About IHPC

Established
1998

> 300
Researchers with industry & academic experience (mostly PhDs)

Multi-disciplinary computational expertise under 1 roof

> 250
Technical articles published annually

Spearheads innovations through Modelling, Simulations and AI

Strong collaborations with industry & government agencies

Achievements & Awards

- International & local technology awards
- Co-innovated award winning products with partners
- Talents recognised in top international professional bodies
- Winner of best papers, competitions & Hackathons

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SG Passion Made Possible

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Co-innovation through deep multidisciplinary modelling, simulation and knowledge-driven AI

Computing Science
- Complex systems & multiscale optimisation
- Physics & data-driven digital twin

Social & Cognitive Computing
- Social & behavioural insights
- Behaviour & cognitive influence
- Social & human-level AI

Engineering Mechanics
- Design & optimisation of structural materials
- Virtual manufacturing & processes
- Design, structural reliability & health monitoring
- Mechanics-coupled systems

Materials Science & Chemistry
- Materials selection & design
- Chemistry & catalysts
- Polymers & formulations
- Semicon & electronic materials

Fluid Dynamics
- Engineering fluids flow
- Coupled & multiphase flow
- Computational geometry, design & optimisation
- Physics-based data driven modelling of flow

Electronics & Photonics
- Nano & quantum photonics
- Electromagnetics & wireless power
- Inverse imaging for NDT
- Irradiance & light-matter interactions

- High performance, distributed & efficient computing
- Knowledge-driven AI

Cross-departmental Initiatives

- Digital Manufacturing Processes & Design
- Accelerated Materials & Chemicals Development
- Green Marine, Offshore, Oil & Gas Engineering
- Transport & Trusted Connectivity
- Environmental & Food Sustainability

Create Impact through Modelling, Simulation & Knowledge-driven AI

Design better products & services cost effectively

Understand phenomenon of complex problems

Optimise processes & operations

Detect and **Predict** outcomes

A. Accelerate Exploration

- Explore many options
- Do what experiments cannot

B. Shorten Design Cycle

- Quick product or system development
- Less prototyping & testing
- Optimal design, process or solution
- Reduce cost

C. Quicken Time-to-Market

- Better products
- Productivity gain
- Lower TCO

Research Focuses in IHPC for Enhancing Maritime Operation

Insights from Data

Safety research, risk reduction

Operation efficiency enhancement

Planning and strategies evaluation

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Operational data within the S-100 framework: challenges for the Common Maritime Data Structure

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Authors: Zhu Yongqing, Renuga Kanagavelu, Ricardo Shirota Filho, Theint Theint Aye, Rick Siow Mong Goh

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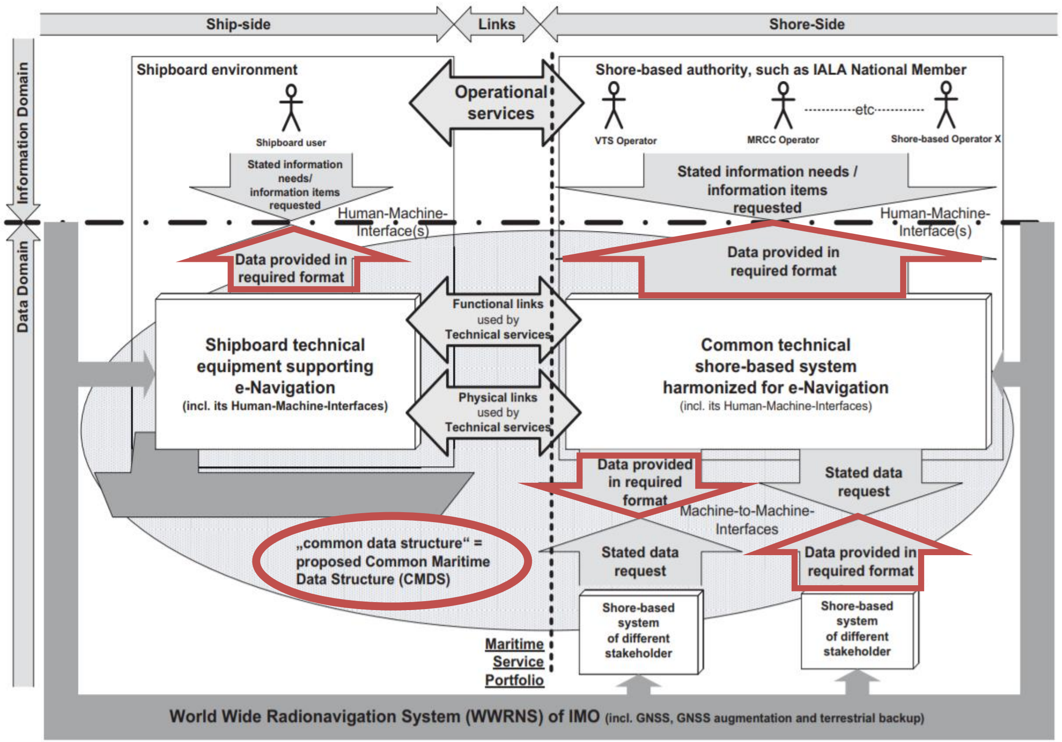
Context: IMO e-navigation

E-navigation is defined as

"the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."

Source: http://www.imo.org/en/OurWork/Safety/Navigation/Pages/eNavigation.aspx

Context: Common Maritime Data Structure, 16 maritime services



MS1	VTS Information Service (IS)
MS2	Navigational Assistance Service (NAS)
MS3	Traffic Organization Service (TOS)
MS4	Local Port Service (LPS)
MS5	Maritime Safety Information Service (MSI)
MS6	Pilotage service
MS7	Tugs Service
MS8	Vessel Shore Reporting
MS9	Telemedical Assistance Service (TMAS)
MS10	Maritime Assistance Service (MAS)
MS11	Nautical Chart Service
MS12	Nautical Publications Service
MS13	Ice Navigation Service
MS14	Meteorological Information Service
MS15	Real-time Hydrographic and Environmental Information Service
MS16	Search and Rescue Service

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Motivation

- Singapore is an important transshipment hub in South-East Asia
- Maintaining competitive advantage is core strategy for SG relevance
- Singapore nominated Domain Coordinating Body for MS8 and MS16 under IMO, together with Norway

IHO S-100 Framework and CMDS

- IHO S-100: the Universal Hydrographic Data Model
- Developed to replace S-57, used mainly for production of ENC
- Fully compliant by design to ISO 19100-series of Geographic Information Systems (GIS)
- Selected as basis for CMDS

Official webpage:
http://s100.iho.int/S100

Source: Ward and Greenslade (2011)

Strengths and weaknesses of S-100

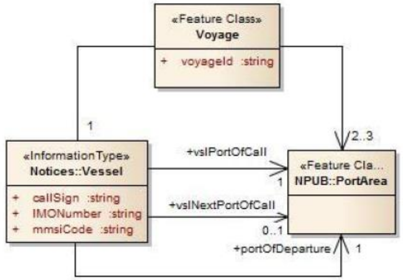
- GIS meant for representing spatial or geographic data
- As a GIS, S-100 is built around the concept of geospatial coordinates
- Convenient for hydrography, meteorology, navigation
- Not so straightforward for non-geographical applications, also referred to as “operational data” (cargo, crew and passengers, certificates, environmental, etc.)
- With increasing digitization of maritime, growing interest to go beyond geographical

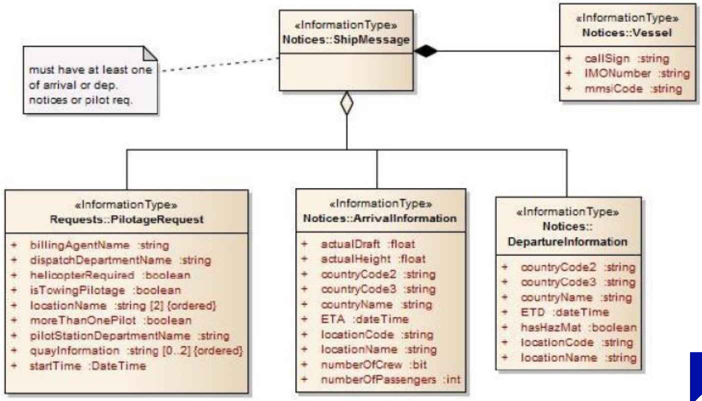
Geospatial coordinates at the center of S-100

- S-100 specification currently at version 4.0.0.0
- Detailed documentation, 700+ pages
- Data model is organized into registers
- Two main constructs of S-100:
  - Feature Type: represents “real-world phenomenon”, but tied to geospatial coordinates (show specific construct of standard)
  - Information Type: provides information about some other entity; not tied to geospatial coordinates, but not meant to be an independent entity

Past attempts: NOAPR feasibility study using S-100

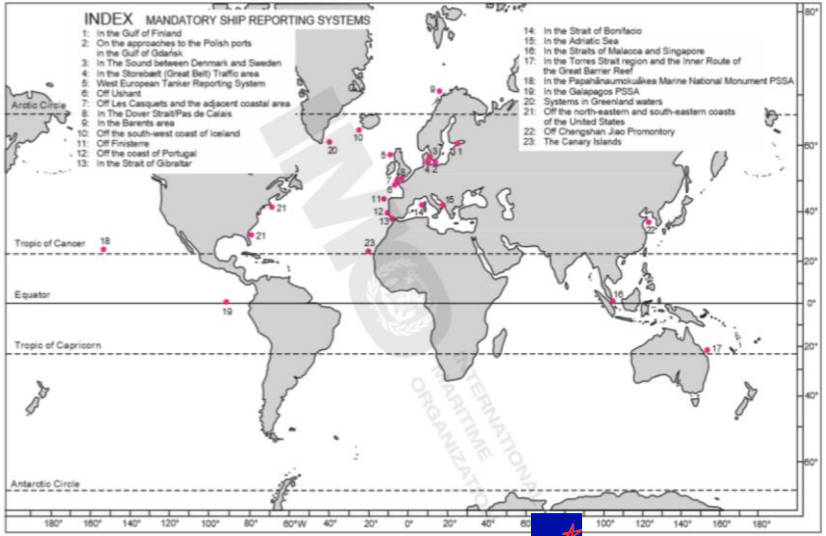
- Notice of Arrival and Pilotage Requests (NOAPR) feasibility study
- Submitted to IMO in 2011 by Jeppesen with Norwegian Coastal Authority
- Strategy was to define ‘voyage’ as main feature
- Limited scope of study (concept exploration), but useful insights





MS8: Vessel Shore Reporting

- Vessel Shore Reporting identified as maritime service 8 under IMO e-Navigation SIP
- Singapore and Norway as Domain Coordinating Bodies for MS8
- Encompasses two regimes:
  - IMO Mandatory Ship Reporting Systems
  - Pre-arrival notification



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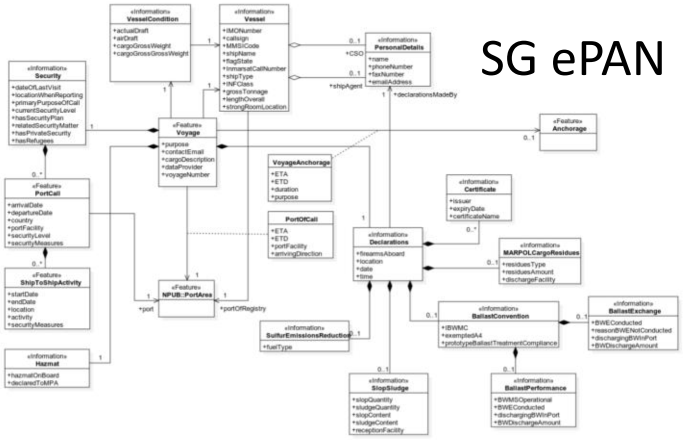
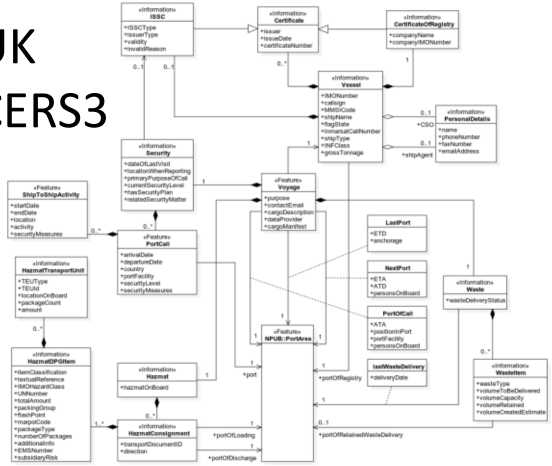
Case study: Pre-arrival forms



SG ePAN

- Modeling exercise using pre-arrival forms from 3 different ports/countries:
  - Singapore
  - United Kingdom
  - Norway
- Following S-100 specification 4.0.0
- Goal to understand both the common information requirements and the challenges in complying to S-100 specifications

UK
CERS3



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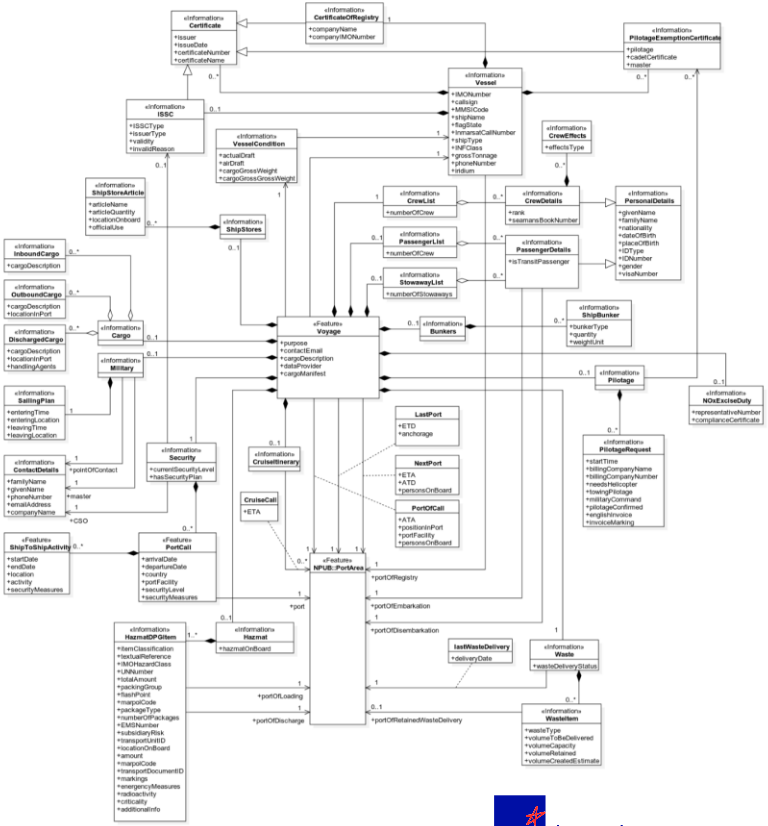
Case study: Pre-arrival forms

- Conclusions:
  – Information and level of detail requested varied largely (could be partially explained in single window)
  – Possible to arrive at a model for each form, but S-100 may make it difficult to design an efficient model for a generic pre-arrival form
  – Small-scale case study, need to dig deeper

NOR SafeSeaNet



Next steps

- Continue to investigate pre-arrival forms and required information, with special interest in non-geographical content
- Potential goal to produce a product specification for MS8
- Expand scope to other maritime services
- Connection to other data models such as IMO Reference Data Model / FAL forms and ISO 28005
- Explore collaborations with other researchers

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Thank you

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