

Pointing to the Future of MarineTech

Confronting the Rising Cyber Threat: How Maritime Can Shore Up Its Defences



On the second day of the MarineTech Conference, Capt Naoki Saito shared how the maritime industry can respond to the increasing threat of cyber attacks.



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Cyber attacks continue to pummel the maritime industry with no end in sight. How can it respond?

Just two weeks ago, cyber attacks hit three major ports across Canada, shutting down their main points of contact by taking their websites out of commission.

These ports are not the only ones to have been targeted by hackers this year. Across the Atlantic, Portugal's Port of Lisbon suffered a debilitating attack in January that saw it lose confidential information like financial reports, port documentation and cargo manifests.

As the maritime industry continues to digitalise its ports and ships, cyber attacks have emerged to be one of the biggest threats. Now, it is no longer a question of if, but when such incidents will happen, noted speakers at the second and final day of the MarineTech Conference. To mitigate such threats, the sector will need to shore up its cyber security infrastructure and place more focus on cyber risk management.

"Unfortunately, cyber attacks will occur even if we apply the perfect protection countermeasures – because hackers are progressing day by day," said Captain Naoki Saito, General Manager and Head of Cyber Security of the Maritime Education and Training Certification Department at ship classification society ClassNK. "It will be important to update the cyber security management system, taking the latest information into account."

Paying a high price

Indeed, recent years have seen cyber attacks rising exponentially in the maritime industry. According to a survey by security consulting firm Fundamentals First, attacks increased by 400 per cent between 2020 to 2022.

They also come at a high cost, with ship owners paying an average of US\$3 million in ransom payments, according to a joint report by maritime cyber security company CyberOwl and law firm HFW.

Onboard ships, Capt Saito noted they have the ability to compromise shipboard systems, impacting a vessel's ability to safely navigate and manage their cargo. These could have serious consequences for lives and livelihoods.

Like a virus, attacks on ships could easily spread to ports as well. "This compromise could also lead to disruption of shoreside systems because lateral movement is possible through shared wire movement networks and other interconnections," he said.

Ports and shipping companies also often face an uphill battle to defend against such attacks, noted Dr Quang-Vu Pham, Head of Data Privacy and Information Security at the Hamburg Port Authority, in a separate presentation.

"They are often instigated by state-sponsored hackers that are politically motivated and have very large resources," he said. "As the defenders, we are at a disadvantage."

Mounting a successful defence

To successfully counter such formidable threats, the maritime industry will need to do so in a systematic and pragmatic manner.

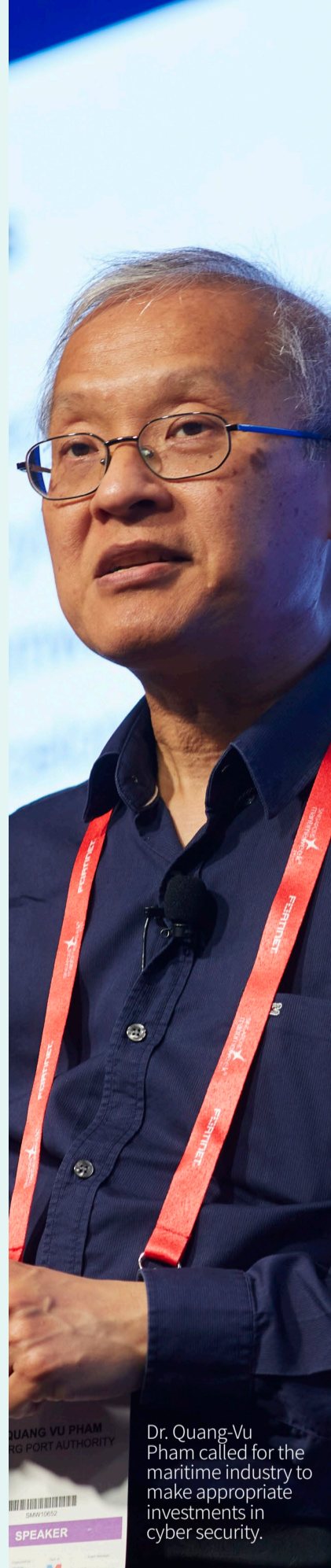
To this end, both speakers had presented a cyber security framework that touched on five points: identify the biggest risks; protect assets; detect threats; respond accordingly; and recover as fast as possible.

For instance, Dr Pham noted that in the area of protection, the industry should employ a zero-trust concept. This means that no user, device or application should be trusted without verification. Minimising user access, along with protected layers of data encryption and vulnerability scanning, would help improve threat detection and mitigation.

To further fortify defences, Capt Saito shared that the International Association of Classification Societies had recently published new Unified Requirements for cyber security in the maritime sector: E26 and E27. These requirements – which look to enhance the cyber resiliency of ships and their on-board systems and equipment – will be made mandatory for ships constructed from 2024.

Lastly, cooperation between the various port authorities and companies will be the crucial factor tying everything together, he noted. "Information sharing will be important within the maritime industry to catch up with the latest cyberattack." For instance, the Port Authorities CIO Cybersecurity Network (PACC-Net), a group of 11 ports and port authorities, will be testing their information sharing protocol at an inaugural tabletop exercise today.

"This is not a project, but a process," said Dr Pham. "You have to make the appropriate investments when it comes to cyber security." ■



Dr. Quang-Vu Pham called for the maritime industry to make appropriate investments in cyber security.

ESTABLISHING A SECURE FRAMEWORK

IDENTIFY

Pick out the important areas that are at highest risks of cyber attacks. These include Industrial Control Systems such as terminal operations and IT systems like Port Community Systems.

PROTECT

The industry needs to shore up protection by introducing measures such as a zero-trust concept, which requires explicit verification and restricts user access only to those who are authorised.

DETECT

To detect threats, the right infrastructure needs to be in place. For example, this means having Security Operation Centres that can accelerate incident response times and minimise the impact of harmful events.

RESPOND AND RECOVER

Business continuity plans are crucial to restoring operations after an attack. For instance, an IT Disaster Recovery Plan can help to get information systems back in place.

All Hands on Tech: The Quest for Cyber Talent in Maritime

Roping in cyber security professionals requires stronger cross-collaboration between academic institutions and industry partners.



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In the face of a global technology revolution, the need for cyber security professionals has – and will – become more critical than ever. There is a shortage of 3.4 million people in the global cyber security workforce, according to the (ISC)² Cybersecurity Workforce Study 2022.

The maritime industry is no exception, a panel discussion on Wednesday revealed. “Unfortunately, each sector does not have enough cyber security experts to develop these capabilities,” said Captain Naoki Saito, General Manager and Head of Cyber Security, Maritime Education and Training Certification Department, ClassNK.

Besides a shortage of experts to train the next generation of new talent, resources in the industry are also limited, especially when compared to other industries.

For instance, Dr Quang-Vu Pham, Head of Data Privacy and Information Security, Hamburg Port Authority, lamented that while flight simulation training is a staple in aviation, “no such thing exists for the maritime industry”.

The cyber talent crunch dominated the discussion, which was moderated by Ong Chin Beng, Chief Information Security Officer, Maritime and Port Authority of Singapore.

Part of the problem is, of course, also the perennial image problem that maritime faces. This is mostly due to a lack of familiarity with what the industry entails, making it a less attractive choice compared to sectors like finance, which also offer higher compensation.

As a result, competition for cyber talent is steep, said Dr Goh Weihang, Associate Professor, Singapore Institute of Technology. “When we train, we train for everyone – maritime is just another industry. Everyone wants cyber talent. The numbers challenge is real,” he added.

Building bridges between academia and industry

The key to addressing this talent shortfall lies in creating opportunities for exposure and experience, which can be forged through partnerships between academia and industry.

Even if cyber security professionals possess the skills and expertise, they may not necessarily know how to apply them seamlessly to the maritime environment, especially on board vessels.

“People see cyber security as an IT risk, a tech risk, which is not the case. Cyber security risk is a business risk.”

Martin Johannesson
Head of Information Technology
Port of Gothenburg

“Talent sometimes tends to be a bit technical,” observed Martin Johannesson, Head of Information Technology, Port of Gothenburg.

Michael Vrettos, Senior Marine Cyber Security Expert, RINA, concurred on the gap between knowledge and practice. “Integrating OT (operational technology) systems with tools they built for an office environment is difficult. This is why partnerships with academia can really assist them. Give them a grace period and educate them in the maritime reality,” he explained.

Artificial intelligence (AI) will also feature heavily in cyber security training, said Dr Goh. And while some wonder whether AI might potentially eliminate the need for human talent, Dr Pham is not concerned. In fact, he sees AI as a useful assistive tool.



Michael Vrettos, Senior Marine Cyber Security Expert, RINA (left), and Martin Johannesson, Head of Information Technology, Port of Gothenburg (right), speaking on a panel discussion about strengthening cyber talent and capability development in the maritime industry.

“AI had to learn from humans, so it should have the same difficulties as its human counterparts,” he said. “It cannot fully replace cyber specialists, but it can relieve them from daily routine work.” ■

“With the rise of new technology comes new cyber attack risks. A robust defence is very much needed.”

Ong Chin Beng
Chief Information Security Officer
Maritime and Port Authority of Singapore



Dr Sewoong Oh (second from left), Principal Research Engineer, Maritime Digital Transformation Research Center at the Korea Research Institute of Ships and Ocean, speaking at a panel on seafarer safety with (from far left) Ben Palmer OBE, President, Inmarsat Maritime; Mario Moretti, Managing Director, V.Ships Asia Group; and Simon Frank, General Manager, IMC Crew Management.

How can the sector be proactive instead of reactive when it comes to safety?

Rethinking Safety at Sea



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What is safety? This was the poser that moderator Dr Su Yi presented at the final panel of the two-day MarineTech Conference.

“We all come from different sides of the industry, so when we talk about the term ‘safety’, what is at the top of your list?” asked the Executive Director of the Institute of High-Performance Computing at Singapore’s Agency for Science, Technology and Research.

It was an important starting point to frame the discussion on “Seafarers and Safety - Predicting Dangers and Unpredictable Circumstances through IoT Capabilities and Predictive AI”.

Ben Palmer OBE, President of maritime satellite service provider Inmarsat Maritime, dived in first with his take. “Historically, we’ve taken a somewhat reactive view,” he said. “There’s an opportunity to get into a slightly broader definition of safety - one that is predicated on a more proactive, predictive, and more preventative view of safety.”

For Simon Frank, General Manager of shipping company IMC Crew Management, he felt strongly that the discussion on safety has been wrongly pegged to the profit imperative. “What you often see is that the discussion (on safety) quickly turns into a commercial discussion about downtime,

about how we make sure the ship is always operational. Basically making sure we are not losing money. And that’s wrong.”

Instead, he said safety should centre on people. This sentiment was shared by the rest of the panellists, including Mario Moretti, Managing Director of ship management company V.Ships Asia Group. He observed that the COVID-19 pandemic has shifted the focus to the mental well-being of seafarers, and it is important that crew safety encompasses mental health too.

Staying connected

One way to support this, he said, is for increased Internet connectivity onboard so that seafarers can connect to their families as well as enjoy online entertainment in their free time. The downside to not having this is a possible impact on their performance and correspondingly, the safety of the ship.

“Connectivity is a must going forward,” said Mr Moretti. However, some audience members voiced their concerns via the real-time Q&A system, highlighting that seafarers may not have adequate rest if they are watching movies online during breaks, and how most of the Internet capacity onboard is taken up for entertainment purposes instead of business.

Nonetheless, the panel doubled down on the need for connectivity for seafarer welfare, stressing that offering online access to the crew has to be managed by organisations. Mr Frank added that the implications of not having connec-

tivity could be worse, if it leads to poor mental well-being of ship crew.

Data sharing

Another way safety at sea can be promoted is by using data to predict incidents, shared Mr Palmer. This means not just collecting data at the individual ship level, but at “fleet level” to aggregate data sets, he said. With the use of artificial intelligence and machine learning, such data can be used to prevent or even predict mishaps.

This way, the maritime sector can be “ahead of the curve” in managing safety incidents. However, he also stressed the need for deep collaboration on this front, and how data sharing needs to happen on a wider scale in the maritime sector.

Governments can also help by sharing data on incidents, said Dr Sewoong Oh, Principal Research Engineer, Maritime Digital Transformation Research Center at the Korea Research Institute of Ships and Ocean.

Mr Moretti shared about the current obstacles to data sharing. “The more transparent you are, the more you are penalised,” he said. He was referring to how observers would focus on the incident that occurred, rather than how the stakeholders involved successfully managed the incident.

Dr Su rounded up the session with this takeaway point. “If data could be more open and transparent, we can learn from one another’s mistakes and how to better manage such incidents and be more preemptive, which is quite critical for our industry to do better in safety.” ■

A PUBLICATION BY
THE NUTGRAF
CAPTURING THE ESSENCE
www.nutgraf.com.sg

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From left: Caroline Yang, President of the Singapore Shipping Association and Vice Chair of the International Chamber of Shipping, Dr Song Kanghyun, Senior Vice President of the Korean Register, Soren Larsen, Deputy Secretary-General of BIMCO, and Wong Kai Cheong, Vice President of INTERTANKO.

Regulatory Frameworks Strengthening, but Long Way to Go for Decarbonisation

Kinks remain despite clear commitment to greener maritime world.



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If decarbonisation is a ticking clock, an alarm may well ring on July 3 this year. In less than three months, the International Maritime Organization (IMO) will convene in London for the official adoption of a revised strategy to curb greenhouse gas emissions from ships.

The meeting is expected to introduce a basket of mid-term measures, including new economic requirements like fuel levies, to accelerate the green transition. Most importantly, it will send a signal.

“The revised strategy will provide the necessary certainty for all stakeholders to invest in future fuels and ship-related technologies,” said Kitack Lim, who is IMO’s Secretary-General. He noted that major investments were critical for boosting research and infrastructure development.

He was speaking at the inaugural session of the Asian Shipowners’ Association (ASA) International Shipping Forum, held in conjunction with Singapore Maritime Week. Themed “Blue and Safe Shipping”, the forum emphasised the importance of a “blue economy” – that is, one that balances the wellbeing of people, planet, and profit.

“The maritime industry is sharpening its lens to view issues from a blue economy perspective,” said Teo Eng Dih, Chief Executive of the Maritime and Port Authority of Singapore, in his opening remarks. “As world trade continues to expand and shipping traffic increases, the responsibility of maintaining safety and preserving the environment will grow.”

While decarbonisation is high on the industry’s agenda, the devil is in the details. July 2023 marks an important milestone as the industry sails towards sustainability, but challenges remain especially when it comes to existing regulations and upskilling talent.

Rough seas ahead

Fresh carbon intensity measures that came into force at the start of the year make it mandatory

for vessels to calculate their energy efficiency and carbon intensity indicator (CII) rating. However, this regulation is not “fit-for-purpose”, according to Caroline Yang, President of the Singapore Shipping Association and Vice Chair of the International Chamber of Shipping.

In a panel discussion which Ms Yang moderated, the consensus among the speakers was that while the framework demonstrated a clear commitment to decarbonisation goals, it was a blunt instrument.

“Many factors influence CII,” said Dr Song Kanghyun, Senior Vice President of the Korean Register, a classification society. “Some are beyond the control of operators.” Dr Song, who is also representing the Association of Asian Classification Societies, cited the example of rough weather con-

ditions along some sea routes which necessitate higher fuel consumption in ships.

As shipping continues its sustainability drive, there is also a need to maintain safety standards among seafarers. Ammonia, for instance, is an up-and-coming alternative marine fuel that is toxic, corrosive, and flammable. Seafarers need to be retrained and reskilled for the adoption of new fuels to be successful.

“The speed and scale of change cannot come at the cost of safety,” said Guy Platten, Secretary-General of the International Chamber of Shipping, in a speech.

“With the emergence of new technologies, we need to ensure that people are trained to use them,” he added. “It is an opportunity to ensure that no one gets left behind.” ■



Green Conversations

At a green corridor workshop on Tuesday, about 40 members of the maritime industry deep-dived into issues such as fuel supply, scalability, and incentives to move the needle on zero-emission shipping. The workshop was hosted by the Maritime and Port Authority of Singapore and the Port of Rotterdam, both of which had signed a memorandum of understanding (MoU) in 2022 to set up the world’s longest green and digital shipping corridor. Earlier this week, Singapore inked another MoU to establish its second such corridor – this time with California’s San Pedro Bay port complex.

Methanol Sparks Discussion at ICOPCE

Risks of alternative fuels were addressed at the biennial conference.



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If you fail to plan, you plan to fail. This maxim from American founding father Benjamin Franklin set the tone for a conference on chemical spills and strategies to reduce their risks.

As the maritime industry sets its sights on alternative bunkering fuels such as methanol, they need to be aware of the potential hazards and have in place suitable contingency plans, industry speakers noted at the event.

“It is important that Singapore continually raises the awareness and importance of spill prevention and mitigating measures, especially when the shipping industry is moving into the new era of decarbonisation,” said Captain M Segar, Assistant Chief Executive (Operations) of the Maritime and Port Authority of Singapore (MPA).

He was speaking at the 13th International Chemical and Oil Pollution Conference and Exhibition (ICOPCE) at Marina Bay Sands on Wednesday. The biennial conference is a platform for industry players to share best practices and their spill strategies for marine fuels.

“There have been efforts in exploring the use of alternative marine fuels, such as methanol, ammonia, and hydrogen, which will reduce our carbon footprint significantly. The adoption of these fuels in the near future will present new challenges to the maritime industry and port authority,” added Capt Segar.

Alternative fuel of the future

Some conference speakers delved into the use of methanol, which is identified as a lower-carbon alternative to fuel oil.

“You need the full ecosystem to be responsive, and at the top level in dealing with HNS (hazardous and noxious substances)...The crew should, of course, be well-trained and ready, but the port state and the industry should be ready to tackle any problem quickly too.”

Christophe Logette
Director
CEDRE



The event featured a range of industry experts, including (from left) Jody Shields, Manager Commercial APAC, SMIT Salvage; and Captain Clint Bout, General Manager and Head of Marine, Hafnia.

Methanol, however, is highly flammable, and the flame is hard to spot with the naked eye. To counter these risks, Singapore is developing standards for the safe and efficient bunkering of new fuels, such as methanol as well as ammonia.

Singapore will conduct its first methanol bunkering pilot in the third quarter of 2023. Since last year, it has completed more than 70 methanol loading and discharging operations for industrial use – more than 400,000 tonnes – in Jurong Island.

The Singapore Chemical Industry Council, for instance, has also set up a working group to outline safety, operational, and other requirements for methanol bunkering in Singapore. These will be covered in a “technical reference” that is expected to be ready in 2024.

Meanwhile, MPA will run a Hazard Identification and Hazard and Operability Study workshop in May 2023 – before carrying out a “full deployment exercise” later in the year to test the effectiveness of emergency responses for methanol bunkering.

“Most important is the need for industry collaboration so that we can make positive steps ahead,” added Captain Daknash Ganasen, Senior Director (Operations and Marine Services) of MPA.

“We will continue to work with regional partners and the industry towards creating a safe, efficient and sustainable global hub port that is ready for decarbonising.”

MPA, the conference organiser, also ran a tabletop exercise painting the scenario of a methanol spill at sea.

Participants learned about the hazards of methanol, ways to detect and put out a methanol fire on a ship, and how seafarers might be trained to

handle the fuel safely. One of MPA’s port chemists also showed them a modelling study of plume clouds formed by the sudden release of methanol into the atmosphere. ■

“Not too many people want to go to sea anymore these days – that’s our biggest challenge. But bringing these new energy sources on board with us, we find a lot of young people are very interested in that. Often we see during interviews, the first thing they ask is, ‘What are you doing for the environment?’ We can then say, okay, this is what we are doing, and they are often very enthusiastic about coming on board.”

Jody Shields
Manager Commercial APAC
SMIT Salvage



AN ACTION-PACKED AGENDA

From visiting the world's busiest container transshipment hub to trying out cutting-edge virtual reality technology to boost maritime safety, delegates had a full day learning about new maritime developments. They ended the evening with get-togethers to share ideas on how shipping can be safer, greener and smarter.

Making Waves

In this series, we speak to individuals who are making a splash in the industry, from venture capital to championing the rights of seafarers.

*Researcher Li Haobin from the National University of Singapore shares with **Toh Wen Li** how he taps his expertise in simulation-based optimisation to transform the maritime industry.*

Q: Tell us about the cutting-edge research you are doing at the Centre of Excellence in Modelling and Simulation for Next Generation Ports where you are the co-director.

We are focusing on this technology called digital twins. We are trying to build a “crystal ball” for the industry so they can look ahead and play with different decisions and scenarios.

The concept of a digital twin comes from NASA and was originally used for space-ships. Later, we found that a similar concept could be applied to industrial systems such as in ports or logistics. We combine modelling, optimisation, and analytics with simulation runs of an industrial system – virtually, independently, and much faster than the real world.

Q: What are some of the real-world applications?

The technologies we develop can help the industry solve its problems, including manufacturing processes and warehouse issues. We were given this task by port operator PSA Singapore: Can you come up with a method to improve the efficiency of the algorithms that control equipment such as AGVs (automated guided vehicles), quay cranes, and yard cranes?

First, we used a simulation modelling approach to replicate real-world situations. Then, we tried to modify these algorithms and test out ideas to improve efficiency. We did not need to conduct the experiment in the ports – everything could be done digitally in our labs. We found a way to significantly improve the efficiency of these algorithms. If we didn’t make the algorithm fast enough, the equipment would have to pause and wait for new instructions before it could move on.

For the Tuas mega port project, we wanted to know what could be the best design. We built a model to compare the different designs for the port and identify the potential problems or bottlenecks. Some operation details were unknown to us – for example, cargo through-

put and vessel schedules – so we needed to make reasonable assumptions that reflected historical trends as well as future changes, to complete the modelling.

Q: How did you get into this line of work?

I came to Singapore in 2003 on a scholarship to major in industrial and systems engineering at NUS. My hometown, Nanjing, used to have one of the largest river ports in the world. But the size of container vessels handled in Singapore was much bigger. It was the first time I saw so many containers moving around at such a high frequency. When I saw all the container trucks on the road, that excited me: I knew I must study the methodology that drives the system to work so efficiently in this small country.

During my undergraduate studies, I did a module on simulation taught by Prof Lee Loo Hay and found there was a gap between theory and industrial practices. After doing a PhD under his supervision, I developed a simulation modelling approach with the team – a framework called O²DES. Prof Lee thought this could be a practical development, so he proposed setting up the Centre of Excellence in Modelling and Simulation for Next Generation Ports.

I was the centre’s chief technology officer until last March, when I was appointed as the co-director after Prof Lee passed away. Having taken up the job at a young age, I still have a lot to learn, but I felt it was my responsibility to continue Prof Lee’s work and research, and carry out the dream we had.

Q: What are some of the challenges you face at work?

The areas we are working on are quite niche and do not have wide visibility to students, compared with data analytics or AI, which have applications in the consumer market.

It is hard to get well-trained talent in simulation modelling and analytics. But by leveraging on education in NUS, we can train students and equip them with the necessary skills, so that they can conduct research in our centre and contribute to the industry in future.



Q: What is your vision for the industry?

Full automation. People have the impression that the maritime industry is heavy-duty, dirty and dusty work. Not many young people, especially Singaporeans, are willing to work there. A solution to this could be automation – let humans work in a more comfortable environment and have them make decisions only when it is critical enough.

We could also have more integrated systems. In the maritime industry, we have port operators, shipping lines, government agencies, logistics companies... there are many different players. In the past, everyone might work on their own and not plan in an optimal way. Now, we are trying to make the information flow smoothly among them, and let the machine algorithms analyse the data from a holistic view and suggest decisions for each stakeholder. We hope this will make it possible for the different players to work more coherently and improve the overall efficiency. ■