Present & Future of Digital Maritime

Gregory S. Yovanof, Ph.D.
Managing Director, STRATEGIS – Maritime Center of Excellence

p-NET, "5G & GOVTECH", Foundation of the Hellenic World,
Athens Greece | October 25, 2023

STRATEGIS
maritime center of excellence

Outline

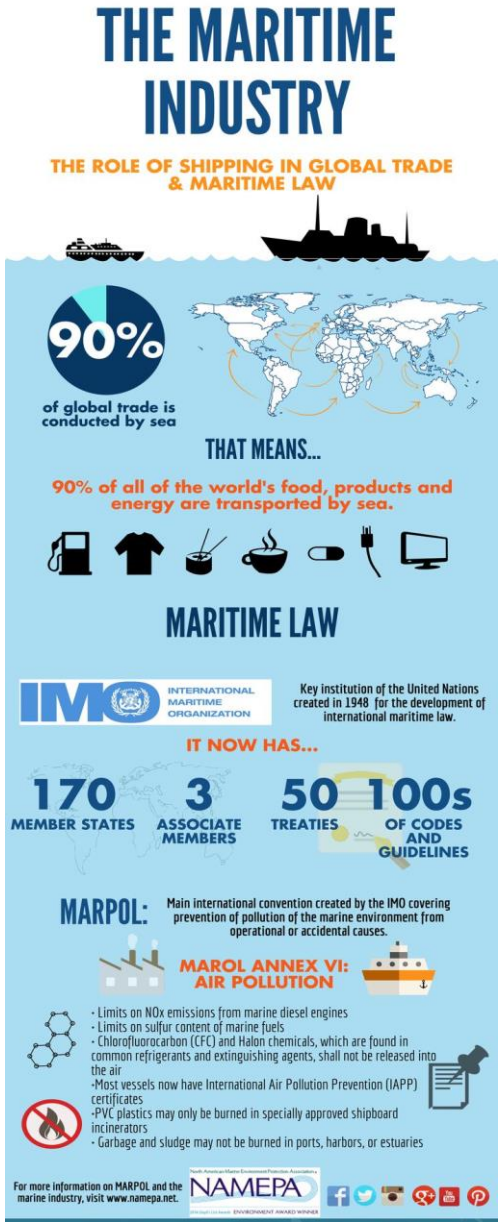
Present & Future of Digital Maritime

- Trends in Shipping & Maritime
  - Twin Transformation: Digitalization & Decarbonization
- Technology as an enabler of Twin Transformation
  - Smart Ships, Smart Ports, Port-Cities, Connected Maritime Ecosystem
  - Autonomous Shipping, IMO MASS Regulation
  - Maritime Surveillance
- Networks of Innovation
  - STRATEGIS Maritime ICT Cluster & Euroclusters

The Maritime Industry

- **"Shipping** – probably the most important business on the planet"
  - "Without ships there is no world trade and even the most pessimistic global economic scenario… sees a big future for shipping"
    - Nick Brown, Lloyd's Register's Marine Communications Manager

More than 90 per cent of global trade is carried by **sea**

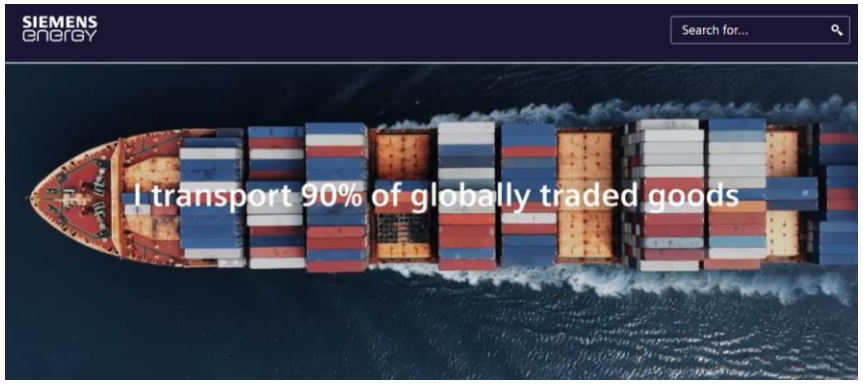


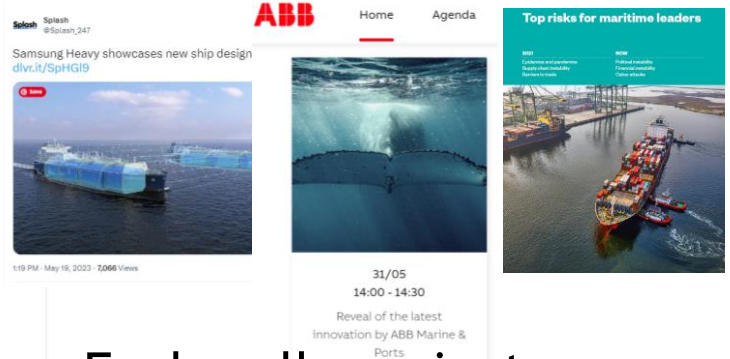
"Global Marine Trends 2030," Lloyd's Register, QinetQ, Strathclyde Univ., 2013

Global Maritime Trends

- UNCTAD calls for a "just and equitable transition" to a decarbonized shipping industry in its **Review of Maritime Transport 2023**
  - It highlights the pressing need for cleaner fuels, digital solutions and an equitable transition to combat rising carbon emissions and regulatory uncertainty in the shipping industry
  - But this comes with substantial costs

Decarbonization in Maritime





Fuel cell projects are the "wave" of the future in decarbonizing the maritime sector

- VIDEO: Siemens Energy, "Decarbonizing the sea: it's time to turn the tide" May 9, 2023

BCG Tells Carriers to Digitize or Die *
(Feb. 5, 2018)

- The container shipping industry must join the **Digital Revolution** or face being sidelined *
  - "Digital opens the door for carriers to strengthen their direct **relationships with end customers**,
  - further **reduce their costs** (including for fuel, vessel operation, and customer service),
  - & pursue **new revenue streams** beyond traditional shipping services,"

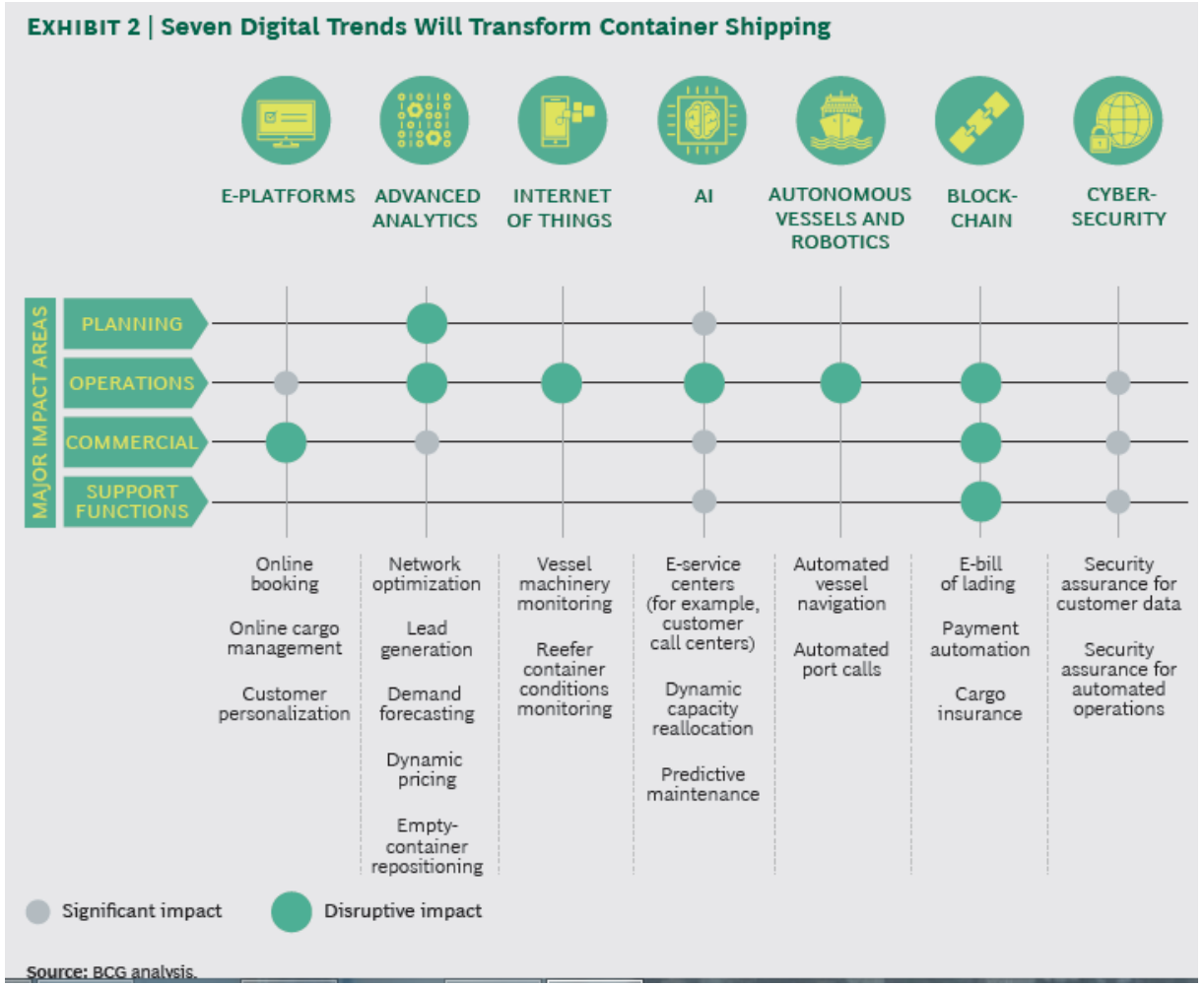
Sam Chambers, Splash247, "Boston Consulting report tells carriers **to digitize or die**," Feb. 5, 2018

* BCG, "The Digital Imperative in Container Shipping", Feb. 5, 2018

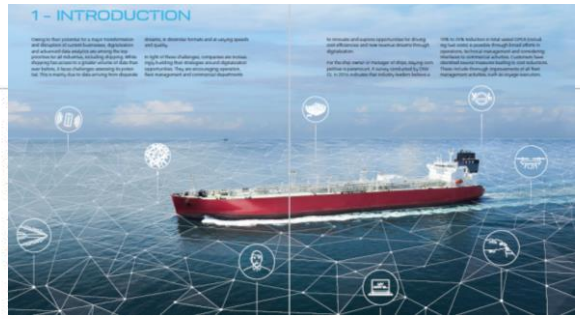
BCG, "The Digital Imperative in Container Shipping" (Feb. 5, 2018)

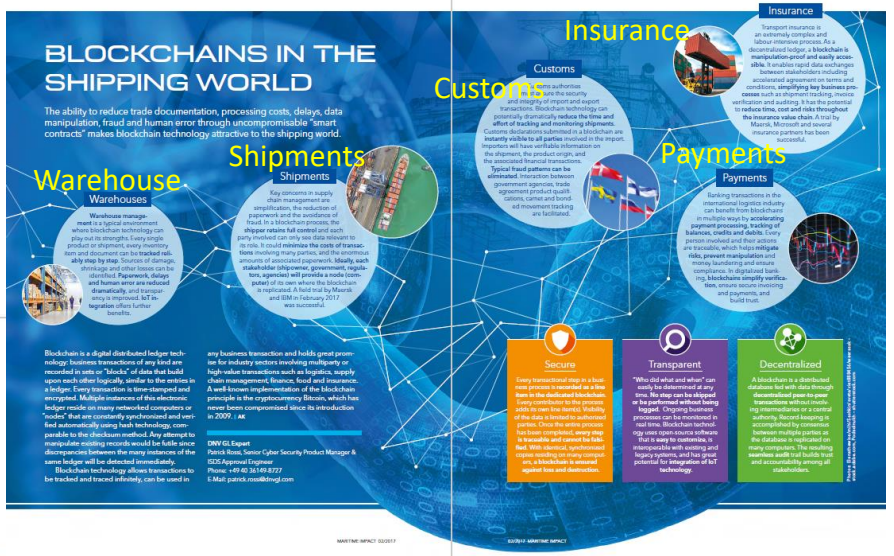
Seven Digital Trends Will Transform Container Shipping

- e-Platforms
- Advanced Analytics
- Internet of Things
- Artificial Intelligence (AI)
- Autonomous Vessels & Robotics
- Blockchain
- Cyber-Security



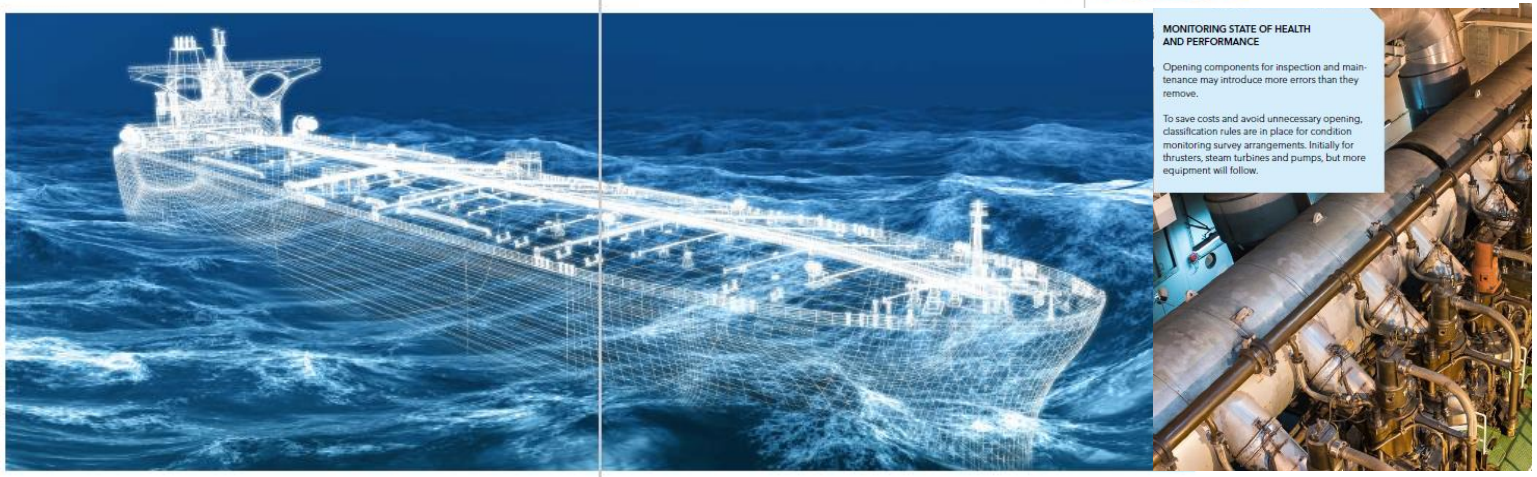
Creating Value From Data in Shipping





Use of **Connectivity** and **Sharing** of Data for **Competitive Advantage**

Example: Improving ALERT Management System



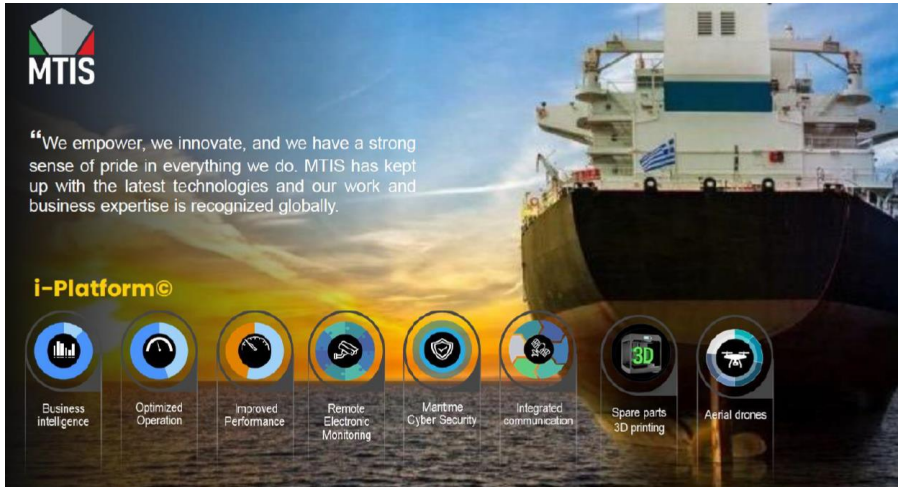
DNV-GL, "Creating Value From Data in Shipping," Feb. 2018
https://www.dnvgl.com/maritime/Creating-Value-from-Data-in-Shipping/guidance-paper-download.html

IoT Brings Future-ready Communications Solutions to the Maritime Sector

"IOT Brings Future-ready Communications Solutions To The Maritime Sector"
IEC – Telecom, 04 Oct 2022

- From voice applications to M2M devices enabling value-added services over satellite connectivity, today IoT solutions can help the maritime sector to
  - identify the most energy-efficient routes,
  - plan the most optimal engine configurations,
  - lower carbon and GHG emissions,
  - reduce fuel consumption (which represents 50-60% of total vessel operating costs), and much more.
- While earlier voice and data transmissions were dependent on costly VSAT relays, the creation of **LEO satellites** in the microwave **Ka-band** has enabled higher data rates and security.
  - Along with 5G capabilities, this is expected to revolutionize connectivity at sea.

MTIS i-Platform: A Digital-Ship Platform

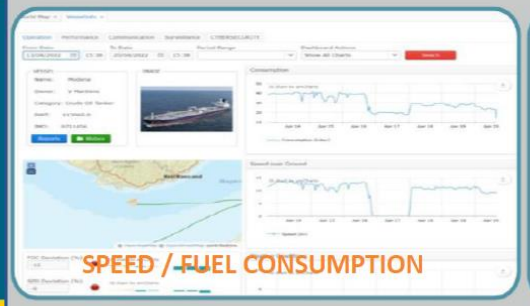


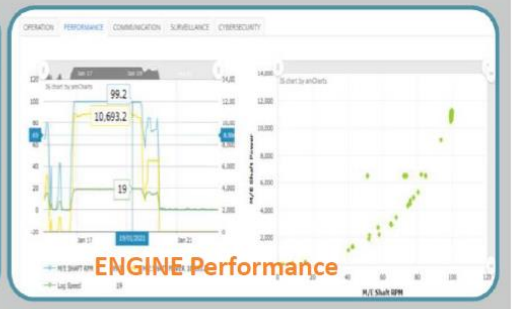
MTIS

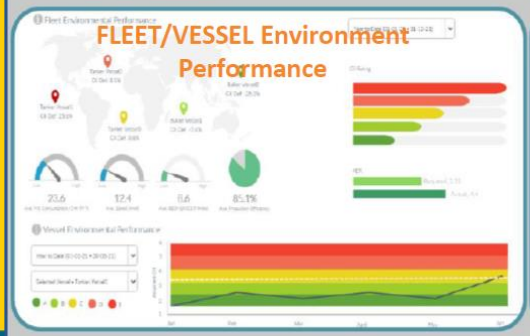
Digitalizing Shipping:

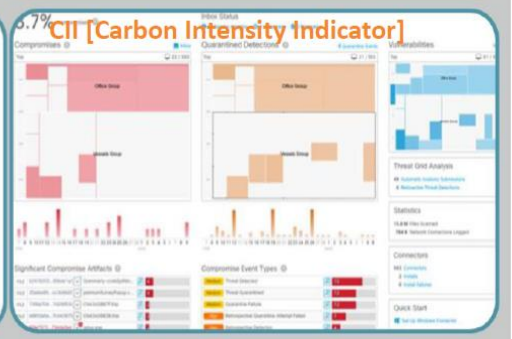
ALL HANDS ON DECK

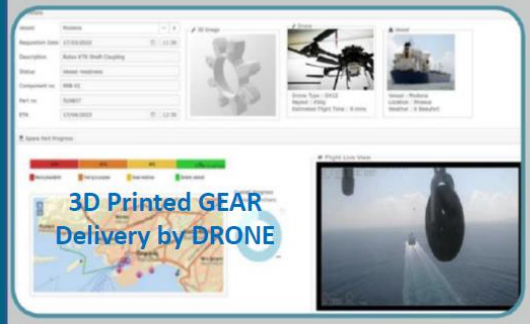
i-Platform© Indicative screenshot











www.mtis.tech

Hamburg Port Authority – A Network for Water, Roads & Rail

IT-supported traffic management, data exchange and video & telco all run on the same system

This means cargo containers can be forwarded more quickly by **water, road & rail**

Port of Rotterdam Joins Forces With IBM to Become Smartest Port in the World

- **Port of Rotterdam** teams with **IBM Internet of Things** to digitize operations and build a connected, smart port of the future
  - **IBM** is helping reshape Europe's largest port with Digital Twin, predictive weather insights, 3D printing, & connected devices

The Connected Maritime Ecosystem

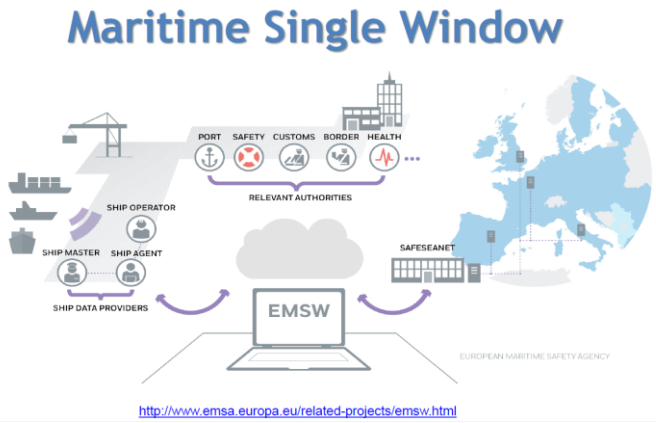
Representation of the Connected Maritime Ecosystem

https://smartport.nl/wp-content/uploads/2019/04/SmartPort-whitepaper-SmartShipping.pdf

- Today, the maritime industry is at the cusp of a new era—one driven by increased **digitalization** and innovation, in particular, **automated ships**
  - This evolution has the potential to impact all aspects of operations and business in the industry
- The "**Connected Maritime Ecosystem**" aims to
  - utilize the full potential of autonomous ships,
  - maximize their business impact on different activities and
  - create new opportunities for all parties in the maritime ecosystem

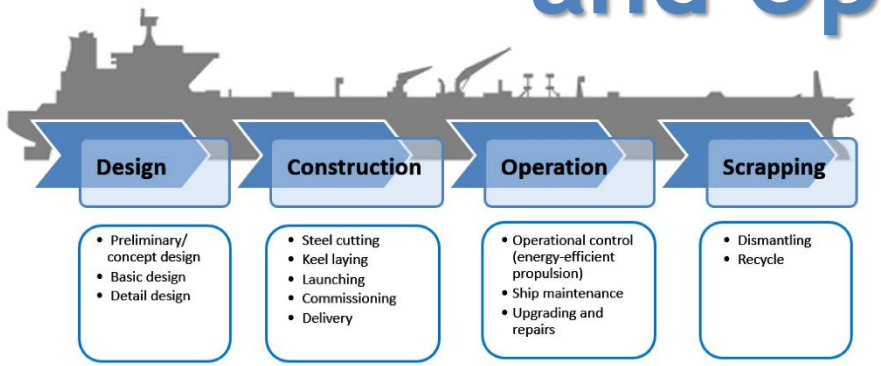
DNV: D-INF [Data collection infrastructure and vessel connectivity]

"DNV approves maritime digital infrastructure projects," MarineLink, June 6, 2022.



- Classification society DNV has published **D-INF (data collection infrastructure and vessel connectivity) class notation** which addresses a key challenge in maritime connectivity (**interoperability**),
  - by setting out the requirements for the complete data collection infrastructure, including onboard data servers, data relay components and remote data servers, covering the full **ship-to-shore communication framework**
  - **DNV Approves Maritime Digital Infrastructure Projects** [MarineLink Jun. 6, 2022]: Classification society DNV has recently approved several projects for digital infrastructure solutions developed by COSCO, Kongsberg Digital & Samsung Heavy Industries (SHI)

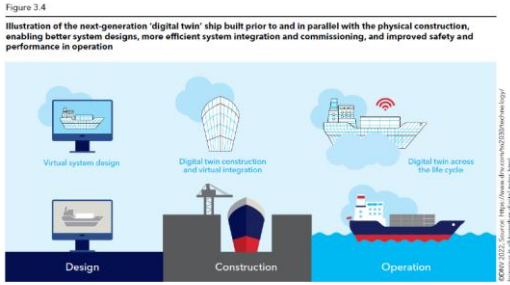
Closed-Loop Ship Design, Manufacturing and Operation Framework *



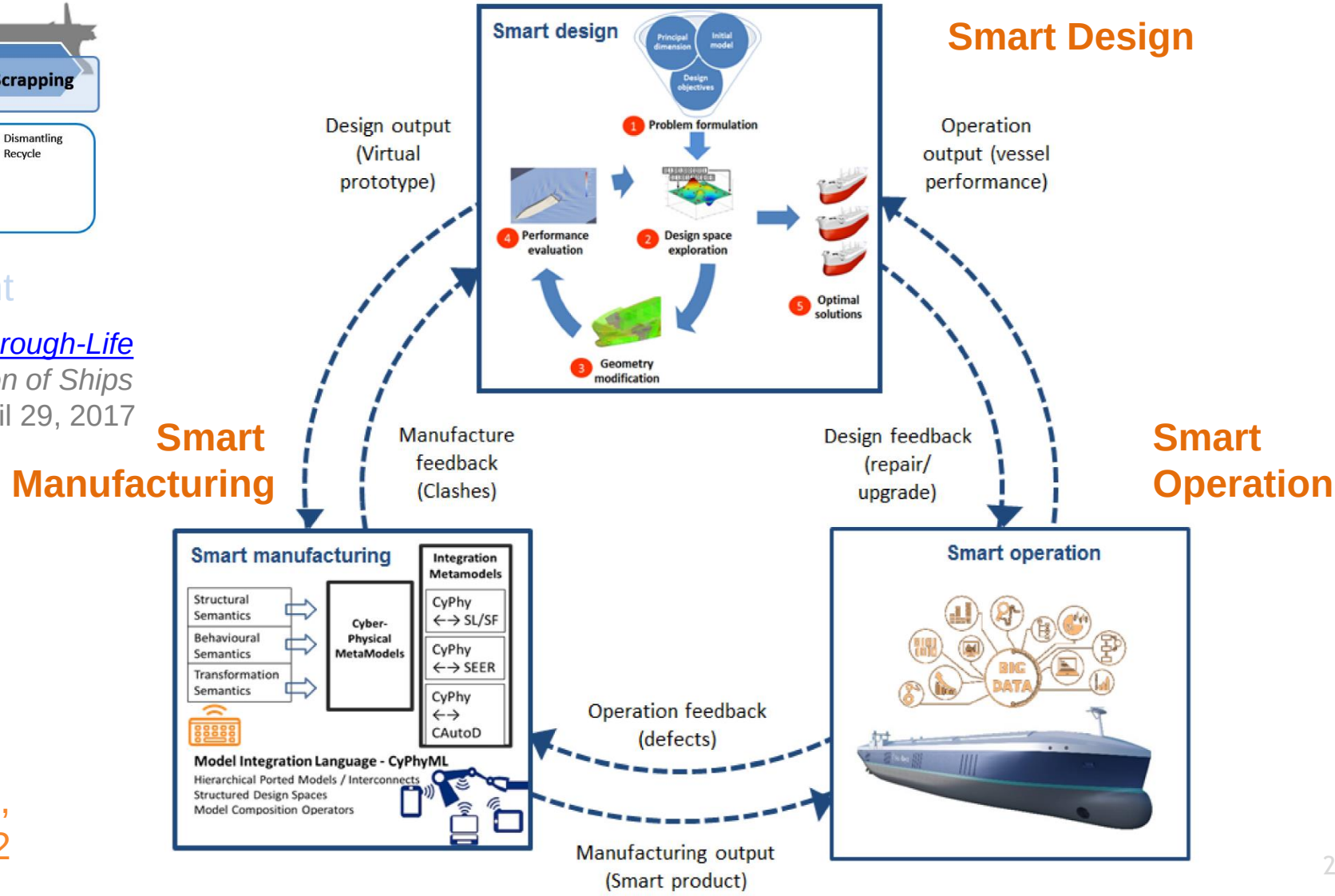
Ship Lifecycle Management

* Joo Hock Ang, et al., *"Energy-Efficient Through-Life Smart Design, Manufacturing and Operation of Ships in an Industry 4.0 Environment"*, MDPI, April 29, 2017

Use of a 'Digital Twin' in Ship Building



DNV Maritime Forecast 2050, 2023 Edition, Sep. 19, 20232



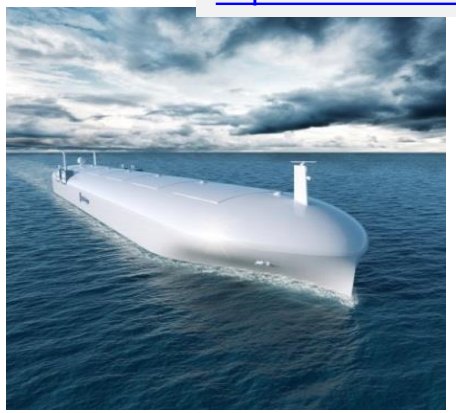
Autonomous Ships Are Almost Here!

- **Oskar Levander**, SVP Concepts & Innovation, Rolls-Royce, **"Forget Autonomous Cars — Autonomous Ships Are Almost Here"** Jan. 28, 2017
  - IEEE Spectrum, *"Autonomous Ships on the High Seas", Feb. 2017*
  - Although robotic ships are some ways off in the future, it's not a question of ***if*** they will happen but ***when***

Autonomous, Unmanned Ship of the Future – MUNIN

- EU-funded project **MUNIN**
  - Maritime Unmanned Navigation through Intelligence in Networks
  - Concept study of a fully unmanned **handymax dry bulk** carrier on intercontinental voyage
  - The MUNIN project relies on an advanced sensor system that gathers information from **onboard**, **ashore** and **offshore** to enable vessels to act autonomously

http://www.unmanned-ship.org/munin/



MUNIN – FP7 GA-No 314286
Sep 1, 2012 – Aug 31, 2015
Budget: 3.8 million EUR

MUNIN

Autonomous Ships & Smart Ports

- According to the IMO, **"Maritime Autonomous Surface Ship (MASS)"** refers to a ship which, to a varying degree, can operate independent of human interaction.
  - The IMO's Maritime Safety Committee (MSC 100) in December 2018, approved the framework and methodology for the regulatory scoping exercise on Maritime Autonomous Surface Ships (MASS).

YARA Birkeland

The first ever zero emission, autonomous ship - enters service after the christening ceremony in Norway [APR 29, 2022]

Fleet Operation Center

Completed for Crewless Maritime Autonomous Surface Ship Project.

The **DFFAS** (Designing the Future of Full Autonomous Ship) project comprises 30 Japanese companies

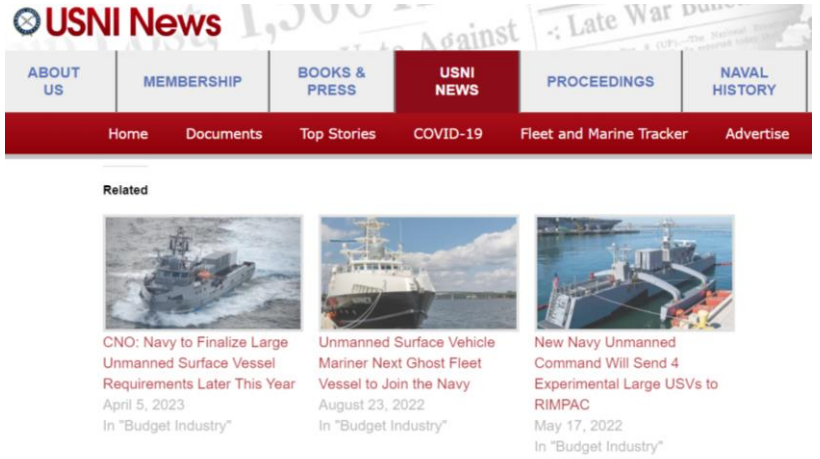
Digital twins for the maritime sector

Demonstration trial

The Port of Rotterdam, Netherlands, aims to be prepared for autonomous ships by 2030. But how will ports elsewhere fare? Credit: Eric Bakker/Port of Rotterdam.

‘Sea-Hunter’ a drone ship with no crew, just joined the U.S. Navy fleet [Feb. 2018] *

- DARPA hands autonomous sub-hunter prototype over to the US Navy * (**DigitalTrends**, Feb. 2018)
  - Following the successful completion of its Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (**ACTUV**) program, DARPA has officially transferred the technology demonstration vessel, christened **Sea Hunter**, to the Office of Naval Research (ONR) [Credit: DARPA VIDEO]



- **2 Navy Ghost Fleet Unmanned Ships now in the Western Pacific** (USNI News, Sep. 21, 2023)
- USVs *Mariner* and *Ranger* and the staff Unmanned Surface Vessel Division ONE (USVDIV-1) left California last month and sailed to Hawaii as part of a wide-ranging testing program for the Navy’s future USV fleet.
- The service believes **unmanned** or **optionally manned** vessels will be key to how the Navy’s surface fleet will operate in the future by extending the awareness and deepening the magazines of manned ships” - Cmdr. Jeremiah Daley said.

Autonomous ships on the horizon

- By 2024, the Norwegian container ship Yara Birkeland is expected to carry fertilizer autonomously from plant to port with zero emissions.
  - Credit: Torstein Bøe/NTB/AFP via Getty

"Autonomous ships are on the horizon: here's what we need to know" [NATURE, 27 Feb. 2023]

- Ships and ports are ripe for operation without humans — but only if the maritime industry can work through the practical, legal and economic implications first.
  - Rudy R. Negenborn, Floris Goerlandt, Tor A. Johansen, Peter Slaets, Osiris A. Valdez Banda, Thierry Vanelslander & Nikolaos P. Ventikos

JAPAN: MEGURI 2040 Phase Two

The Nippon Foundation MEGURI2040
Fully Autonomous Ship Program

The 749-gross-ton container ship Mikage

The Sunflower Shiretoko, a large car ferry of more than 10,000 gross tons being used for demonstration testing

The land-based Fleet Operation Center, currently under construction

The 749-gross-ton SUZAKU, the coastal container ship used in the demonstration test

無人運航船プロジェクト MEGURI 2040 | 日本財団 THE NIPPON FOUNDATION

https://www.nippon-foundation.or.jp/en/what/projects/meguri2040

- The Nippon Foundation's **MEGURI2040** project has envisioned the fully autonomous navigation program.
  - The project was launched in 2020 with the aim to reach a full-scale commercialization of fully autonomous ship technology by 2025.
- Japanese autonomous ship project moves on to second stage [Safety4sea, Aug. 30, 2023]
  - MEGURI2040 Phase Two will focus on demonstrating ship-shore operations using **four different vessel types** including a **newly built container ship** equipped with a fully autonomous operation system, an **existing container ship**, **Ro-Ro** vessel, and remote island route ship equipped for partial autonomous operations, as well as two fleet operation centres.

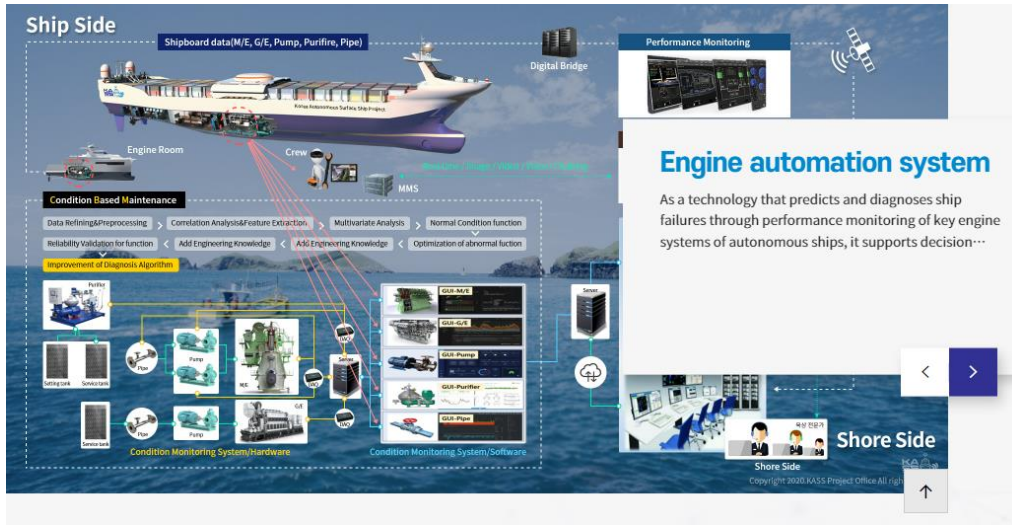
KASS: Korea Autonomous Surface Ship Project

https://kassproject.org/en/main.php

TECHNOLOGY

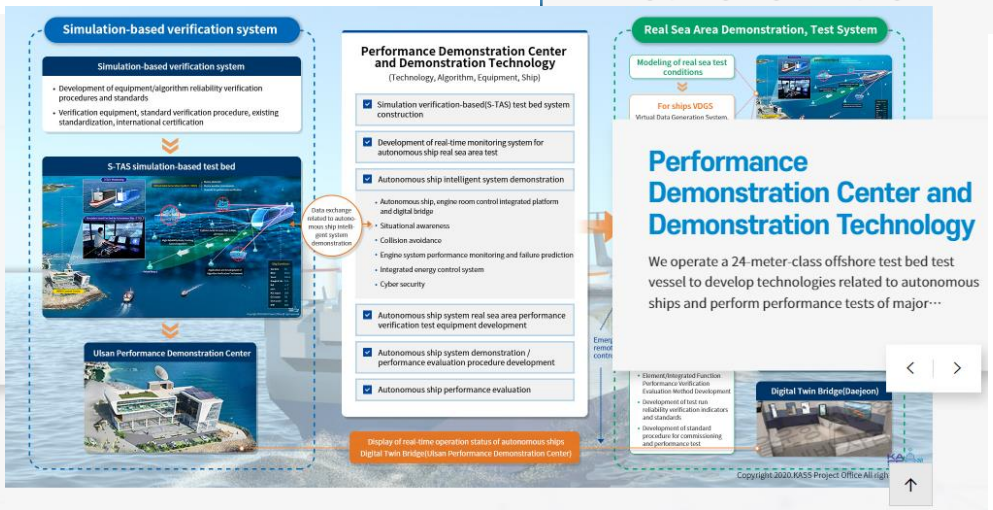
Intelligent Navigation System

This is a technology that supports the safe autonomous navigation of ships through autonomous decision-making by recognizing and analyzing the maritime…



Engine automation system

As a technology that predicts and diagnoses ship failures through performance monitoring of key engine systems of autonomous ships, it supports decision…



Performance Demonstration Center and Demonstration Technology

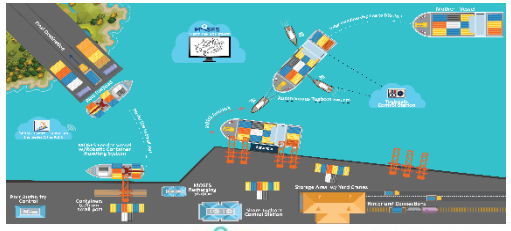
We operate a 24-meter-class offshore test bed test vessel to develop technologies related to autonomous ships and perform performance tests of major…

Short-Sea Shipping
Autonomous Ships & Smart Ports

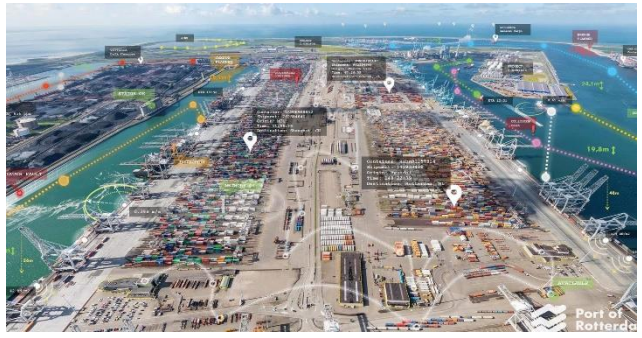
DOCKSTHEFUTURE
NETWORK OF EXCELLENCE
Towards the Port of Tomorrow

The DocksTheFuture Network of Excellence

- Supports ports to develop innovative projects to achieve their sustainable targets.
- The core topics of the network
  - **Energy efficiency** (e.g., cold ironing, smart grid)
  - **Alternative fuels** (e.g., bio-fuels, hydrogen)
  - **Sustainable and resilient transport infrastructure**
  - **Emerging technologies and digitalization across the logistic chain**
  - **Cyber security**
  - **Innovative financing tools**
  - **Multimodal transport**
  - **City-Port relation**
  - **Circular economy**



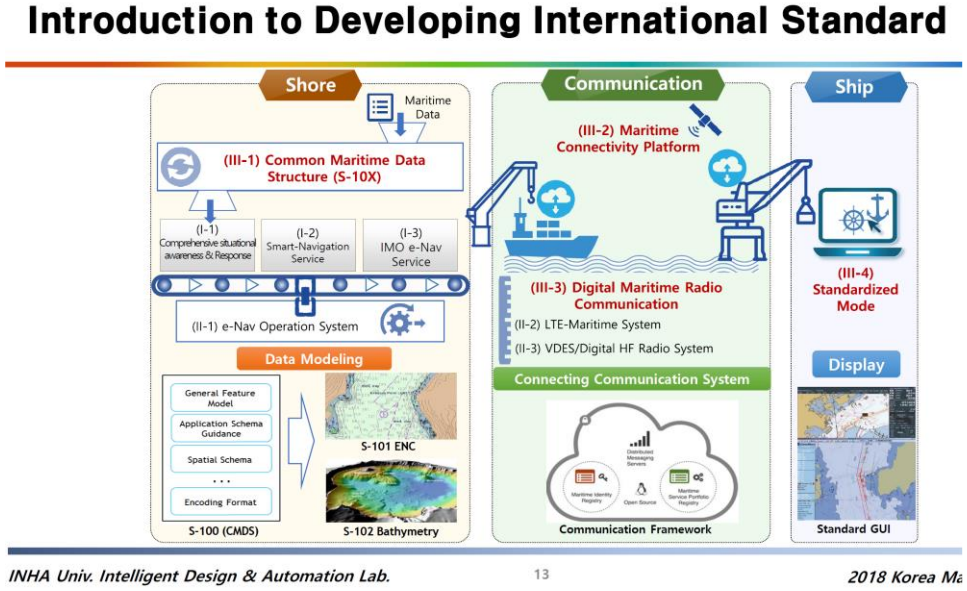
Europe's Largest Port
Prepares for Autonomous Ships
Port of Rotterdam - DIGITAL TWIN



Smart Port Initiatives Worldwide

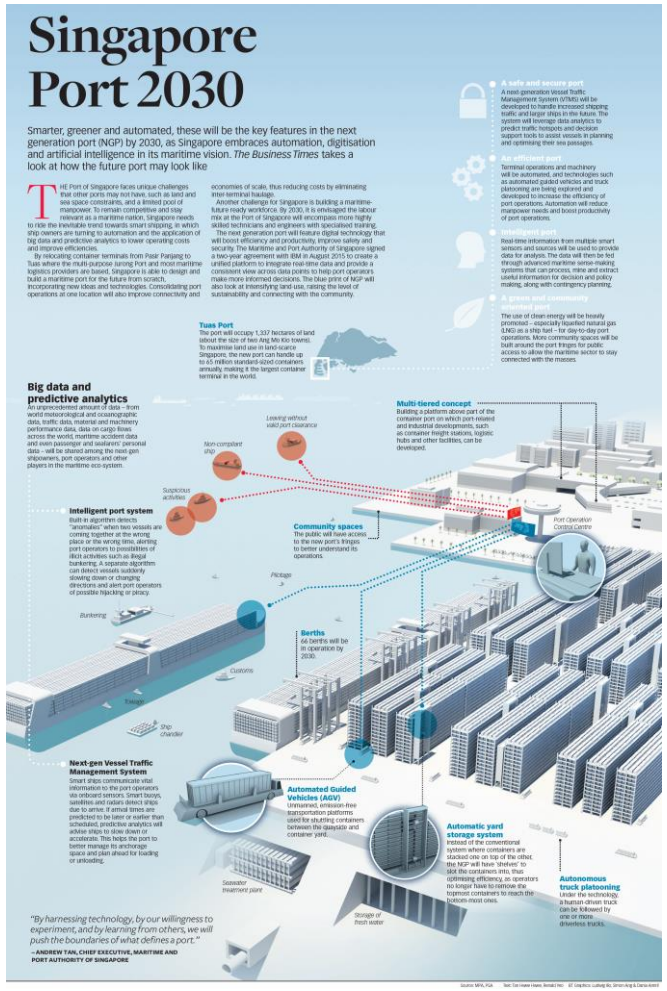
S. Korea Strategy of Smart Ship & Ocean

- S. Korea eager to lead the way in autonomous ship market

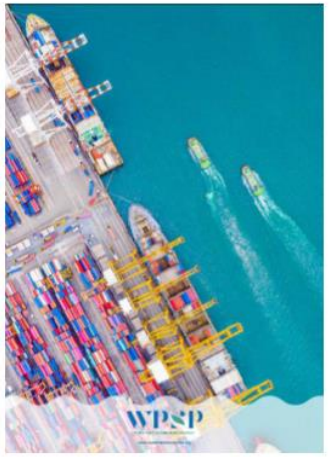


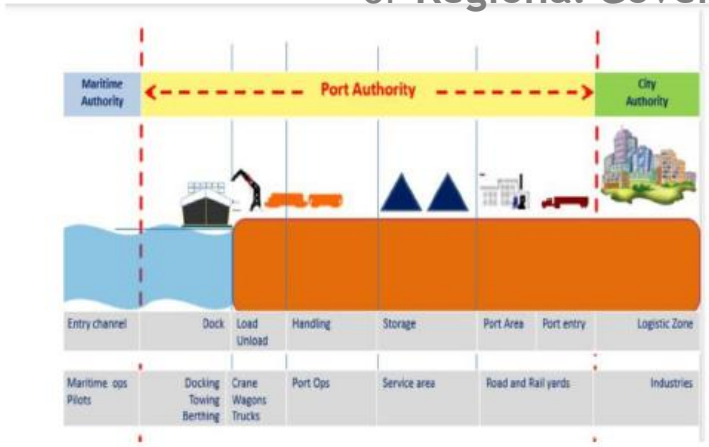
The Vision of Singapore Port 2030

- Smarter, greener and automated, these will be the key features in the **next generation port (NGP)** by 2030, as Singapore embraces **automation**, **digitization** and **artificial intelligence** in its maritime vision



Smart Port-Cities





- Cross View of the Port with the city
  The Future of Ports Jan. 23, 2021

Some ports go beyond the concept of smart ports and work towards the **"Smart City"** concept

- One of the main challenges of Smart Port-Cities is the establishment of effective policies between the **Port Authorities** & the **Municipality** or **Regional Governments**

Realizing Global Maritime Surveillance
The Challenge

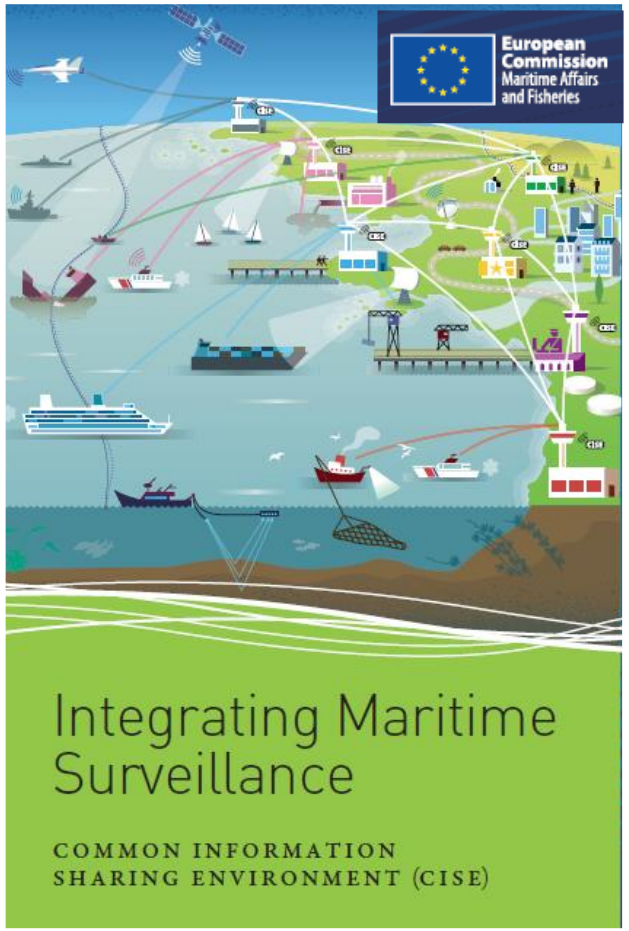
- The **variety** or **structural variability of data from ocean observing** may be among the most compelling problems for the ocean science and management communities

http://www.global-economic-symposium.org/knowledgebase/realizing-global-maritime-surveillance

Common Information Sharing Environment
CISE

Integrating Maritime Surveillance

- **Common Information Sharing Environment** for the surveillance of the EU maritime domain
  - **COM(2010) 584 final Directorate-General** Communication from the Commission to the Council & the European Parliament on a Roadmap towards establishing CISE

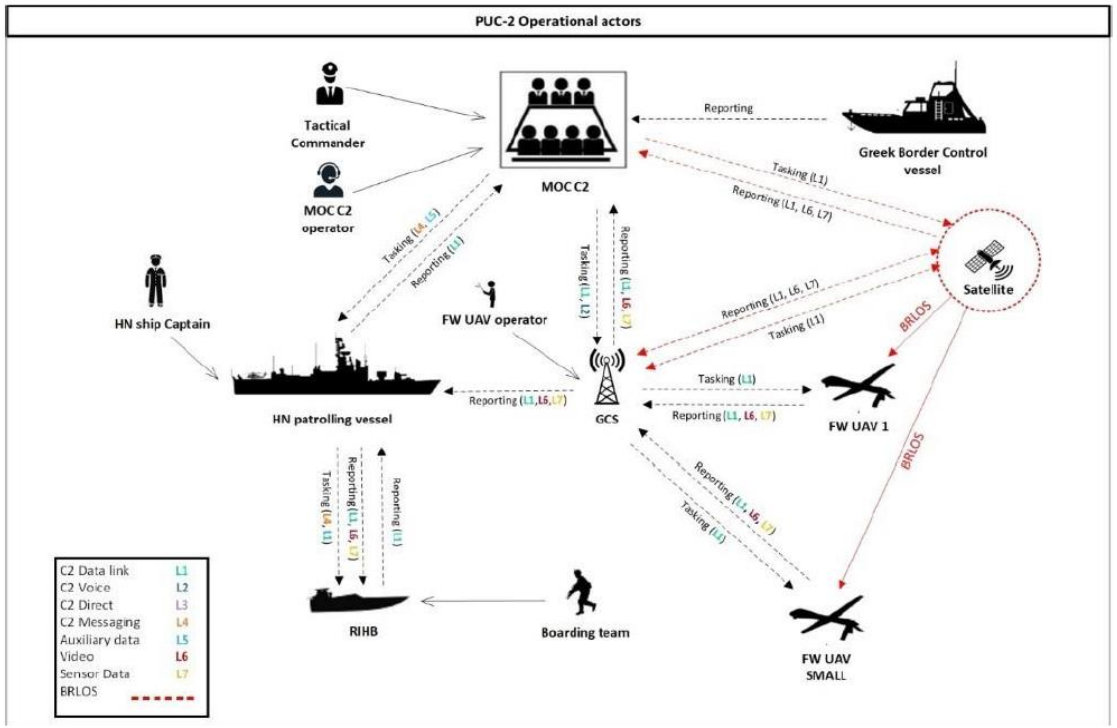


ARESIBO project: Connectivity in Maritime Surveillance

ARESIBO is an innovative system for improved situation awareness in the border security domain

ARESIBO D3.3

7.2 PUC2



https://aresibo.eu/sites/default/files/documents/d3.3.pdf

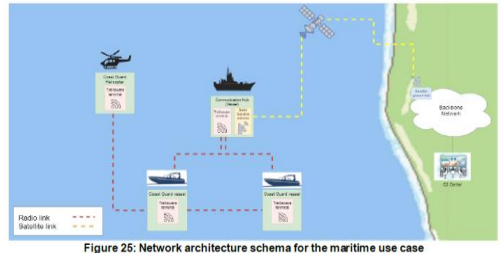
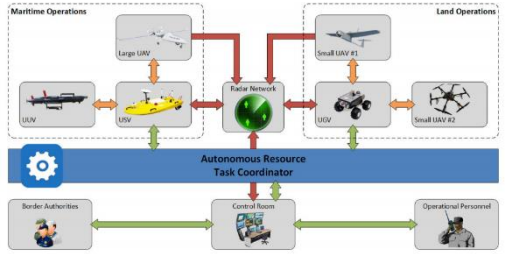


Figure 25: Network architecture schema for the maritime use case



Connectivity

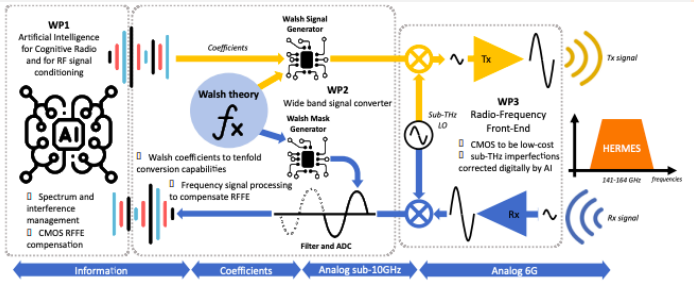
Wi-Fi and Wi-Fi + Cellular:	Wi-Fi 802.11 a/b/g/n/ac; dual channel (2.4 GHz and 5 GHz); HT80 with MIMO
Bluetooth	4.2[3]
Wi-Fi + Cellular:	GPS & GLONASS GSM UMTS/HSDPA 850, 900, 1700, 1900, 2100 MHz GSM/EDGE 850, 900, 1800, 1900 MHz CDMA CDMA/EV-DO Rev. A and B. 800, 1900 MHz
12.9-inch Wi-Fi + Cellular:	LTE Multiple bands 1, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 25, 26, 28, 29 and TD-LTE 38, 39, 40, 41

1-1ermes

http://www.h2020-hermes.eu/

HERMES proposes the fusion of Artificial Intelligence (AI) and deep sub-micron CMOS technology to open a new generation of WALSH-transform based 6G wireless transceivers.

Cognitive Radio at Sub-THz frequencies



IDE INTRACOM DEFENSE

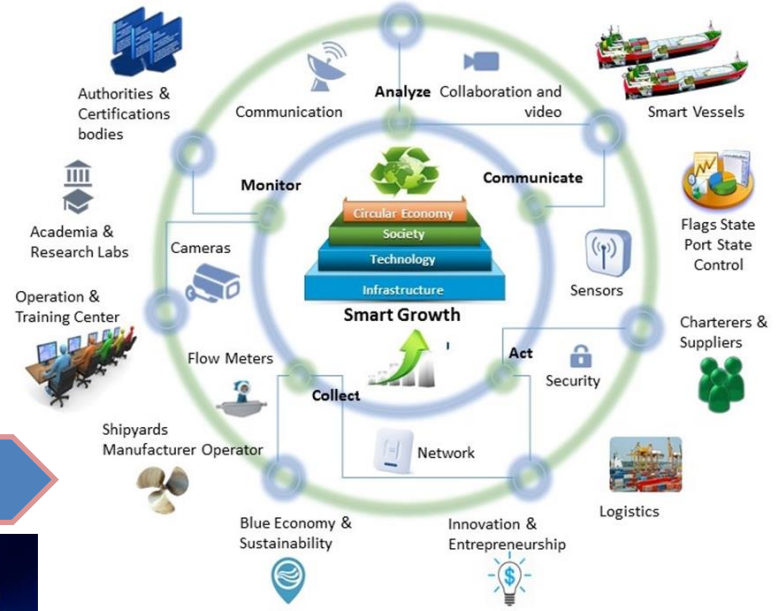
Walsh-transform based Spectrum Sensing for Maritime Surveillance

STRATEGIS Maritime ICT Cluster

Contributing to Piraeus Maritime Cluster & Blue-Growth Digital Innovation Hub (BG-DIH)

Knowledge

MARITIME Digital Transformation

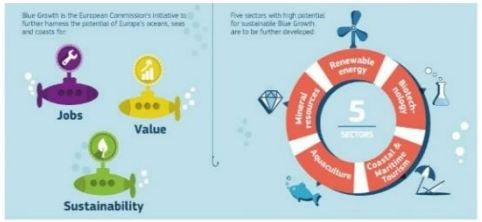


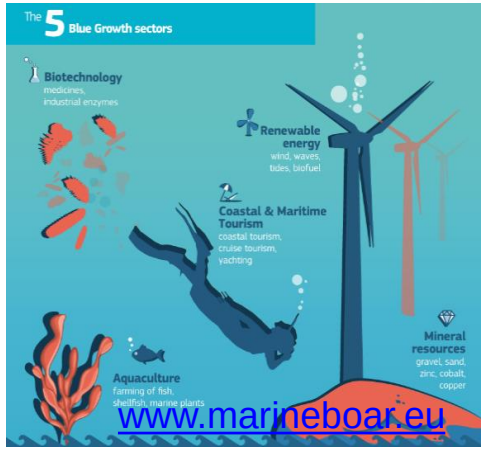
Established, Feb. 2016

www.strategis-cluster.net

Strategic Partnerships/Collaborations

- Maritime Surveillance [PROTeus Cluster]
- Blue Energy [PELAGOS Cluster]
- Blue Biotechnology [BIONIAN Cluster]
- Defence & Dual-Use Technologies [EDSP, AUG Signals Hellas]
- Marine & Maritime - MARE Technology Cluster, **FVG** (MoU, Feb. 19, 2021)
- Blue Technologies - Blue Italian Growth TC (BiG Cluster) (MoU, Sep. 28, 2021)
- MedBAN Cluster Alliance [Rome, Jul. 6, 2022]
- ENMC – European Network of Maritime Clusters [Seville, Oct. 5, 2023]
- Euroclusters Joint Initiative [Sep. 2022]
  - MedBAN [Mediterranean Blue Acceleration Network]; IKAT Tourism





Conclusions

The twin transformation of **Digitalization** and **Decarbonization** (Greening) shapes the future of Maritime Industry. Digitalization of the maritime industry is set to radically enhance the **operational efficiency, safety and environmental performance** of ships.

Autonomous vessels and robotic systems will play a key role in the Digital Maritime of the future. **Maritime connectivity** underpins these disruptive technologies and is an enabler for the digital future of shipping.

The adaptation of the **legislative and regulatory framework** and the upgrading of maritime infrastructure lag technological progress for the widespread adoption of the disruptive innovations.

5G technology will play an important role in the connectivity & remote control of autonomous ships in the future, while already playing a key role in the digital transformation of smart ports.

Gregory S. Yovanof

e: director@strategis-cluster.net

m: +30 6973 696 408

w: www.strategis-cluster.net

Thank You!