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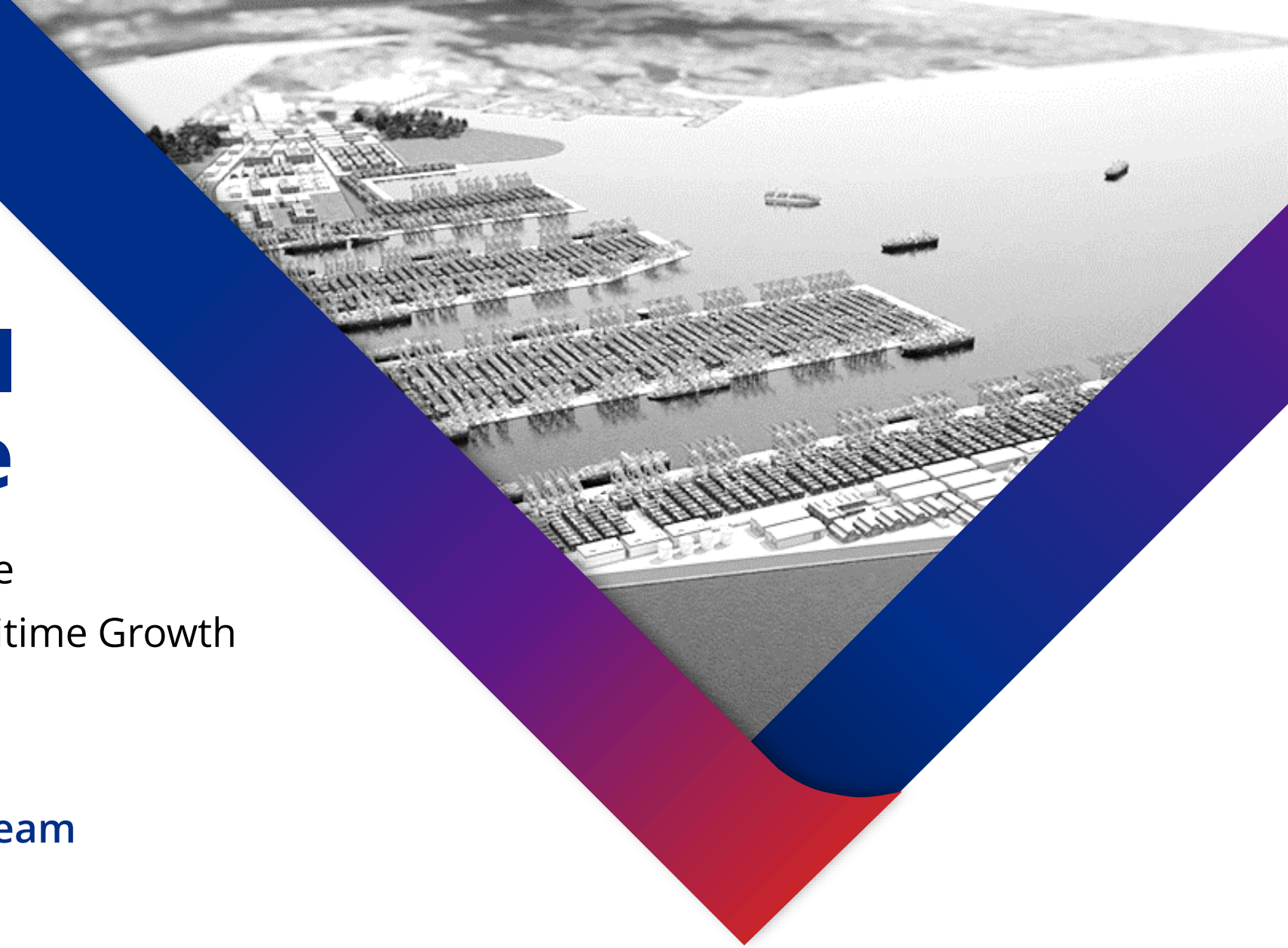

Maritime AI Programme

AI and Big Data Intelligence

The Future Engine for Maritime Growth

Fu Xiuju, Qin Zheng and team

Oct 2022

Needs & Barriers for Maritime AI Development

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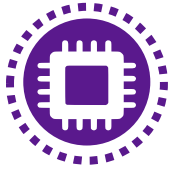
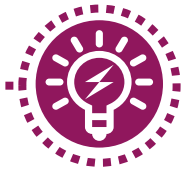
1. Maritime data are far from full utilisation due to data issues; R&D is needed to exploit maritime data to create values
2. While there are companies adopting AI, many are still new or at nascent stage
3. Marrying maritime domain knowledge and AI modeling is critical for building up maritime AI ecosystem
4. Need for maritime AI tools and automation platform to accelerate adoption
5. AI capabilities are needed along various parts of value chain, and prioritisation of high impact use cases is needed to demonstrate value for scaling up

Maritime data silos, lack of data quality and quantity

Lack of easy-to-use AI models & automation tools



Obstacles in computational efficiency when scaling up



Lack of solid AI service examples with trust & explainability

Takeaways from the 1st **Maritime AI Workshop** and discussions with more than **20 maritime companies**

Maritime AI Programme Objectives

Key drivers and objective:

- To be the central node and coordinator for maritime AI research and drive translation to maritime industry;
- To help maritime industries overcome the barriers and build capabilities in developing AI solutions and facilitating industry wide adoption

Scope for the programme lead:

- Support SMI and MPA in planning of R&D initiatives to support Singapore R&D Roadmap 2030, e.g. identify capabilities and research projects to be developed in the next 5 years and beyond;
- Drive coordinated approach for maritime AI R&D projects to synergise for impact;
- Develop maritime AI ecosystem, and promote cooperation among IHLs, RIs, industry and relevant AI partners;
- Lead development of core initiatives and collectively deliver AI models and tools to industry

A*STAR Track Record in Maritime Research

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Maritime projects between IHPC and industry / public sector partners

- **Traffic safety** with maritime safety operators & tech companies
- **Port operation** (tanker, container, G&B operations) with port, terminal operators and shipping companies
- **Decarbonisation** with local and overseas partners
- Maritime **supply chain** for food systems resilience

Relevant capabilities from whole of A*STAR

- Satellite VDES
- Automated Guided Vehicles (AGVs)
- Singapore Integrated Transport & Energy Model (SITEM)
- Centre for Frontier AI Research (CFAR)
- Co-host of National Quantum Computing Hub

Active maritime research collaboration with IHL partners across the R&D ecosystem

- Centre of Excellence in Maritime Safety (CEMS); Singapore Poly
- Maritime Energy & Sustainable Development (MESD) Centre of Excellence; NTU
- Technology Centre for Offshore and Marine, Singapore (TCOMS); NUS
- Centre of Excellence in Modelling and Simulation for Next Generation Ports (C4NGP); NUS

Proposed Maritime AI Programme Research Scope

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Data Sources

Public sector & open data
MPA data: e.g. high resolution AIS, radar…
Open data: Weather data …

Private sector data
Company specific data: operations, cargo data, sensor data, scheduling …

Data Excellence

Big data processing, structure & framework for AI models

Data Quality Modeling
- for measuring and enhancing data quality
- for data augmentation
- multi-modal data fusion

Data Privacy Preserving Framework for AI modeling, such as federated Learning (data privacy), MPC
…

AI Modelling Excellence

Explainable AI

Multi-modal AI

AutoAI

Knowledge base development

Federated Learning (AI accuracy)
…

Computing Excellence

Computing resource efficient AI

HPC based AI

Quantum computing

Hybrid-based computing

…

Applied AI Excellence

Phase 1: use cases

Next generation port

Smart shipping

Decarbonisation

…

Phase 1: Enabling technologies research
Maritime data toolkits & platform-type AI models development

Phase 2: Scaling-up research
Maritime Data Bank and AI ModelStore

Maritime AI (Phase 1) Use Cases and Industry Partners

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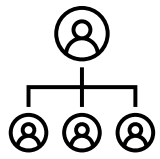
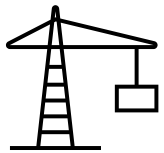
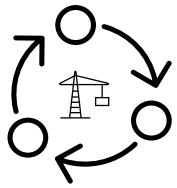
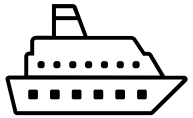
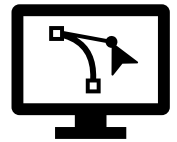
Industry Value Chain for Singapore

AI R&D and talent development, multidisciplinary efforts, industry collaborations and technology translation

- *Explainable AI for Maritime Traffic Safety Management
- Federated Learning for JIT Operation
- *Predictive Maintenance for Maritime
- Global Maritime Supply Chain Intelligence
- *Multi-modal AI for Maritime Emission Monitoring and Reduction
- ...

Authority	Terminal operators	Marine service providers	Shipping lines	Tech companies	Class/ Association


Value Chain

*Confirmed use cases

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Collaboration with Industry Partners

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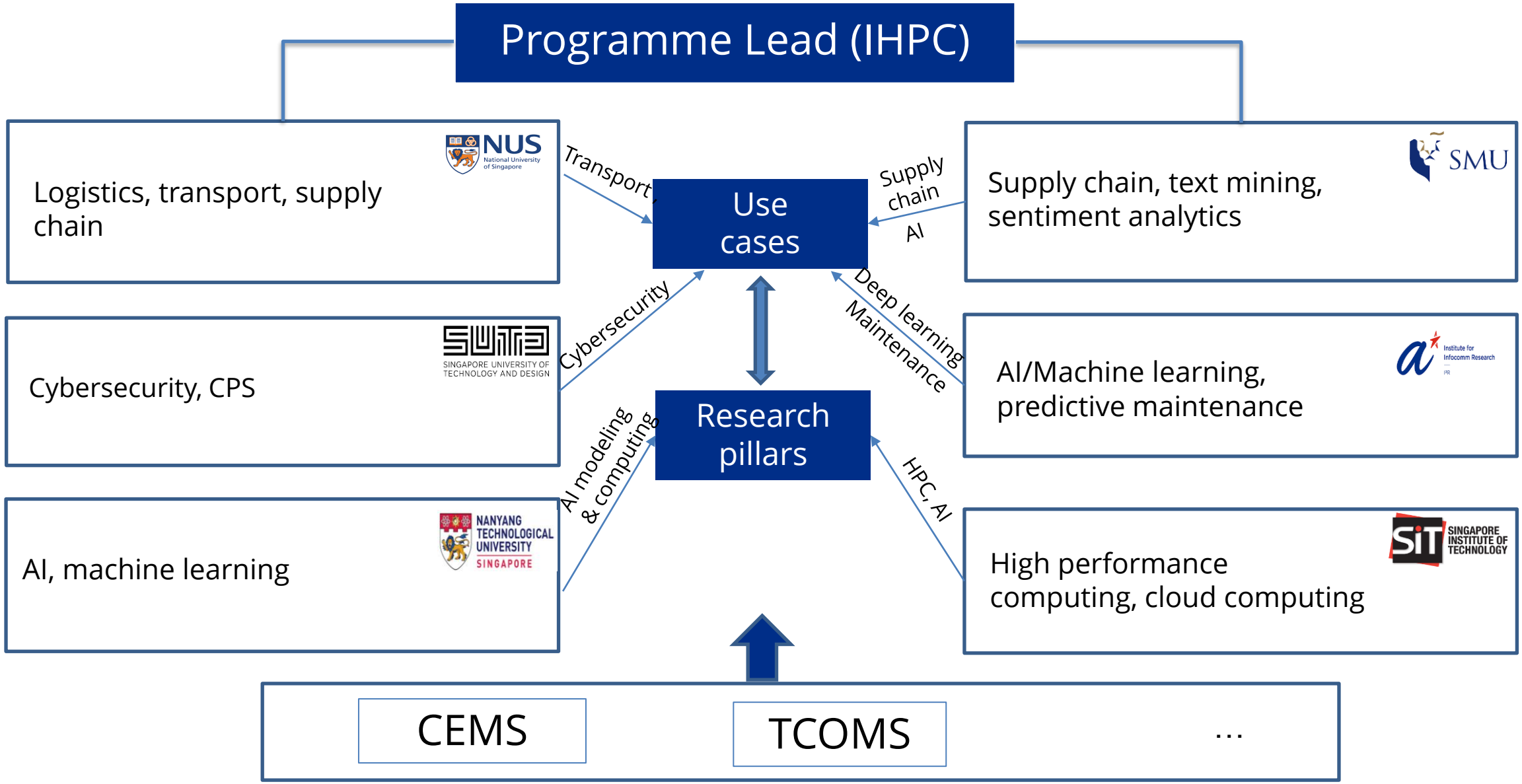
Collaboration with IHLs and RIs



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Technical Deliverables

Deliverables		Details	Long term goal
Phase 1	Phase 2		
Maritime data processing toolkits => To develop toolkits and provide "good" data to facilitate AI modelling	**Maritime Data Bank** => To enable companies to easily leverage on right data sets & experiment with AI	- **Standardised** data sets which are **"AI ready"**, e.g., traffic, AIS, operation - rich, high quality, multi-modal, trustable, searchable	Build up qualified data sources to facilitate AI development and collaborations Establish trust among siloed data owners to share data for industry-wide benefits
Maritime AI Model toolkits => To develop and validate maritime AI toolkits and frameworks to streamline maritime AI development	**Maritime AI ModelStore** => To enable non-experts to rapidly develop AI apps	- Platform with repository of AI models - Easy to use for non-expert, curated use cases and models - **Resource-efficient** & **scalable** computing environment	Scale up development and adoption of AI by companies, and promote Maritime AI
Selected Maritime Use Cases => To develop, validate and enhance maritime AI models with practical maritime applications	**Platform for benchmarking of maritime AI apps**	- Prototype platform for **testing, benchmarking and validation** of maritime AI models - specific applications such as traffic safety, leveraging on SG as one of the world's busiest port	Establish Singapore as **global maritime AI CoE for testing** and validate AI algorithms for maritime transformation

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An Illustration Using the Maritime Traffic Safety Use Case

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Phase 2

International Test Centre

(The first framework proposed for maritime)

Maritime Data Bank

Standardised maritime traffic data sets to enable model development, training & evaluation

Standardised maritime traffic **knowledge base** covering various **traffic scenarios** for testing, e.g., near miss, hotspot

Maritime data processing toolkits

Traffic data from MPA, near miss case data from PSA, AIS data from other waters, etc.

Maritime AI ModelStore

Maritime AI toolkits for **intelligent decision support** based on maritime data bank

Repository of AI models which is **easy to be adapted** for other waters and traffic

Maritime traffic AI model repository

- Traffic Data Bank

1) ***Standardized datasets*** for model development & training

2) ***Identified traffic scenarios*** for model testing

- AI ModelStore

1) Baseline performance (e.g., IHPC model)

2) Standards and ***evaluation metrics*** for benchmarking & testing

Testing results with **validation by operators**

- **Enhancing** models developed **individually**
- **Collaborative** development of the **best AI tool for SG**

Ensemble

Ecosystem partners in co-development, testing and applications:

VTS users	Port service providers	Classification society	VTS tech companies	Maritime tech companies
Need various traffic safety functions and **VTS** systems	**Need** collision risk detection function within port water	**Testing** (and certification) for traffic safety and autonomous navigation	**Developing** and testing its traffic safety functions in VTS systems	**Developing**, evaluating and testing **ship-based traffic risk rating**

Programme Targets (Phase 1)

Maritime AI Research

- **I**nternational publications, TDs/patents
- **S**tudents and scientists/engineers trained
- **C**ollaborative projects with RIs and IHLs

Maritime AI Innovation

- **D**emonstrators/use cases (with AI models and data toolkits)
- **C**leaned/ Reusable maritime AI datasets
- **M**aritime AI toolkits
- **M**aritime AI Platform framework designed for benchmarking/testing

Maritime AI Adoption

- **Q**uantifiable performance improvement for industry partners
- **A**dditional companies trained and participated in trials
- **I**ndustry research spending (IRS) in cash and in-kind

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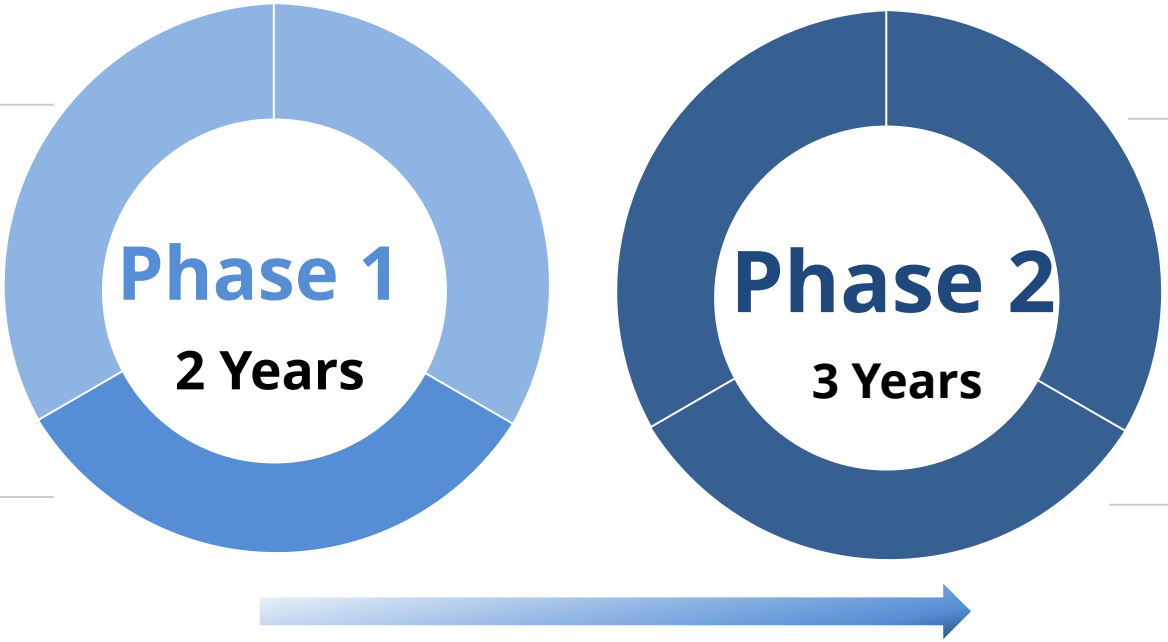
Summary

Maritime AI Enabling Technologies

AI Models and Data Toolkits

Use Cases with Confirmed Partners and Data



Data Bank
Qualified data sets and processing toolkits

AI Model Store
Scale up development & deployment of AI

International Test Centre
Foster co-development and validation of AI models

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Thank you!

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