



Centre for Maritime Digitalisation (C4MD)

Advancing A*STAR capabilities in computational modelling, simulations and AI for safe, efficient and sustainable maritime.

ABOUT C4MD

An Important Node in the Maritime R&D Ecosystem

Singapore's vision for maritime is to be a "Global Maritime Hub for Connectivity, Innovation and Talent". In the Sea Transport ITM (2025), innovation and digitalisation straddle across two main pillars – Innovation and Digitalisation & Productivity.



Leverage port technology and automation
Enable global digital connectivity and platform

Digitalisation & Productivity Pillar

- interoperability
- Enhance business productivity via digital solutions

The Maritime Transformation Programme (MTP) is a key driver of the Sea Transport ITM initiatives and seeks to leverage the National Research Foundation (NRF) Research, Innovation and Enterprise Funds (RIE Funds) to grow maritime research and development (R&D) capabilities and transform the sector.

As the central node in the maritime R&D ecosystem, A*STAR's Centre for Maritime Digitalisation (C4MD) will facilitate and catalyse the collaboration with research performers, including Singapore Maritime Institute (SMI) funded Centres of Excellence (CoEs) and Programmes to develop new capabilities and solutions for the agency and industry.

OUR MISSION

Advance A*STAR capabilities in computational modelling, simulations and artificial intelligence (AI) for safe, green and sustainable maritime

Become a **translational research centre** to develop innovative digital solutions for maritime sectors Strengthen collaboration between A*STAR RIs and SMI funded COEs and Programmes to develop new research capabilities for **co-innovation across the value-chain**



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ABOUT C4MD

Leveraging A*STAR's Areas of Strengths to Support MTP's Priorities

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The Maritime and Port Authority of Singapore (MPA) has outlined 5 Strategic Research Thrusts¹ for the MTP, aligned with the Singapore Maritime R&D Roadmap. These are:

- 1. Efficient and Intelligent World-Class Next Generation Port
- 2. Strategic Sea Space and Maritime Traffic Management
- 3. Smart Fleet Operations and Autonomous Vessels
- 4. Effective Maritime Safety & Security
- 5. Sustainable Maritime Environment & Energy

Tapping on A*STAR's capabilities in computational modelling, simulations and AI, C4MD will help to support and drive MTP's priorities in the following areas:

Thrust 1: Green & Smart Shipping

- Predictive maintenance
- Physics-based AI for ships, propellers & offshore structures design
- Design for green shipping through hull resistance reduction
- Efficient propeller, energy saving devices and ballast water treatment system

Thrust 3: Electrification & Energy Mix

- Harbour craft electrification
- Low and zero emission marine fuels
- Mitigation measures
- Catalysis and model predictive

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Thrust 2: Maritime Traffic Management

- Proactive traffic management
- Emission monitoring and reduction
- Supply Chain Intelligence

Thrust 4: Port System & Safety

- Just In Time (JIT) operation
- Automated Guided Vehicles (AGVs)
- Life cycle model
- Standardised method to

control

- Marine environment sensing, assessment and analysis
- Renewable tidal, wind turbine and wind farm performance analysis

test and evaluate data integrity for digital bunkering system Future comms

^{#1}: https://www.mpa.gov.sg/maritime-singapore/innovation-and-r-d/maritime-innovation-ecosystem/maritimetransformation-programme



MARITIME AI PROGRAMME

Anchoring Digital Excellence in Maritime Research

With our deep AI expertise and experience in maritime R&D, C4MD will lead the development of digital excellence in maritime R&D. Through quality collaborations with industry partners, we have driven impactful innovations in past and current projects in the realms of **maritime traffic** management, decarbonisation and port operation optimisation.



(e.g. near miss, hotspot)

Port Operation Optimisation

- Develop port resources and operational optimisation models
- Address inefficiency & silo tanker vessels operations across terminals and jetties
- Improve **vessel-port coordination** for operation efficiency

- Central node for maritime AI research and translation to maritime industry
- Scenario based study for future harbour craft electrification
- Improving collaboration in global supply chains

Launched in October 2022, the Maritime Al Programme was initiated to develop a central node for driving a coordinated effort for Maritime AI research, build capabilities for the maritime industry and facilitate industry-wide adoption of AI and other related advanced digital technologies.

A*STAR's Institute of High Performance Computing (IHPC) will lead the development of Maritime AI in four pillars over two phases:



- **1. Maritime Data Excellence**
- 2. Al Modelling Excellence
- **3. Computing Excellence**
- **4. Applied AI Excellence**

Maritime AI Research Pillars

Computing Excellence

Applied AI Excellence



MARITIME AI PROGRAMME

Al and Big Data Intelligence - The Future Engine for Maritime Growth

Through the Maritime AI Programme, we hope to develop technologies that could help streamline and advance maritime operations through "AI-aided" maritime transformations, particularly in the following areas:



Leveraging maritime data and AI toolkits, the programme aims to develop advanced AI algorithms, tools and applications that will lead to quantifiable performance improvement for industry partners and all use cases, particularly in:

1. Maritime Traffic Safety

 Safe navigation at strait and crowded waters, next generation vessel traffic services (VTS)

2. Smart Port Operation

 Vessel operation events, situation prediction

3. Global Maritime Traffic

 Vessel & fleet operation and route patterns



4. Global Maritime Port Network

- Port network analytics and text
 - mining for maritime risks



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MARITIME DECARBONISATION

Pursuing Digital Excellence in Maritime Decarbonisation

Given the current projections for the increase in global temperatures and the critical need to address greenhouse gas emissions, the International Marine Organisation (IMO) has set stringent targets for transition to a low carbon future.

In line with the global commitment towards zero carbon and maritime decarbonisation, C4MD strives to develop innovative digital solutions for safe, efficient and sustainable maritime.

The combination of advanced computational fluid dynamic (CFD) modelling and AI algorithms has led to the advancement of digital solutions which have paved the way towards maritime decarbonisation over the years.



2017

2020

LNG as alternative fuels

New LNG technology on LNG shipping, transport, storage and usage; CFD based risk assessment for LNG bunkering

Green shipping

Ship hull design for performance; Design of energy saving devices; UV-based ballast water treatment; Scrubber tower.

Renewable energies

Design and analysis of floating offshore wind turbine and offshore wind farm; Bi-directional tidal turbine design

2023 ----0

Other alternative fuels

Ammonia, methanol as alternative marine fuels: Storage facilities, bunkering risk

assessment and mitigation measures

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Future Initiatives Alternative fuels: Risk assessment and mitigation measures for hydrogen **Green shipping:** Optimisation of propeller, future ship and design **Renewable energies:** High power rating tidal turbine and tidal turbine farm



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