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Innovation in shipping

A special report

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Innovation in shipping

The maritime sector's fragmented approach to research and development is born out of a business model that prioritised cashflow and balance sheets at the expense of innovation. In an era of radical technological and operational revolution, many companies are no longer fit for purpose.

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The principal project of the era, decarbonisation, has spawned hundreds of technology projects, with as many again in the pipeline.

Why shipping is struggling to innovate

Shipping is struggling with innovation, but technological breakthroughs are not the problem; the required advances needed are in scalability and availability, **Richard Meade** reports

The wave of techno-optimism that began to spread in the wake of Covid breakthroughs should be visible by now.

Forced to embrace digitisation out of remote working necessity, firms outlined juicy research and development plans and governments promised to spend big on science.

While it would be a stretch to say that the pandemic fuelled optimism, it certainly catalysed investment in technology research across sectors — and crucially coincided with an innovation arms race that was already escalating between China and the US.

Having overtaken European R&D spending back in 2014, China is openly looking to outstrip America's previously unassailable status as world leaders in tech innovation.

Back in the glory days of moonshots and competition with the USSR, the US government spent 1.9% of GDP on R&D, but that has retreated to less than one-third of those levels in recent years. China is taking the advantage.

"Technological innovation has become the main battlefield of the international strategic game," said China's president Xi Jinping in a speech last year to Chinese scientists, prompting Washington to propel its own legislative efforts to re-ignite American research.

All things considered, we should be living through a golden age of innovation right now.

And yet it is hard to see the evidence for that in shipping.

The principal project of the era, decarbonisation, has spawned hundreds of funded technology projects, with as many again in the pipeline.

However, the rapid scaling required is yet to emerge and the industry is barely touching the sides of the $1.4trn hole required to get this project moving at sufficient pace.

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Collaboration is often promised and yet rarely witnessed. The misalignment of incentives between owners and charterers remains a major blocker to the data transparency required to scale digital innovations beyond siloed projects.

Digitalisation efforts remain stubbornly fragmented. Optimisation experts are over-supplied, but the industry is still flooded with start-ups trying to solve problems in isolation.

Ambitions are high and intentions are good, but the fragmented ownership landscape increases the risk of hard-to-scale island solutions between few players that end up generating significantly less value than a scaled solution would have done.

And yet scale remains elusive in a sector that has not evolved significantly since the 1970s.

Shipping companies have long prioritised cost control over commercial and technical innovation.

In an era of limited technical innovation, when cashflow and a strong balance sheet were far more important than managing technical change, that was sustainable.

However, the business models upon which the majority of shipping companies are operated, are not fit for purpose in an era of radical technological and operational revolution.

Technology already exists

The innovation project for shipping is not about developing new technology. Whether it is new fuels and infrastructure or artificial intelligence and optimisation, the technology already exists.

The major breakthroughs for which shipping is waiting are around scalability and availability — but it also needs companies that are set up for change.

Wärtsilä's recent decision to restructure its Voyage business speaks of a deeper frustration in shipping about the unfulfilled promise of digitalisation.

Despite the initial promise of delivering sophisticated optimisation services to an industry looking for efficiencies, persuading clients to pay has proved trickier than producing the technology.

The upshot is that investment in truly digital solutions has been painfully slow across the sector.

Transitions are non-linear affairs and a more optimistic reading of the slow progress — be it in the development of zero-carbon technology or the take-up of digitalised optimisation tools — would argue that foundational changes take time.

Felix Wong/South China Morning Post via ZUMA Wire

According to China's president Xi Jinping, "technological innovation has become the main battlefield of the international strategic game".

> *Digitalisation efforts remain stubbornly fragmented. Optimisation experts are over-supplied, but the industry is still flooded with start-ups trying to solve problems in isolation*

The diffusion that follows once a critical mass of first-movers and adopters have shown the way will be a rapid process.

However, we are not there yet. Despite the initial flurry of marketing promises and industry rhetoric, we are currently in a phase of development that will require the shipping sector to negotiate changes beyond its traditional borders.

Whether that is a case of unlocking the incentivisation blockers between charterer and owner or aligning port, ship and end-user optimisation tools, these are changes that require time.

A study published in September by the Global Maritime Forum assessing industry-wide progress towards the goal of having scalable zero-emission fuels make up 5% of international shipping fuels by 2030, found the sector only partially on track.

In terms of technology and supply of the fuels, there is no shortage of trial activity. Currently there are at least 203 shipping decarbonisation pilot and demonstration projects in the pipeline and funding for the initial stages of development has been reassuringly plentiful.

The problems come, however, when it is time to scale operations.

Moving from pilots to scalable production commitments, investments and infrastructure development is now a key requirement, concluded the report, which cites earlier research estimating the total additional capital needed for shipping's decarbonisation at $1trn-$1.4trn.

Class society DNV concluded in early October that the level of "onboard investment" in decarbonisation by 2050 will need to be between $200bn and $450bn.

Guesswork estimates

However, given that more than 80% of the total costs will be required upstream in infrastructure investment, such estimates are akin to guesswork right now.

And yet few have questioned that the technology innovation will ultimately be a brake on progress.

Designs for zero-emissions engines already exist and various incarnations of prototypes are being rolled out. DNV expects the first ammonia engine to be ready in two or three years, with a deepsea version to follow by the end of the decade.

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Bridge to the future: investment in digital solutions such as artificial intelligence and the Internet of Things has been painfully slow.

The investment required to catalyse innovation — particularly when it comes to zero-emissions vessels and fuels — is not the technology itself; it is in the scalability and availability of the technology that already exists.

Walk into any major yard today and there will be an array of sophisticated Internet of Things sensors available to retrofit to almost any vessel.

Combine those with the promised savings offered by AI optimisation tools and you are left questioning why any vessel going near a yard for survey is not automatically installing readily available kit.

Cost is, of course, part of it — particularly for the 70% of the industry that controls 20 ships or fewer, and the average shipowner who, lest we forget, controls fewer than five vessels.

Yet this is not just a question of low margins. These solutions, however enticing the pitch may be, are not standardised.

Digitalisation is still a fragmented project, and the market is still flooded with start-ups trying to solve problems in isolation.

There is not an industry-standard tool. The Microsoft Excel equivalent of vessel optimisation software packages that everyone uses and understands, does not exist.

Instead, there are several hundred competing vendors in a market that stubbornly refuses to consolidate.

> *Few deny the direction of all this. Controls relying on dials, warning lights, displays and spreadsheets will be replaced by integrated information streams and intelligent algorithms, providing decision-makers and regulators with the information that matters*

Commercial perspective

Standardisation would help from a commercial perspective — it is still too often too difficult to prove material benefit from optimisation tools without long-term investment and ideally a scaled fleet enterprise.

Yet ultimately costs still need to be reduced — and without consolidation, that seems unlikely.

Without the gravitational pull from owners and charterers aligned in their willingness to pay for such services, there is still nobody with sufficient scale to drive the market.

Few deny the direction of all this. Controls relying on dials, warning lights, displays and spreadsheets will be replaced by integrated information streams and intelligent algorithms, providing decision-makers and regulators with the information that really matters.

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> *The promised secret ingredients to revolutionise shipping's future do not come with a magic wand and even sophisticated organisations prepared to run ahead of the pack are struggling to roll them out*

The question mark is around the pace of change.

Frontrunners like Wärtsilä Voyage are not the only commercial entities who have misjudged the timing of the curve.

The promised secret ingredients to revolutionise shipping's future do not come with a magic wand and even sophisticated organisations prepared to run ahead of the pack are struggling to roll them out.

A 2019 McKinsey study of land-based companies found that when moving from digital pilot projects to a company-wide roll-out of the system, only 33% of the companies surveyed had been successful.

The renowned maritime economist Martin Stopford pointed out in a recent paper that while the problems of managing this sort of change are extensively covered in books on change management, there are few "off the shelf" solutions.

"They will need skilled people to make them work," he said.

Managing change

And herein lies the crux of shipping's laggardly pace of innovation uptake: the vast majority of shipping companies, and the business models that guide them, were not designed to fund or manage change on the scale that lies ahead.

Today's organisations were developed during an era when cashflow and a strong balance sheet were far more important than managing technical change; but change they must.

The challenge is strategic rather than operational.

Just as shifting to new fuels will not, in isolation, form a clear pathway to the future, the uptake of new technology will not make companies inherently more efficient.

BackyardBest/Alamy Stock Photo

Walk into any major yard today and there will be an array of sophisticated Internet of Things sensors available to retrofit to almost any vessel.

The ability to yield a return on invested capital will not improve just because the fuel mix changes or AI is installed.

Tightening environmental regulation will only further fragment an already tiered market, with the lowest performers likely to find it increasingly difficult to secure employment, and the introduction of new vessels trading in green corridors likely to define the best-in-class environmental benchmark.

Owners operating their own vessels will have to consider whether the earnings spread between CII ratings justifies the required upgrades to compete on certain trades, while some tonnage providers may find it increasingly difficult to compete.

These changes will happen whether the companies adapt or not.

The technology and innovation required to transition shipping into a zero-carbon sector are not the missing ingredient; it is the companies themselves that must change.

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Business leaders recognise the significance of start-up thinking, though very few acquisitions of digital businesses by physical product businesses are successful. Innovation transforms expectations, **Richard Clayton** reports

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The giants of Silicon Valley have an attitude to business with which maritime would struggle, according to Sameer Kalra, president of Alfa Laval's Marine Division.

Silicon hubs and start-ups offer fresh perspectives for shipping

Maritime innovation cannot exist in a vacuum. Either it must add value to whatever technology is already in place, or replace that technology with something even better.

Unfortunately, although there are many start-ups beavering away at new ideas and solutions around the world, few of them reach a level of commercial success — and fewer still can be considered transformative.

Why is that?

Speaking on a Lloyd's List webinar earlier this year, Richard Buckley, founder and chief executive of 90 Percent of Everything, observed that tech firms have a tendency to exaggerate their potential benefits.

"I think as technology providers, we grossly oversell the promise of how our role will help decarbonisation," he said. "We need to be very careful on that."

Mr Buckley was tracking more than 500 maritime start-ups focusing on voyage routeing and optimisation but was disappointed by how little discussion there had been about ways in which real seafarers would use such technology in practice.

The consequence, he believed, was that the exponential growth in maritime start-ups was not sustainable.

However, the benefit of this level of innovation coming to shipping as a result of decarbonisation was the impetus it gave to "thinking differently about how to solve maritime problems".

Another perspective was offered by Sameer Kalra, president of Alfa Laval's marine division, who explained to Lloyd's List at SMM in Hamburg why and how the Swedish company left the comfort and safety of physical products and took its first steps into the digital world.

In mid-2019, Alfa Laval analysed the software landscape to see which companies were out there and what they did, he recalled.

"We identified the leading players. We asked which [of them] were addressing the right problems seen from a customer standpoint — and, of these, which were profitable because they were adding value for the customer."

Mr Kalra said he was reluctant to start the journey by acquiring a start-up with no record of profitability.

A recent McKinsey study found that only 4% of acquisitions of a digital business by a company with a history of physical products had been successful.

"The mistake many companies make is to treat a digital product as if it was a physical product," Mr Kalra explained.

"The digital business is a lot about gaining a leading market position until it owns the customer interface."

The giants of Silicon Valley have an attitude to business with which maritime would struggle.

Digital businesses must be fast, nimble and open to acquisitions, he said.

"It is based on scale, speed and agility. If you are not prepared to go down that path, you should not own it."

Quite how different a digital business is to traditional shipowning or even a traditional service supplier was revealed last month by Paul Sells, global head of digital solutions at American Bureau of Shipping.

Mr Sells joined ABS at the beginning of the year from an augmented reality business in California.

He sympathises with shipping's unease about the pace of digital transformation, but he is convinced innovation is inevitable for maritime.

"I have spent the past 10 years in Silicon Valley, working with start-ups. I am recruiting extensively from there. It is the past that I am familiar with; it is the people that I know."

Mr Sells has brought product developers and tech leaders to ABS to work alongside the deep industry expertise in-house.

"Building products is a skillset that is transferable from industry to industry," he confirmed. "You must have industry knowledge as well."

The Silicon Valley strategy is simple, he insists: "Make it easy. Make it better. Iterate on that."

It is a way of thinking about products that comes out of the expectations of digital natives, who expect ease of use.

"Commercial software is influenced by ease of use and users look for that same ease of use in maritime technology.

"We are utilising some of the industry best practices used by B2C [business-to-consumer] and some of the larger B2B [business-to-business] companies to help us deliver a more comprehensive user experience in line with their expectations."

Maritime leaders are aware of the advantages of entrepreneurial thinking, even if the promises are sometimes overstated.

> *The digital business is a lot about gaining a leading market position until it owns the customer interface*

Sameer Kalra
President, marine division
Alfa Laval

Speaking in June at the S&P Global Bunkers and Shipping Summit in Singapore, Su Yin Anand, head of shipping at Western Australia-based mining company South32, urged the industry to take a chance on start-ups.

She said they offered interim solutions while shipping waits for alternative fuels to become available at scale.

> *What we need is to find more good start-ups with sound pilot projects to give the money to*

Su Yin Anand
Head of shipping
South32

> *Commercial software is influenced by ease of use and users look for that same ease of use in maritime technology*

Paul Sells
Global head of digital solutions
American Bureau of Shipping

"For the start-ups to stand a chance in the industry, to work in the industry, and to innovate through some of the decarbonisation challenges, we will need many more collaborations."

The problem is not so much funding, as venture capitalists have funding for the right projects, Ms Anand said.

"What we need is to find more good start-ups with sound pilot projects to give the money to."

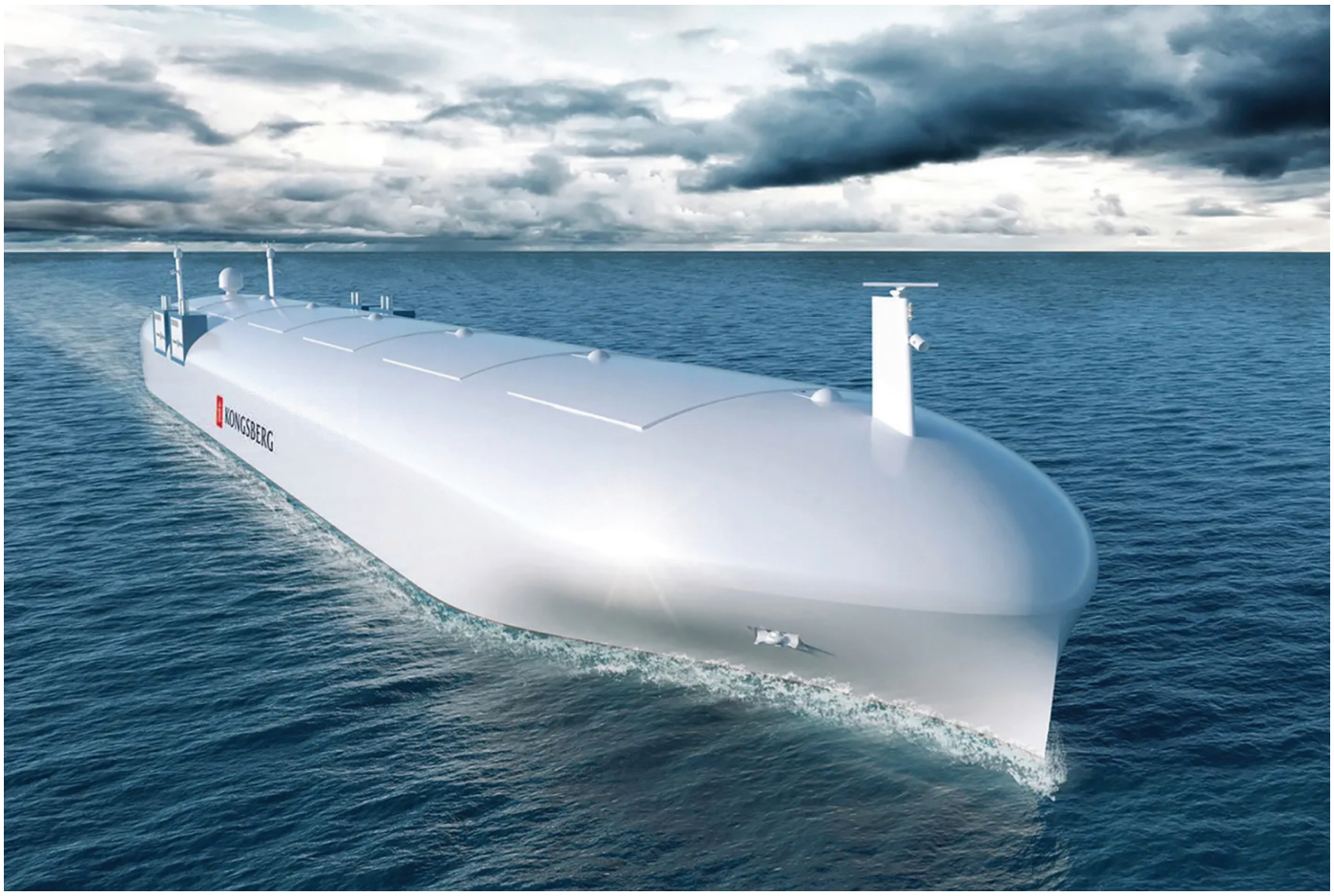
She added that start-ups need to build more awareness in the industry to allow them to showcase their projects.

Mr Kalra makes the same point from the corporate position.

"There will always be a risk in moving into a new business area, especially a highly competitive space such as digital software," he concluded.

"The worst thing is not taking any risk at all.

"However, risk should be quantified upfront, so you manage your expectation of the business three years, five years, even 10 years from now."



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Flag states should think carefully about registering for autonomous vessels until there is a legal framework specifically tailored to MASS.

MASS misunderstandings reveal barriers to innovation

Autonomous ships are at the higher end of innovation and will probably not feature globally for many years; yet discussion about regulations and vessel operations continues to fill conference agendas, **Richard Clayton** reports

Few projects encapsulate innovation in maritime better than autonomous vessels. Early concepts were introduced almost a decade ago, stimulating an industry-wide discussion about the future of the seafarer in a data-led, machine-driven ecosystem.

An International Maritime Organization seminar in September this year on the development of a regulatory framework for Maritime Autonomous Surface Ships revealed that the anxieties generated by autonomy have not been eased.

Several speakers continued to press for a common understanding of terms.

Among these were Anne Miettinen, who works as a senior ministerial adviser in the automation unit of Finland's Ministry of Transport and Communications.

Without nailing down what is meant by an autonomous surface ship, she said, it will be much harder to determine the scope of a MASS Code.

Even more problematic, observed Youri van Logchem, a senior lecturer at the Institute of International Shipping and Trade Law at Swansea University, UK, were questions such as whether an autonomous surface vessel can even be regarded as a 'ship' under the 1982 United Nations Convention on the Law of the Sea.

The convention assumes a ship has a master, officers and crew on board.

In order for a flag state to grant its nationality to MASS, the convention stipulates there has to be a genuine link. Such a link is assumed to exist when a state has actual control over a ship.

"However, is a flag state able to exercise control over a remote controller if they are not located in the territory of the flag state?" Dr van Logchem wondered.

"Can the human controller on shore in a remote-control centre be considered the 'master'?" he asked.

He added that where the convention speaks of a singular master: "How can this requirement be transposed to one or more controllers that are located in an onshore remote-control facility?"

Innovation that would remove the master, officers and crew from a ship goes far beyond simple technologies that increase levels of efficiency or reduce CO_2 emissions by a few percentage points.

Until there is a legal framework incorporating provisions specifically tailored to MASS, flag states should think carefully about registering for autonomous vessels.

An IMO intersessional working group submitted its 'regulatory scoping exercise' report to the Maritime Safety Committee back in May 2021.

This report highlighted how much the maritime safety regulations are based on the human presence on board. An initial four 'degrees' of autonomy for ships was created.

Soon after, three class societies came up with their own definitions for levels of autonomy in a ship's navigation functions, which provided more nuanced approaches to gradations in ship systems autonomy.

Placing the definitions side by side made it clear that while some of the terminology was specific, some was open to interpretation.

While there was a general focus on system functionality, there was little agreement on what the "human in the loop" would actually be doing.

A collaboration of industry stakeholders, under the banner One Sea, put out a white paper earlier this year, aiming for precise definitions of automation and autonomy, fearing that "ambiguity is causing misunderstandings" regarding scope, application and the functions of different technologies and concepts.

The white paper said the need for greater clarity had been driven by rapid progress in autonomous ship technology. This had prompted immediate regulatory attention "even before the stakeholders have agreed to common terms of reference".

This discussion suggested that, for it to be successfully adopted, innovation must not only align with existing regulations — or be sufficiently advantageous to the industry to necessitate a change of regulation — but must also support and enhance existing operations.

For One Sea, the location of the human operator in the loop is not relevant for the taxonomy of automation and autonomy. Humans can be on the ship itself, on board another ship, or even on shore.

What mattered, they said, was the understanding that levels of autonomy could be assessed on a scale based on the need for human attention/attendance. Level 0 (zero) signified a vessel fully controlled by humans and level 5 a vessel from which humans had been removed.

The experience of MASS and the autonomy discussion is that innovation at an industry-wide level must be evolutionary rather than revolutionary.

In their presentation at the IMO's MASS seminar, Ocean Infinity chief vessel operator Ann Till and her colleagues reminded attendees of the 'myth' that MASS was about technology.

People remain at the heart of autonomous ship development, she said, which focused attention on the training and competence needs of future technology.

Innovation — in this case Maritime Autonomous Surface Ships — requires comprehensive regulation to ensure increased levels of safety and encouragement for growth.

However, as the pace of introducing new regulations cannot match the pace of development of MASS technology, shipping must accept a restraint on the introduction of such profound innovation.

> *Without nailing down what is meant by an autonomous surface ship, it will be much harder to determine the scope of a MASS Code*

Anne Miettinen
Senior ministerial adviser, automation unit
Finland's Ministry of Transport and Communications

> *People remain at the heart of autonomous ship development, which focuses attention on the training and competence needs of future technology*

Ann Till
Chief vessel operator
Ocean Infinity

Ports await 5G connectivity to accelerate innovation

dpa picture alliance/Alamy Stock Photo

Singapore is aiming for full maritime 5G coverage in anchorages, fairways, terminals and boarding grounds "by the middle of 2025".

Smart ports and smart shipping have been promoted by tech companies for many years, even though super-fast, low-latency connectivity has not been available; 5G is near and promises transformation, **Richard Clayton** reports

Innovation in ports and harbours is expected to have a significant impact on the wider supply chain and on shipping over the next five years.

Much has been said about artificial intelligence, the Internet of Things on the quayside, augmented and virtual realities, drones, simulator training and much more. Yet how close are these to coming on stream?

Connectivity in the maritime world has seen a huge amount of investment in recent years, especially the positioning of small Low Earth Orbit satellites this year and into 2023.

While LEOs will not be the answer to all maritime's connectivity issues, they offer an alternative to the long-established geostationary satellites.

Down on the ground, there is the exciting potential offered by dedicated 5G networks, which are claimed to be 10 times faster than 4G and allow more devices to be connected.

The low latency offered by 5G could be a game-changer for ports in reducing the time lag between data transmission to ensure a steady flow of data needed for autonomous vehicle navigation.

Singapore appears to have taken a lead on 5G.

In August this year, senior minister of state for transport and finance Chee Hong Tat informed the Safety@Sea conference that the government wanted to achieve full maritime 5G coverage in anchorages, fairways, terminals and boarding grounds "by the middle of 2025".

The network would be rolled out progressively across Singapore's port waters and would serve as a testing ground for marine tech research and development, focusing on new applications that can improve maritime and navigational safety.

Initial projects would look at remote guiding of ships within Singapore's waters by harbour pilots.

Not only will this enhance efficiency and productivity; it will also reduce safety risks involved for pilots boarding and disembarking from ships.

5G coverage will also allow Singapore to trial innovations such as delivery drones and autonomous vessels, with onboard sensors generating vast amounts of critical data for collision avoidance, docking and other activities.

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While the 5G network is being rolled out, Singapore plans to introduce an Active Anchorage Management System to monitor ships anchored in Singapore's waters in real-time.

Several data sources will be combined to allocate space for vessels to anchor safely. It will go live in the third quarter of 2023.

Yet Singapore was not the first port to announce it was launching 5G capability.

In 2019, Hamburg Port Authority teamed up with Deutsche Telecom and Nokia on a similar project, named 5G-MoNArch, standing for 5G Mobile Network Architecture.

The EU-funded project aimed for faster speed, improved connection density and greater energy efficiency of 5G over 4G.

Hamburg's many customers found the diversity of applications could not be supported by the existing 4G network; for example, VR and AR technologies could only be used inside buildings.

However, an upgrade to port-wide 5G capability would allow new technology infrastructures to be planned within the port area much more efficiently.

Yet Hamburg has confirmed to Lloyd's List that while the 5G field trials were completed in 2019, "HPA is not doing anything further in this respect".

Nevertheless, the port sector has emerged from the coronavirus pandemic even more convinced about the need for faster, more agile connectivity.

According to International Maritime Organization research, three-quarters of port operators believe automation will be critical to maintaining competitiveness by the middle of the decade, while two-thirds of port operators consider automation to be key to achieving operational security and efficiency.

In 2021, Antwerp made innovation the central proposition of its 5G standalone campus network project.

The aim was to implement fresh ideas to keep the port at the cutting edge and give it a competitive advantage.

Pilot projects included connected tugs that could stream real-time video and images and other data such as radar and sonar to the port's central control room.

There was a tangible business benefit of enabling the port to increase the throughput of ships each day.

Tenants in the port would leverage the 5G network to streamline their own operations and make hazardous tasks safer.

One chemical company used AR solutions around its site for safer machine inspections, while another leveraged computer vision and AI to assist fault detection in high-voltage cables.

Following these trials, Orange Belgium opened its first permanent Orange 5G Lab in Antwerp. The lab blends Orange Belgium's 5G expertise with Port of Antwerp co-innovation use cases to create new concepts.

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Modern approach: the now-combined Port of Antwerp-Bruges is pushing on with its Smart Port concept, in which smart technology and digitalisation play a key role.

> *"According to IMO research, three-quarters of port operators believe automation will be critical to maintaining competitiveness by the middle of the decade"*

However, while the now-combined Port of Antwerp-Bruges pushes on with its Smart Port concept, in which smart technology and digitalisation play a key role, 5G connectivity that will underpin this concept is still "in the future".

Yet not entirely. Another Antwerp-Bruges member port, Zeebrugge, rolled out a private 5G network, together with Citymesh and Nokia, in 2020.

Smart ports, like smart cities, will require super-fast connectivity with low latency, which has not been available via wireless technologies such as WiFi, 3G or 4G LTE (Long-Term Evolution).

5G is still at an early stage of its evolution, yet initial results have been encouraging.

Shipping's innovation revolution will require 5G connectivity to become stable and reliable.

Hamburg port began early and is now waiting; Antwerp has taken it one step further; Singapore's expectation of 2025 for full 5G roll-out looks reasonable.

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