



navigating with AI and big data

Maritime Singapore's aim to double its port capacity by 2030 has stirred interest in traffic management along the narrow Singapore Strait. Jon White learns how a multi-party industry collaboration keeps this dream afloat

From smart traffic lights to predictive flight paths, multi-agent technologies have been used extensively in coordinating the movements of unmanned vehicles in the air and on the ground. In 2015, transport researcher Professor Lau Hoong Chuin of the Singapore Management University (SMU) mooted

the idea of extending the use of artificial intelligence (AI) to enhance safety and efficiency on the seas.

Sharing his dream, Prof Lau reveals, "While optimisation models have been successfully deployed for coordinating land and air traffic, my wishful thinking was, in an age of maritime digitalisation and automation, wouldn't it be nice if similar models can be applied to coordinate maritime traffic to enhance safety and efficiency?"

Prof Lau's thought comes against the backdrop of a booming maritime scene. Singapore is one of the world's busiest ports, with about a thousand ships anchored in its waters at any one time and a ship arriving or departing every two to three minutes. Vessel traffic — comprising cruise ships, regional ferries, container ships, barges, and tugs — is only expected to grow, making narrow channels even more complex to manoeuvre and navigate. Ensuring navigation safety and efficiency in Singapore's waters is, thus, of utmost importance.

MAXIMISING PROGRESS

Building on his research on AI planning and scheduling, Prof Lau reached out to industry partners to build an AI solution. "It's almost obvious that no single party can claim that they have the full know-how and solutions," he ventures. "So I always advocate collaboration."

Under the Urban Computing and Engineering Centre of Excellence, a three party private-public partnership, three institutions — SMU, Fujitsu Laboratories Limited, and the Institute of High Performance Computing (IHPC) at the Agency for Science, Technology and Research (A*STAR) — collaborated to investigate and evaluate the use of maritime big data in traffic management technology. The collaboration saw each party bringing its unique capabilities to the table.

“A*STAR IHPC’s interests are in prediction, while Fujitsu’s interests are in big data analytics,” says Prof Lau, describing each entity’s specialty. This meant that IHPC could contribute with its probabilistic modelling and machine learning techniques, while Fujitsu leverages its high-performance computing and data analytics.

MAKING STRIDES

Within three years, the partnership’s solution, which uses AI and big data, was built and validated using real-world data provided by the Maritime and Port Authority of Singapore (MPA). It aims to improve the forecasting of congestion and identification of potential collisions and risk hotspots, and provide timely recommendations on mitigating actions. In particular, the algorithm developed was benchmarked against Vessel Traffic Services (VTS) operators and demonstrated the possibility of quantifying risk in more detail in advance of detection by human operators. For example, based on benchmarking studies, the detection technology was able to flag potential risks approximately 10 minutes before the risk of collision became apparent; in doing so, it would provide approximately five minutes of additional lead time for VTS operators to alert shipmasters to take action against collision. The dynamic risk hotspot detection technology could detect risks up to 15 minutes in advance, enabling VTS operators to take specific measures to diffuse potential close-quarter situations.

Mr Tang Wey Lin, MPA’s then-Deputy Director (Ops-Tech Special Projects), shares that MPA has always taken a keen interest in exploring innovative concepts and new technologies that can enhance operations and strengthen decision-making processes to enhance safety and security of navigation within Singapore waters. Such predictive and analytical tools are vital in augmenting the work of MPA’s Vessel Traffic Management operators, enhancing their ability to better predict risks of

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collision — both in terms of accuracy and timeliness. “MPA’s mission is to ensure that our port waters remain operational 24/7, and that there are no major incidents between vessels that can disrupt traffic flow and port operations, or damage the environment,” he says.

Mr Tang elaborates, “The assurance that MPA provides to the maritime community — that Singapore will always safeguard safety and security despite the dense shipping lane — builds confidence, facilitates trade, and encourages maritime companies to invest in Singapore.”

With his finger on the pulse of the maritime industry, Prof Lau has his sights set on shaping its future. He will continue research work at the lab to improve the algorithms in terms of scalability, robustness, and the ability to handle more complex real-world constraints. “To achieve success, project partners cannot work in silos,” he reflects. “As the project progresses, university professors, students, and researchers should actively and constantly seek inputs from their industry and government partners, and find ways to meet the gaps.”



SPURRING COLLABORATION

The Next Generation Vessel Traffic Management System (VTMS) innovation programme was spearheaded to ensure that MPA continues to provide the best Vessel Traffic Service, thereby ensuring the highest standards of safety, security, efficiency, and environmental protection.

In April 2019, supported by MPA’s Maritime Innovation and Technology Fund under the MPA Living Lab initiative, ST Engineering and Kongsberg Norcontrol launched the first Next Generation VTMS Lab. The S\$9.9 million lab was set up to develop digital technologies and decision-making tools used by maritime operators, such as analysis of vessel routes, prediction of traffic hotspots, and detection of potential collision situations.

MPA welcomes industry players and institutes of higher learning to offer alternative solutions to complement and enrich key VTMS research areas so that MPA can build the most advanced VTMS within the next five years.

“We do not have a monopoly over ideas, so the best way is to work closely with industry and academia,” stresses Mr Tang. “The stronger our industry and academic linkages, the more minds and resources we have to solve complex challenges in the maritime domain.”