipping industry. However, ship ownership and operation has been largely dominated by overseas interests, with UK-owned ships representing about 4% of the world trading fleet according to the DfT Shipping Fleet Statistics 2019. While far from an indication of resurgence, London did deliver its first ship owning Initial Placement Offering (IPO) for four years when Taylor Maritime Investments (ticker: TMIP) debuted on the London Stock Exchange in May 2021, achieving a market capitalisation of $253m.[77]

## ENVIRONMENT

Alongside the economic and strategic potential of the UK maritime sector, Maritime 2050 acknowledges the environmental impact of shipping and related supply chain activities. Among a number of long-term goals in its 2019 Clean Maritime Plan,[78] the government set out a number of short term objectives to complete by the end of 2020. Thetius estimates that around 70% of the initial steps set out in the plan have been achieved to date, but there have been some significant omissions. For example, the government is yet to establish the Maritime Emissions Regulation Advisory Service (MERAS), scheduled for launch by the end of 2020. International commercial law firm Hill Dickinson LLP also highlighted the government's apparent failure to deliver on a commitment to launch a call for evidence on non-tax incentives to support the transition to zero emission shipping by the end of 2020.[79] In their 2021 Transport Decarbonisation Plan,[80] the DfT indicated that consultations will now be conducted in 2022, as part of a refresh to the clean maritime plan.

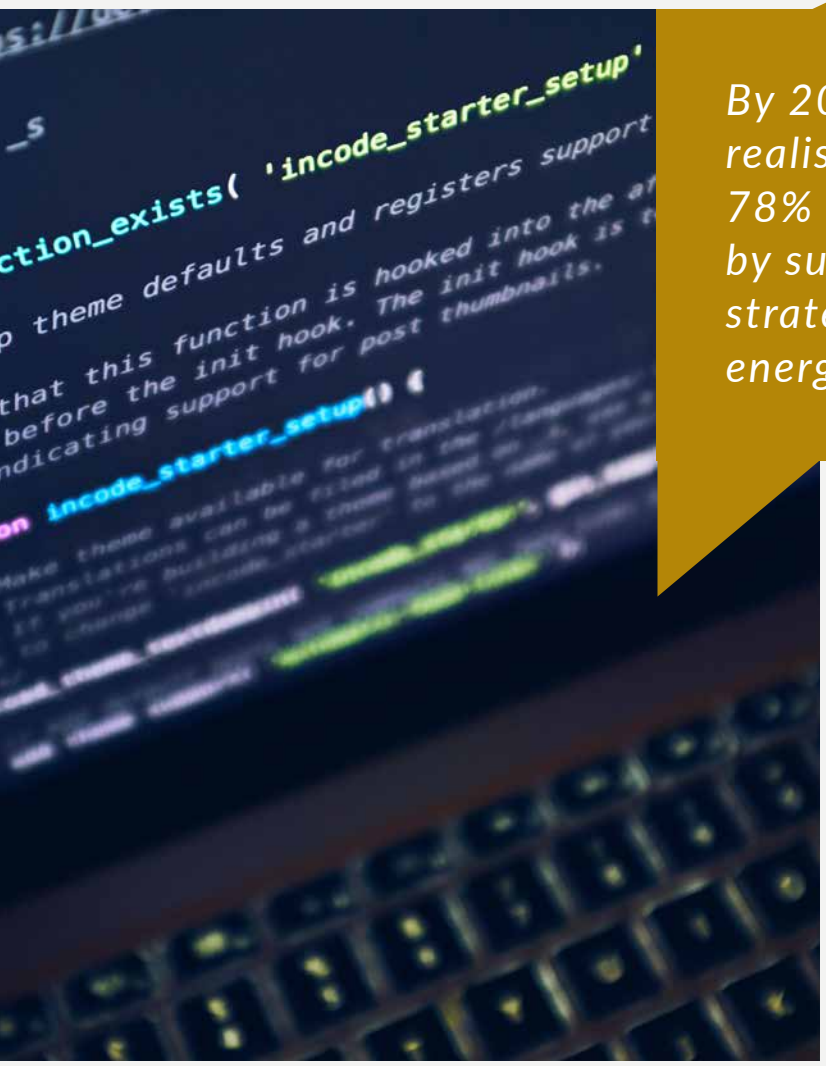
76 Lloyd's List. (2020, December 16). UK plans to rival Singapore are more proposal than policy. Retrieved from https://lloydslist.maritimeintelligence.informa.com/LL1135153/UK-plans-to-rival-Singapore-are-more-proposal-than-policy

77 Taylor Maritime Investments Limited. (2021, May 24). Results of Initial Public Offering. Retrieved from https://polaris.brighterir.com/public/taylor_maritime_investments/news/rns/story/rg7yo7r

78 Department for Transport (DfT). (2019, July 1). Clean Maritime Plan. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815664/clean-maritime-plan.pdf

79 Hill Dickinson LLP. (2021, January 27). Decarbonisation and shipping: The UK's position on greenhouse gas emissions from shipping - Lexology. Retrieved from https://www.lexology.com/library/detail.aspx?g=654fd973-2f9f-494b-a4a2-b2fdc5c116b0

80 Department for Transport (DfT). (2021). Decarbonising Transport - A Better, Greener Britain. Retrieved from https://www.gov.uk/government/publications/transport-decarbonisation-plan




*By 2035, the overall aim is to realise carbon reductions of 78% compared to 1990 levels, by supporting decarbonisation strategies in transport, energy, and infrastructure.*

In November 2020, the UK Prime Minister announced a ten point plan to support a country-wide transition to net-zero carbon emissions. By 2035, the overall aim is to realise carbon reductions of 78% compared to 1990 levels, by supporting decarbonisation strategies in transport, energy, and infrastructure. With reference to maritime trade, the plan introduced a DfT 'Clean Maritime Demonstration Competition' for innovative clean maritime and smart shipping projects. The competition was posited as a one-year 'springboard programme', executed alongside trade body Maritime UK and growth facilitators KTN. The competition closed in June 2021, and results were announced at London International Shipping Week in September. 55 innovation projects, involving over 170 UK businesses and academic institutions, were granted a share of just over £23m ($31m) in grant funding. The highest single project grant was just over £2.0m ($2.7m), towards designing, building, and testing an electric charge point situated on a wind turbine. The project will be run by a consortium including engineering company MRJ Controls, technology companies Artemis Technologies and XceCo Ltd., and crew transfer vessel (CTV) operator Tidal Transit, with support from the Offshore Renewable Energy Catapult. The project will access existing infrastructure on offshore wind turbines to provide renewable electricity to electric crew transfer vessels (eCTV). The highest single award for a pre-launch feasibility study, totalling just over £600,000 ($808,000), was awarded to Bluewater Engineering Limited, to fund research and development activities for their innovative SKYTUG concept. Still in the concept phase, SKYTUG intends to decarbonise ocean freight transport by connecting ships to kite-powered tugs, providing clean propulsion without requiring purpose designed ships or costly capital expenditures from shipping companies. The business model would be akin to carbon-free-propulsion-as-a-service, leaving ship operators a choice of more conventional ship designs that lend themselves readily to voyaging in unfavourable wind conditions, and that have more familiar maneuvering characteristics.

## INFRASTRUCTURE

Maritime 2050 set out a series of support measures for UK sea ports, principally focussed around access to capital, support for planning and development activities, strengthening public and private sector partnerships for strategically significant ports, and enhancing UK transport network connectivity.

In September 2019, the government announced that it had formed the first Port Economic Partnership (PEP) between the DfT and Port of Southampton, operated by Associated British Ports Holdings Ltd. (ABP). Set out in the Maritime 2050 document, PEPs are a key output designed to offer government assistance to strategically significant ports. Southampton also serves as an example of the Maritime 2050 ambition to improve freight connectivity in the UK, announcing the completion of a major improvement scheme to increase to 775m the maximum length of train the port's branch line can accommodate. That equates to new capacity to transport up to 84 more containers per day on their Freightliner-operated service alone.

In July 2020, The UK government announced a £705m ($952m) borders fund to help prepare for new paradigms outside of EU and customs union membership. The funding was welcomed by the British Ports Association (BPA), but met with some criticism from parliamentary opposition parties, who believed the funding was insufficient and untimely. However, the government followed up in October 2020, launching a further £200m ($269m) Port Infrastructure Fund,[81] offering further support to sea ports, air ports, and rail terminals with EU freight connections in implementing new infrastructure to facilitate customs clearance and sanitary checks.

*Maritime 2050 sets out a standing commitment to UK maritime security in home waters, but also commitments to continue support for an international rules-based system of maritime security and law enforcement.*

## PEOPLE

Maritime 2050 describes several central commitments concerning people in the maritime sector, mainly based around training and education, career development, diversity in the maritime workforce, and considering the human element in the face of technological change.

The government built on these commitments by publishing its People Route Map in September 2019, which describes five key focus areas for the government: inspiring people; expanding the talent pool; skills and training; career progression; and social frameworks.

The government has partnered with industry bodies like Maritime UK and the Institute of Chartered Shipbrokers (ICS) to begin delivering on some of these objectives. In 2020, the government established the Maritime Skills Commission (MSC) jointly with Maritime UK, using £300,000 ($404,000) of DfT funding. The commission is tasked with ensuring that the maritime sector has a suitable talent pool from which to source the shipping, ports, engineering, leisure marine, science, and professional services workforces that are fit for the future.

81 Cabinet Office. (2020, October). Port Infrastructure Fund - Fund Prospectus. Retrieved from https://www.gov.uk/government/news/200-million-port-infrastructure-fund-opens-for-bids#:~:text=Port%20Infrastructure%20Fund%20Fund%20Prospectus%20-%20October%202020

To support today's seafarers, UK national minimum wage legislation was expanded in October 2020 to include seafarers working on any ship within UK territorial waters, operating from UK ports and remaining within the continental shelf, or who have other demonstrable links to the UK.

In February 2021, the UK Chamber of Shipping, Nautilus International, and the Rail, Maritime and Transport Workers (RMT) union, jointly published guidance to shipping companies on improving mental mental wellbeing. The guidance highlights the importance of internet connectivity on generational recruitment among other recommendations and signposts a number of resources that shipping companies can use to improve mental health among their crews.[82]

*However, more focussed efforts have also been established to develop smart port concepts in the UK, and promote the use of emerging digital technologies in coastal and seagoing industries.*

## SECURITY

The UK National Strategy for Maritime Security (NSMS) is scheduled for revision later this year in the forthcoming 2021 edition. As suggested earlier in this report, the global geopolitical and economic landscape has continued to shift since the UK published the current strategy in 2015, and cyber security and threats involving novel technologies are continuing to grow in prominence.

In 2019, the government formed the Joint Maritime Security Centre (JMSC), which is responsible for ensuring the UK maintains effective oversight of the maritime security domain and develops the framework by which the UK can respond to maritime threats. It is jointly-funded by the DfT, Ministry of Defence (MOD), and The Home Office, but received additional funding and support from over 15 Whitehall agencies and departments.

Maritime 2050 sets out a standing commitment to UK maritime security in home waters, but also commitments to continue support for an international rules-based system of maritime security and law enforcement. Reports on progress against these targets are anticipated in the 2021 NSMS document when it is released.

82 UKCS et al. (2021, March), Practical Guidance for Shipping Companies on Improving Mental Wellbeing. Retrieved from https://www.ukchamberofshipping.com/documents/1086/Mental_health_guidelines_-_2_-_full_document_-_2018.pdf

*The route map goes to identify four core technology groups that the government believes will be pivotal enablers of maritime autonomy; data and data analytics, AI and machine learning, advanced sensor technology, and improvements in robotics.*

## TECHNOLOGY

Some of the initiatives aimed at propelling technological development forward in the UK maritime sector have already been covered, such as the establishment of MarRI-UK and the Clean Maritime Demonstration Competition. However, more focussed efforts have also been established to develop smart port concepts in the UK, and promote the use of emerging digital technologies in coastal and seagoing industries.

In January 2019, the government published a technology route map, which builds on the technology themes in Maritime 2050.[83] Similar to other route maps, this one identifies five key themes: government leadership and direction setting; infrastructure, support the development of smart shipping technologies; developing future skills; and regulating maritime autonomous systems.

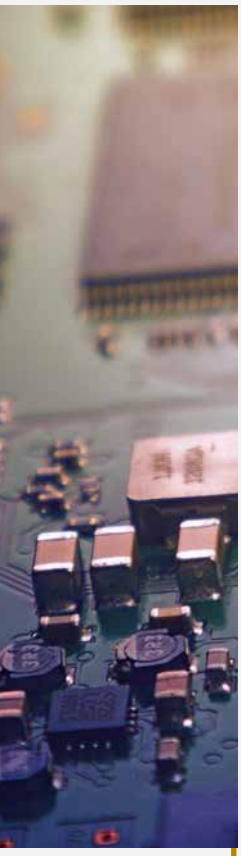
The route map puts a strong emphasis on autonomous systems in maritime, and discusses the government's role in helping new technologies bridge what it refers to as the 'valley of death' between research and commercialisation—where viable concepts fail to transition to commercial revenue and investment models. Through a series of accelerators, networking events, and 'hackathons', the government sees its role as that of a facilitator—the connecting tissue that brings various industrial players together. It also has a role in raising awareness of the industry, combatting what it calls 'sea blindness' among the wider population. A key partner in this will be CSmart, a maritime training provider run by Carnival Cruises and based at the Arison Maritime Center in the Netherlands.

The route map goes to identify four core technology groups that the government believes will be pivotal enablers of maritime autonomy: data and data analytics, AI and machine learning, advanced sensor technology, and improvements in robotics. The report notes that the government believes these technologies will have a far broader impact on the future of society, beyond the maritime sector alone.

The route map announced the establishment of the Maritime Innovation Lab (MARLab) to 'pioneer innovative regulatory approaches to Maritime Autonomous Ships (MASS)'. The project set out to create a regulatory framework that facilitates testing of autonomous vessels. The MCA operated MARLab from the Marine Robotics Innovation Centre at the National Oceanography Centre (NOC) in Southampton, using £1.0m ($1.3m) of funding provided by BEIS. At the conclusion of the 2-year MARLab project in September 2020, the MCA announced that they had established a Maritime Future Technologies (MFL) team to facilitate implementation of MASS trials and development projects moving forward. The MARLab project produced some useful work, and despite experiencing setbacks in procurement and difficulties around data protection, delivered on all but one of its key aims - a policy lab regulation workshop with industry. Notably, MARLab worked closely with the Anglo Belgian Shipping Company on design concepts for an autonomous short sea container service between the UK, Netherlands and Belgium.[84]

83 Department for Transport (DfT). January 2019. Technology and Innovation in UK Maritime: The Case of Autonomy - A Maritime 2050 Route Map. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/877630/technology-innovation-route-map-document.pdf

84 Maritime & Coastguard Agency (MCA). November 2020. Maritime Autonomy Regulation Lab (MARLab) Report. Retrieved from https://www.gov.uk/government/publications/maritime-autonomy-regulation-lab-marlab-report/maritime-autonomy-regulation-lab-marlab-report



## TRADE

Since leaving the EU, the UK has sought to sign new trade agreements with EU and non-EU states. At the time of writing, the UK has secured free trade agreements with the EU and Japan, and is prioritising working on agreements with the United States, Australia, and New Zealand. The UK is also considering joining the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and has extant agreements with over 60 other foreign nations.

The UK has also signed mutual recognition agreements (MRAs) with Australia, New Zealand, and the US, in which there is mutual recognition of the results of one another's conformity assessments. These agreements are an important precursor to successful trade deals.[85]

As previously discussed, the establishment of eight freeports in England will be an important factor in UK trade facilitation in the coming years, and the devolved administrations in Scotland, Wales, and Northern Ireland are considering the viability of their own freeport programmes.

Though not one of the ports selected for freeport status, the Port of Tyne was announced as the UK's first Maritime 2050 Innovation Hub in 2019. The first and only such innovation hub in the UK, the port has played host to a number of events that bring together technology innovation and industry from different sectors to collaborate on new ideas and share new concepts and strategies. Key partners include PD Ports, Nissan, Royal Haskoning DHV, Ubisoft, and the Department for Transport. It is hoped that this innovation hub will be a valuable test bed for developing new smart port concepts.

The UK remains a country to watch when it comes to maritime technological innovation. The government has demonstrated an ambition to build upon the UK's maritime heritage and asset base and have provided a suite of measures, including working groups, initiatives, and sources of funding to further these aims. However, political and economic shocks have had an ameliorating effect on progress and a number of tasks that the government had aimed to achieve by now are yet to be completed.

The data collected in the progress study suggests an average of around 63% progress overall toward the aims set out in the strategy framework. It is important to note however, that some of these aims are intended to be long-term, so while the Thetius study looked for evidence of progress in all of the government aims, completion was not expected in some cases for some time to come.

Overall, the picture looks encouraging. There may be debates over the effectiveness of the levels of funding, or whether the aims of the maritime 2050 strategy go far enough to prepare the UK to restore its competitiveness on the global maritime stage. There can be no doubt however, that the principal opportunities, threats and probabilities for technological disruption have been addressed by the government in recent years. As it reaches out to form alliances and partnerships that will help it navigate a new global future, the UK has made a commitment to put maritime technology at the heart of government strategy for decades to come.

85 UK Government - Department for International Trade (DIT). 19 July 2021. UK trade agreements with non-EU countries. Retrieved from https://www.gov.uk/guidance/uk-trade-agreements-with-non-eu-countries

# THE GLOBAL VIEW: TACKLING DECARBONISATION WITH DIGITAL TOOLS

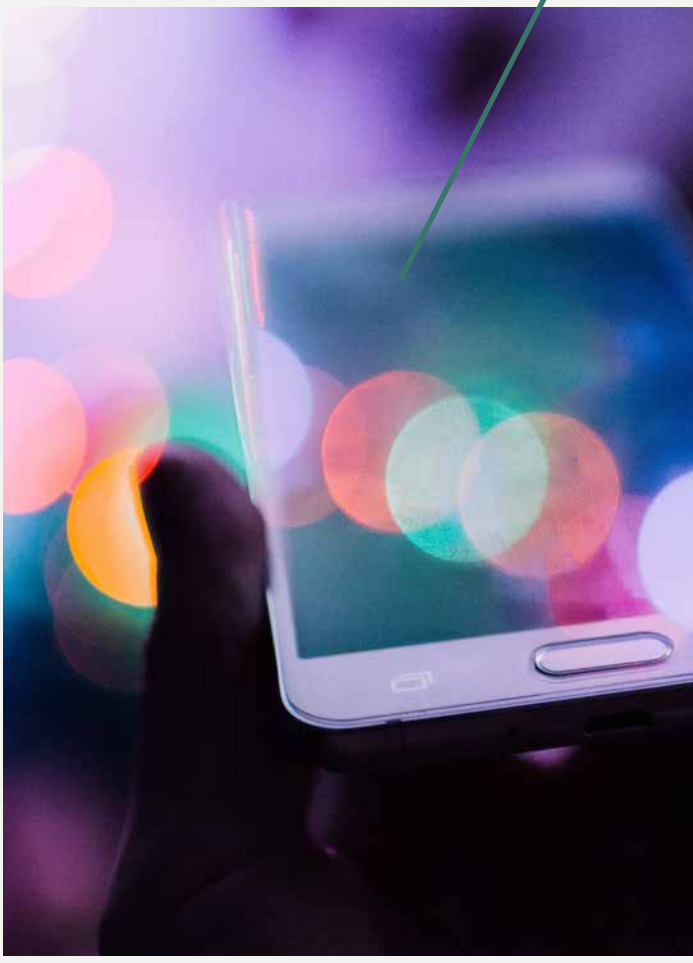
The global transport economy was built on fossil fuels and the automotive industry of the 20th century offers us valuable lessons on the resistance to change, even when the data clearly calls for it.

The 1920s was the decade of the motor car boom. Between 1907 and 1928, the production of motor cars in the US increased by nearly one hundred fold, from just 45,000 vehicles to 4.4 million.[86]

Early on in the decade, a new invention that promised to drastically increase the performance of internal combustion engines was introduced.

Adding lead to petrol had a dramatic increase on a car's performance, boosting the engine's power output, improving efficiency, and reducing maintenance. The innovation came along at the same time as fuel manufacturing was being scaled up to serve the rapidly growing demand from consumer motorists. The additive was cheap to manufacture and was quickly adopted by petrol refineries around the world after being rolled out in 1921.

Just three years later, in 1924, a worker at a petrol refining plant in New Jersey began hallucinating. The next day he was running around the plant screaming in



86 Bradford DeLong, J. (1997). Slouching Towards Utopia? The Economic History of the Twentieth Century. Berkeley: University of California.

*The lessons that can be drawn from the phase out and eventual ban of leaded petrol are plentiful when applied to the biggest challenge facing the global maritime industry today.*

terror. Two days later he was dead. Four more of his colleagues died within the next week, and 35 of the 49 employees at the plant ended up seriously ill in hospital. The cause of the mass sickness was lead poisoning, brought about by the leaded petrol manufacturing process in use at the plant.

Even at the time, the connection between lead and poisoning was well known. Despite that, it took campaigners and scientists another five decades before any action was taken to remove lead from petrol. Over the following decades, scientists found that the use of leaded petrol was linked to heart disease, cancer, strokes, brain development, and even levels of violent crime.[87]

The additive began to be phased out in the 1970s, through economic incentives, changes to car designs, and eventually outright bans. But it wasn't until the late 1990s that major economies began to ban the sale of leaded petrol at the pumps. The United States banned its sale in 1996, with the UK and EU eventually following suit in 2000.

Surprisingly however, it would be a further two decades before the UN finally declared that lead had been eradicated from all petrol pumps. Algeria became the last country to ban the use of leaded petrol, finally depleting its stockpile in June 2021.

Despite the risks being known from the outset, and stark evidence of its potential to take lives it took nearly a century for the world to fully move away from the additive.

Part of the reason for this is that research funded by highly vested interests obscured the real damage done by lead poisoning for many years. But by the time the true damage was known, leaded petrol was so fully ingrained in the automotive industry, the fuel supply chain, and consumer behaviour, that moving away from it seemed almost impossible.. The cost of modifying older car engines to run on unleaded fuel, the marginally higher cost of the fuel itself, and the slow roll out of the fuel to petrol stations, meant that even in advanced industrialised countries, switching over to the new fuel took many decades.

The lessons that can be drawn from the phase out and eventual ban of leaded petrol are plentiful when compared to the biggest challenge facing the global maritime industry today. The decarbonisation of global shipping will require an overhaul of the industry comparable with converting to unleaded road fuels, but on a much larger scale.

87 Wolpaw Reyes, J. (2007). Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime. National Bureau of Economic Research. Retrieved from https://www.nber.org/system/files/working_papers/w13097/w13097.pdf

## THE SCALE OF THE PROBLEM

According to research by UCL, the decarbonisation of the global shipping fleet to the extent required to hit the IMO's 2050 goal, will require investments of $1 - $1.4tn in new technology over 20 years. The investment required to fully decarbonise the world fleet in the same timeframe will be $1.4 - $1.9tn.[88]

Despite the enormity of the challenge ahead, there is reason to be optimistic. Innovators around the world are developing solutions that have the potential to drastically improve or completely remove the carbon footprint of global shipping. New technologies that have the potential to contribute to the decarbonisation of the industry can be broadly split into three areas; operational efficiencies, future fuels, and fuel infrastructure. Though digital technology has a role to play in all three areas, it is the first where the potential impact is highest.

*According to research by UCL, the decarbonisation of the global shipping fleet to the extent required to hit the IMO's 2050 goal will require investments of $1 - $1.4tn in new technology over 20 years.*

## DECARBONISATION THROUGH OPERATIONAL EFFICIENCY

Though it will take many years of research to fully understand the potential of carbon neutral fuels, there are immediate steps the industry can and already is taking towards decarbonisation. These centre around the use of digital tools to make improvements to the ton-mile efficiency of vessels sailing today.

Though shipping is the world's most efficient form of transport, it is littered with inefficiencies. Whether it is in how a ship is routed, its arrival and departure times in port, or simply the way it is maneuvered, there is a significant potential to make gains through more efficient operations. Capturing these gains doesn't necessarily require the use of expensive modifications to the vessel either. The simple use of software tools that can aid decision making can make a big impact.

One such example is Styrsöbolaget, a Swedish ferry operator that owns a fleet of 18 vessels. When trying to find ways to reduce their fuel consumption they installed an energy management system offered by Blueflow, a Stockholm based marine technology company, on four of their vessels. The system measures fuel consumption from all of the equipment on board, and allows the crew to gain a better understanding of how operational behaviours impact upon fuel consumption whilst operating the ship.

During the initial trial, some captains were able to achieve a 50% reduction in fuel consumption by making simple changes to how they accelerate, decelerate, and handle the vessel during mooring operations. After being rolled out to the entire fleet of 18 ships, the system has been able to support the ships' officers in achieving consistent fuel consumption reductions of 20-25% along the operated routes.[89]

88 Carlo, R., Jean Marc, B., de la Fuente Santiago, S., Smith, T., Sogaard, K. (2020). Aggregate Investment for the Decarbonisation of the Shipping Industry. Retrieved from https://www.globalmaritimeforum.org/content/2020/01/Aggregate-investment-for-the-decarbonisation-of-the-shipping-industry.pdf

89 Blueflow Energy Management AB (n.d.). Case study - Styrsöbolaget AB. Retrieved from https://www.blueflow.se/case-1/

*Though it may be possible for heavy optimisation to achieve much of the 2050 goal set by the IMO for existing tonnage, it is a certainty that as well as running a fully optimised operation, new tonnage will need to be capable of running on a range of different fuel types.*

Examples such as the one offered by Blueflow are typical of simple digital solutions that have the potential to make a major impact on vessel emissions. These solutions are often mostly software based, with relatively low hardware costs, and a fast payback time for owners and operators who choose to install them.

Norwegian startup Yxney Maritime has developed a cloud based software solution that combines data from AIS, the fleet management software suite, and a range of third party platforms to produce analysis and insight that can enable fleet management and ship's officers to make better day to day operational decisions about the vessel's handling, but also to accurately assess the impact of specific initiatives to reduce emissions. Yxney's software suite requires no hardware, meaning it can be easily scaled to an entire fleet. The software is currently in use on 300 offshore vessels, and was able to produce a 3.6% increase in operating efficiency during 2020, resulting in a 60,000 ton $CO_2$ saving for their customers.[90]

Vessel performance optimisation software is attracting the interest of investors too. In the 12 months to August 2021, $79m was invested in startups developing technology for the ship management and operations sector.[91] One of the recipients of investment funding was Greek vessel performance software startup Deepsea Technologies. Their platform uses a combination of data science and AI to produce a fleet efficiency rating for a vessel operator, and create actionable insight into how it can be improved. In July this year, Deepsea raised $5.9m from investors including Japanese engineering conglomerate Nabtesco, and Signal Group - a Greek ship management and technology firm.[92]

As well as investing in Deepsea Technologies, Signal Group's ventures arm has backed a number of other startups in the space including BunkerMetric, a bunkers rating and procurement platform; StormGlass, a weather data API; and HarbourLab, a process optimisation platform for maritime stakeholders.

This underscores the wider emerging trend for ship operating businesses investing in, starting, or accelerating technology ventures. This is particularly true in the decarbonisation space, where Maersk Tankers has spun out voyage optimisation platform ZeroNorth; Stena Bulk has spun out their machine learning based reporting tool OrbitMI into a separate venture; and Bernhard Schulte Ship Management has invested in behavioural science startup Signol.

Though it may be possible for heavy optimisation to achieve much of the 2050 goal set by the IMO for existing tonnage, it is a certainty that as well as running a fully optimised operation, new tonnage will need to be capable of running on a range of different fuel types, ranging from traditional fossil fuels to new carbon neutral fuels that are still in development.

90 Yxney Maritime (n.d.). Data Driven Decarbonization. Retrieved from https://www.yxney.com/

91 Thetius Intelligence Platform, 2021

92 Smart Maritime Network. (2021, July 30). DeepSea Technologies raises €5m in new funding. Retrieved from https://smartmaritimenetwork.com/2021/07/30/deepsea-technologies-raises-e5m-in-new-funding/

*Achieving genuine carbon neutrality will require a slew of other technologies including the use of alternative fuels such as hydrogen, ammonia, waste biofuels, battery, wind, and solar power.*

## SOURCING THE FUELS OF THE FUTURE

The focus of this report is on the digital transformation of the world's commercial maritime industry, and the development of future fuels will be covered in more detail elsewhere. Therefore the development of future fuels and the infrastructure required to supply them falls outside of its remit. But it is of note that a range of digital tools will be available to help support the transition. On the landside, the use of artificial intelligence in energy management is growing. Companies such as BluWave AI are leading in this area. The company develops smart grid solutions for landside infrastructure that can help balance energy needs of a grid against available renewable sources such as wind, stored energy, and tidal.[93]

The benefits of increased operational efficiency brought about through digital tools can only go so far. Achieving genuine carbon neutrality will require a slew of other technologies including the use of alternative fuels such as hydrogen, ammonia, waste biofuels, battery, wind, and solar power. Further, carbon capture will also likely be required to offset the fossil fuels that will still be in use as we approach 2050.

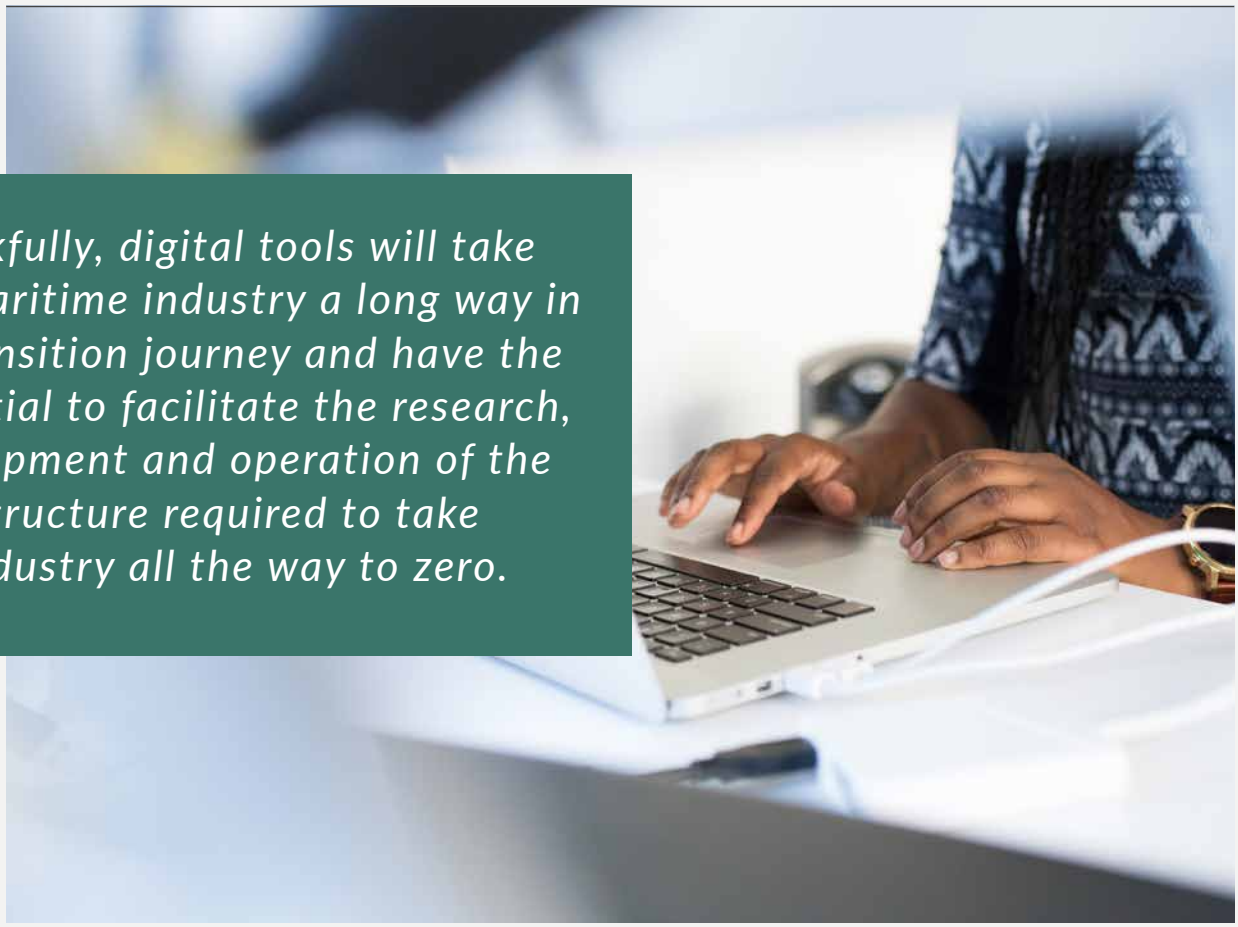
Shipping giant Maersk has already made steps in this direction. After committing to becoming a net-zero ship operator by 2030, in February 2021 the company announced that all future newbuilds will be able to run on carbon neutral fuels.[94] In August this year, the container line purchased eight new 16,000 TEU vessels at a cost of $1.4bn, that can be run on either fossil fuels or green ammonia. Similar moves have been made by tanker operator Euronav, who has also ordered dual fuel ships that could run on ammonia.[95]

It is highly likely that during the maritime industry's energy transition, predictive analytics and AI will play an important role in balancing the supply and demand for different fuel types, ensuring the right fuels are in the right locations at the right time and technologies such as those in development for landside infrastructure by BluWave AI will be critical in the maritime industry too.

93 (n.d.). BluWave-ai, Artificial Intelligence for Clean Energy. Retrieved from https://www.bluwave-ai.com/about-us

94 Ship Giant Maersk Bids Farewell to New, Fossil-Fuel Only Ships, Wittels, Bloomberg, 2021, retrieved from https://www.bloomberg.com/news/articles/2021-02-17/ship-giant-maersk-bids-farewell-to-new-fossil-fuel-only-ships

95 Maersk Makes $1.4 Billion Green Bet on Methanol-Fueled Ships, Wittels, Bloomberg, 2021, retrieved from, https://www.bloomberg.com/news/articles/2021-08-24/maersk-makes-1-4-billion-green-bet-on-methanol-powered-ships



*Thankfully, digital tools will take the maritime industry a long way in its transition journey and have the potential to facilitate the research, development and operation of the infrastructure required to take the industry all the way to zero.*

As well as balancing supply with demand, AI has a role to play in the development of future synthetic fuels too. In 2019, the US Department of Energy unveiled their new supercomputer; Joule 2.0. The giant computer has the same memory as 68,000 desktop PCs and has a network bandwidth of 83.2 terabytes per second. That's enough capacity to simultaneously stream 10.4 million high-definition movies on Netflix. The computer can perform in one second, the same number of calculations that would take one billion gifted mathematicians 56 years to complete.[96]

That enormous computing power is being put to use to model new energy technologies and solve complex calculations that will ultimately feed into the development of technological solutions to America's energy challenges. The ultimate aim is to reduce the cost and time it takes to create new physical technologies such as developing combustion processes that can use alternative fuels or optimising chemical reactor designs.

As the world begins to recover from the initial shock of a pandemic that looks likely to become endemic, the industry must look ahead to the looming challenge of decarbonisation. There is now clear consensus that the disruption caused by COVID-19 will pale into insignificance when compared with the issues caused by climate change and time is running out to mitigate their impact.[97] It took nearly a century to remove lead from petrol. Removing carbon from the energy mix is a challenge that is orders of magnitude larger, that must be achieved on a timescale that is orders of magnitude smaller. Thankfully, digital tools will take the maritime industry a long way in its transition journey and have the potential to facilitate the research, development and operation of the infrastructure required to take the industry all the way to zero.

96 Joule Supercomputer, Joule NETL, Department of Energy, 2019, accessed 2021, retrieved from https://netl.doe.gov/sites/default/files/rdfactsheet/R-D190_2.pdf

97 Sixth Assessment Report, Working Group I, IPCC, UN, 2021, retrieved from https://www.ipcc.ch/report/ar6/wg1/

# CONCLUSION AND RECOMMENDATIONS

This report has explored in depth the first order effects of COVID-19 on the global maritime industry's digital transformation. The pandemic made investing in IT infrastructure a condition of survival, and the ensuing growth in spend on digital products and services has catapulted the industry ahead by three years compared to pre-pandemic forecasts.

*It is clear that while the industry has undergone a rapid shift, true transformation is still some way off.*

*Reinventing logistics, trade and business models, based on data-driven revenue streams and shifts in trade flows will likely take some time yet.*

It is clear that while the industry has undergone a rapid shift, true transformation is still some way off. The industry is still a long way away from UNCTAD's third stage of digitalisation; reinventing logistics, trade and business models, based on data-driven revenue streams and shifts in trade flows will likely take some time yet. But the shocks caused by the pandemic have caused a jolt, not just in maritime but in the wider supply chain and there is no doubt that true transformation is significantly closer than it was in 2019.

For the UK, the pandemic came alongside a far-reaching shift in the country's strategic direction. This shift takes the form of a post-Brexit 'global Britain', where both the maritime and technology industries play a high profile role. The UK's startups make a significant impact on the maritime industry, with no other nation in the G7 producing as many companies focused on the ship operations and management sector. In the public sector, the government has made some progress towards the short term measures of the Maritime 2050 strategy, particularly in technology, people and trade. But the pandemic has clearly derailed the timeline for some of the aims, particularly the pressing issue of the industry's environmental impact.

Efforts to decarbonise the maritime industry will need to eclipse both the impact of the pandemic and the UK government's concerted efforts to transform the industry. If those efforts are not coordinated with enough urgency, the industry will quickly become a world leading contributor of greenhouse gas emissions and face increasingly high public scrutiny. Digital tools have the potential to be a significant contributor to quickly reducing this impact. This is particularly important as carbon neutral fuels, and the infrastructure required for them to be practically useful in the industry are still many years away.

Below are three key recommendations based on the findings of this report. These recommendations are not exhaustive, but are aimed at providing a key next step to support the transformation of the industry for one of three parties; industry, government, and technology companies.

*Below are three key recommendations based on the findings of this report. These recommendations are not exhaustive, but are aimed at providing a key next step to support the transformation of the industry*

RECOMMENDATION

# 1. INDUSTRY: CREATE A LONG TERM TRANSFORMATION PLAN

For shipping companies and other large industry stakeholders we recommend creating a long term transformation plan. This plan should aim to address the route to decarbonisation, and take into account short (1-5 years), medium (5-15 years), and long (15-30 years) term time horizons.

Addressing decarbonisation is an issue that will impact every maritime business, whether a ship owner, chartering interest, third party manager, or industry service provider.

The pressure from the public to fully understand their own impact on the environment will mean that visibility into emissions from all aspects of the supply chain will become mandatory. Maritime will not be exempted from this. The same goes for regulation, with initiatives such as the EU's emissions trading scheme gathering pace and other similar local schemes being put on the table around the world. Further, financial services providers are moving increasingly towards only providing finance for those initiatives that can display green credentials.

It takes time to transform large companies, particularly those that are based on the operation of physical assets. It is therefore imperative for organisations to begin the journey of understanding how they will prepare for the future. This includes financing the changes required to be able to operate a net zero fleet within the next 20-30 years.

Though much of the technology to enable this change doesn't yet exist, this report demonstrates that significant emissions savings can be made today with the implementation of simple tools today. Further, a plan for financing future investments into technologies that don't yet exist is required. For the vast majority of industry stakeholders, decarbonisation is an enormous opportunity but only with the right long term plan in place. Those industry players who don't engage with this process will find it increasingly difficult to do business.

*It is therefore imperative for organisations to begin the journey of understanding how they will prepare for the future. This includes financing the changes required to be able to operate a net zero fleet within the next 20-30 years.*

RECOMMENDATION

# 2. UK GOVERNMENT: BOOST NON-FINANCIAL SUPPORT FOR INNOVATION

As evidenced earlier in this report, the UK has seen growing financial investment into maritime R&D. There is no doubt that further increases in financial support for startups will be important in encouraging renewed research into new maritime technologies. But non-financial support is equally important.

This is particularly true when it comes to one of the UK's biggest weak spots; taking new ideas from a proven concept to a commercially sustainable technology product or service.

*There is a burgeoning maritime technology ecosystem in the UK. Specialist areas such as marine robotics, autonomy and ship management are particularly strong.*

There is a burgeoning maritime technology ecosystem in the UK. Specialist areas such as marine robotics, autonomy and ship management are particularly strong. But building a self-sustaining innovation ecosystem that can tackle some of the global industry's biggest problems will require a more focused approach to bridging the gaps between industry, academia, and innovators.

In practical terms, on top of providing cash funding, this means facilitating better relationships between stakeholders through innovation centres such as the Port of Tyne's 2050 Innovation Hub. It means enabling startups to bridge the R&D "valley of death" and create commercially useful products through industry-focussed acceleration programmes such as Pier71, the Singapore government's maritime accelerator. Lastly, it means supporting industry stakeholders to set up their own venture funding and financing initiatives to allow them to partner closely with promising startups. Singapore provides another great example of this, where the government proactively invests alongside industry and the financial regulator recently passed sweeping reforms to make it easier to form corporate venture funds.

We are at the beginning of the most important shift in the maritime industry's history, the UK can play a major or minor role. Building a technology ecosystem requires long term investment but money alone is not enough. Building the infrastructure that can support lasting innovation will be the key difference. The UK has already achieved this multiple times, and the evidence from the thriving financial technology sector tells us that the payback is huge.

RECOMMENDATION

# 3. STARTUPS AND TECH COMPANIES: UNDERSTAND VARIABLE MARKET MATURITY ACROSS MARITIME

As long as an idea solves a real problem the industry is facing, there is no reason why it shouldn't be adopted by maritime stakeholders. But the industry is nuanced, and the opportunities for startups to have an impact are equally nuanced.

Despite the pandemic, technological maturity varies wildly across the industry and the ability of individual customers to adopt a particular solution varies with it.

*One of the biggest stumbling blocks for startups entering the maritime sector is a misunderstanding of the commercial dynamics that exist across industry stakeholders and consequently how a particular solution should be positioned to potential customers.*

One of the biggest stumbling blocks for startups entering the maritime sector is a misunderstanding of the commercial dynamics that exist across industry stakeholders and consequently how a particular solution should be positioned to potential customers. An industry sector can have multiple different stakeholder types including charterers, third party managers, and ship owners. Knowing where a solution fits requires understanding not just those stakeholder dynamics, but the technological maturity of each individual stakeholder.

For example, there are only a small number of shipping companies that would be interested in supporting startups and technology companies that are developing solutions aimed at solving long term issues such as decarbonisation. These projects could run for as long as a decade of research and development. When they do come to sell a solution, they will likely face an exceptionally long buying cycle that is in line with the renewal of a fleet of ships. These startups will have to be designed with a funding and operating model that reflects that need.

Similarly, even relatively simple digital solutions can face issues when they are pitched at ship operators that do not yet have the technological maturity to implement them. Though rapidly changing, the maritime market's attitude to technology can mean long buying cycles that make the typical growth expectation of venture capital funds unrealistic. Understanding this, and understanding the maturity of stakeholders within your specific market sector is a precursor to success in this industry.

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# ABOUT & ACKNOWLEDGEMENTS

Thetius

## ABOUT THETIUS

Founded in London in 2019, Thetius is a specialist consulting group that exists to enable innovation in the maritime industry. We help leading innovators, investors and corporates in the maritime industry to understand and prepare for the future through research, consulting, and talent services.

## ABOUT THE AUTHORS

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