



MARITIME 4.0: HOW DATA DIGITISATION AND VISUALISATION IMPROVE SITUATIONAL AWARENESS

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MARITIME DIGITALISATION:

- Digitisation is a key component of the current and future development in the maritime domain
- New data streams are becoming available
- Opportunities are emerging for taking advantage of this

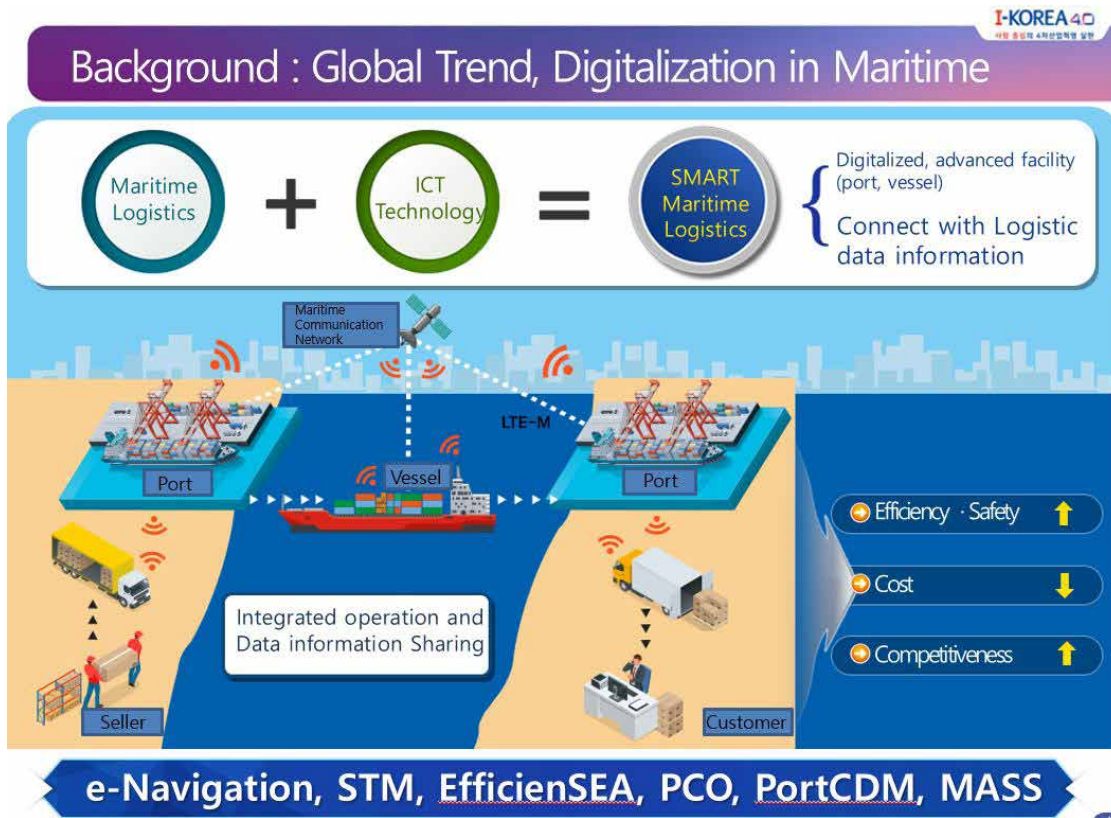
In an age of digital transformation, maritime data digitalisation and standardisation have become paramount to supporting changes along the entire chain of information processing. Without digital data sets, maritime operators will be unable to meet today's demands - let alone the demands of tomorrow. To operate efficiently and safely in the Maritime 4.0 world, port authorities and commercial companies need the ability to process digi-

tal data and integrate it with critical business systems and workflows.

DIGITALISATION IS A KEY REQUIREMENT FOR MARITIME OPERATORS

Much like the fourth industrial revolution, the concept of Maritime 4.0 uses new and disruptive technologies like artificial intelligence (AI), robotics, virtual reality and IoT devices and applications. And while many maritime operators, and the industry overall, have been

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slow to adopt these important technologies, recently the pace of adopting and implementing digitalisation strategies is quickly growing and taking hold (Fraunhofer, 2018).

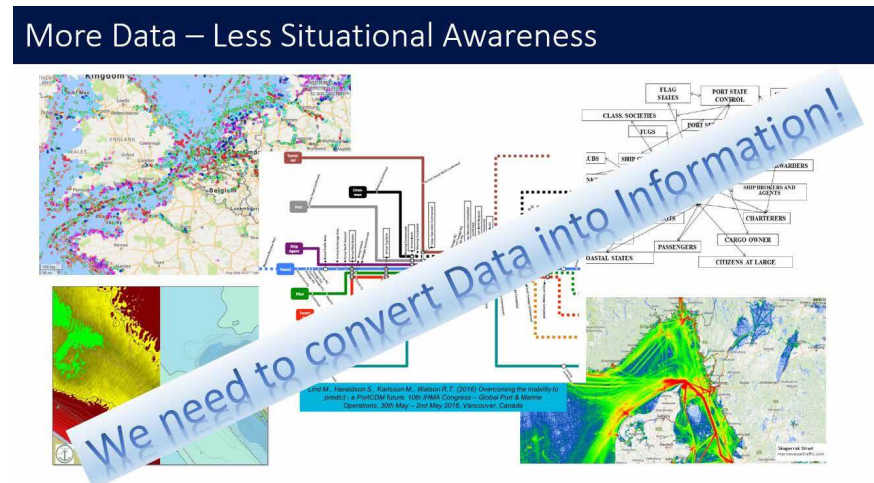
Understanding the need for data harmonisation and standardisation across the maritime industry, the International Maritime Organization (IMO) launched the e-Navigation initiative, which defines maritime services by different categories of digitalisation services in clusters. Within this same context, the International Port Collaborative Decision Making (PortCDM) Council (IPCDMC) promotes port collaborative decision making, which takes advantage of digitisation to increase situational awareness for port and hinterland operators. In its MS4 – Port Support Service definition, the IMO has noted both S-211 as well as the IPCDMC. Along with the IPCDMC, the Maritime Connectivity Platform consortium aims to further the implementation of digital maritime services.

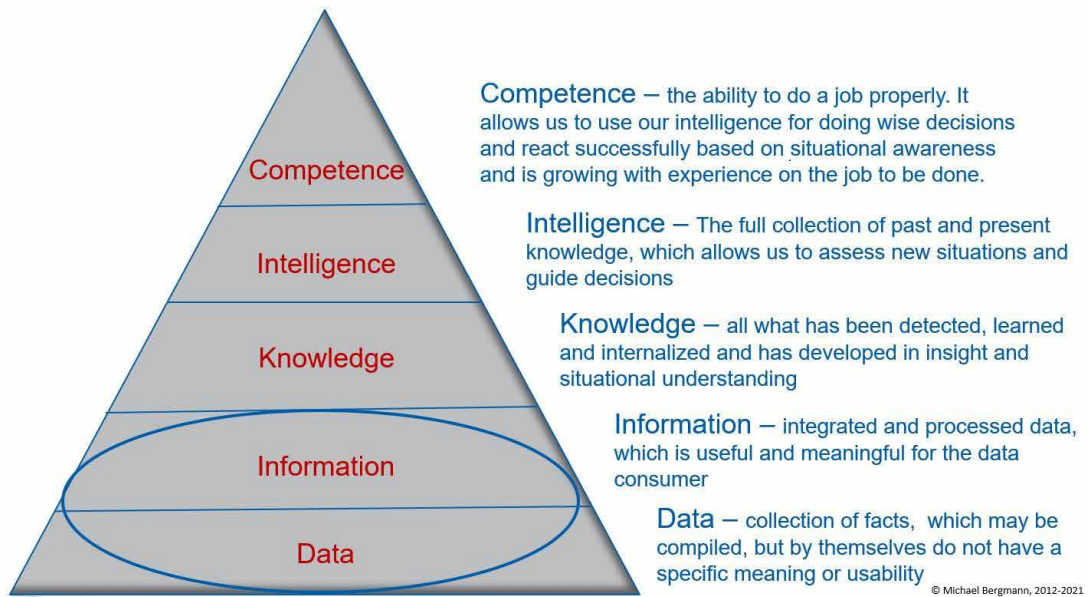
Digital data sharing for enhanced decision-making covers the maritime aspects of the so-called fourth industrial revolution (Maritime 4.0) (Bergmann et al., 2020). Building upon the notion of digital data streams, the need for the maritime domain to define and standardise the when, where, who, what, why and how on events is addressed. Standardised digital data sharing affected stakeholders can gain the necessary situational awareness. It enables coordinated decisions, improves resource utilisation and increases the safety and efficiency of operations.

As digitalisation is changing shipping, data standardisation has been identified as paramount to ensure the tremendous changes along the whole chain of information processing. Digitalisation and maritime informatics can be handled and ensure data sharing enables new opportunities in the global context. Along those lines, sharing data increases the new perspectives for situational awareness; and as a result, it can strengthen the foundations for decision making. With this in mind, it is important to differentiate data from information. Data is the uninterpreted fact. Information provides the facts in a digestible way (Bergmann, 2012).

THE OPPORTUNITIES AND THREATS OF NEW DATA STREAMS ON SHORE

An important aspect of Maritime 4.0 is the PortCDM framework. In its implementation, timestamp data on port calls is gathered and shared in a standardised way and is used to increase efficiency and safety of port calls (Lind et al., 2019). From a Maritime 4.0 perspective, the data streams from records systems like PortCDM compliant tools are growing in diversity, scope and scale. As a result, a growing number of static and dynamic data streams are being published and made available to stakeholders across the maritime ecosystem.





The integration of static and dynamic data, be it real time or near-real time, can provide additional situational awareness because it delivers information about less volatile baseline data as well as data with high volatility (Pigni F et al., 2016). With the increasing availability of static and dynamic data streams and the growing importance of IoT devices, the need for data harmonisation and standardisation has never been more critical for port authorities, commercial shipping companies and other maritime operators. However, due to its global size and scope, the maritime domain needs to ensure that there is worldwide adoption of required standards while fostering a

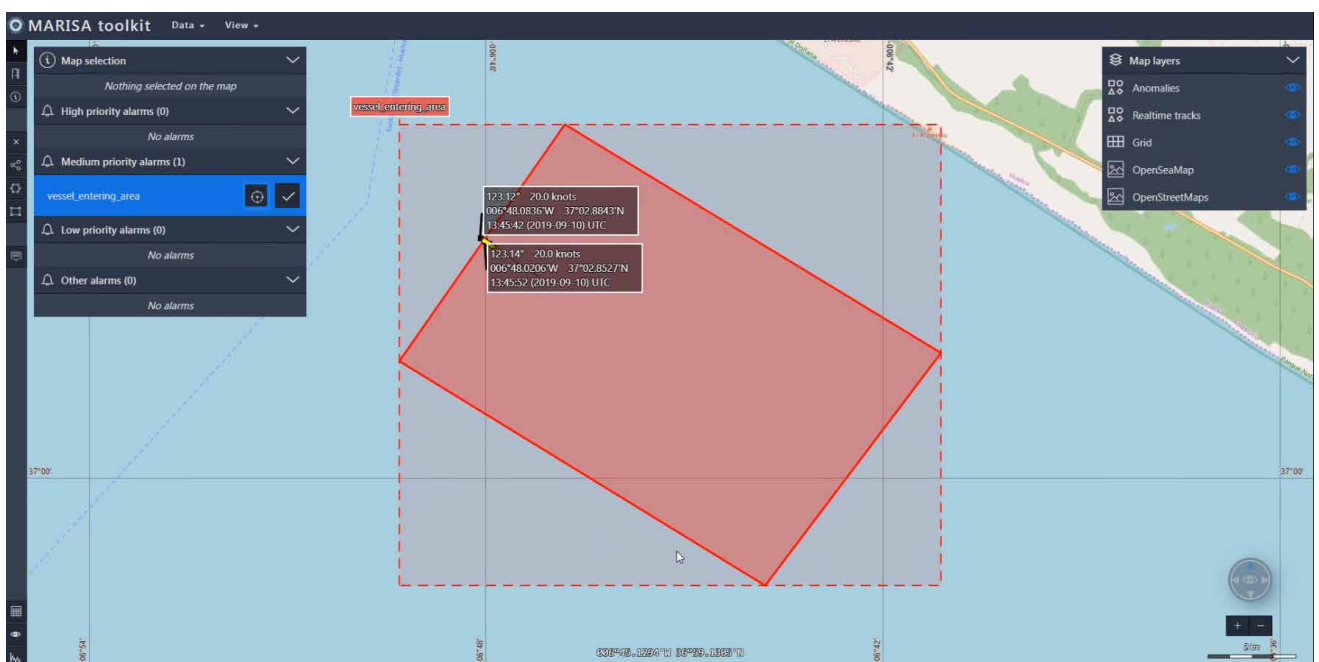
culture that supports open data streams. If data standardisation and harmonisation are achieved, maritime stakeholders can benefit from the data explosion fed by Maritime 4.0 and enabled by maritime informatics.

With the benefits and opportunities of Maritime 4.0, the growing volume of available data also has its own risks and downside. The human brain is limited in its ability to digest data. And while additional data streams are intended to increase situational awareness, and each additional data set can provide more information about a complex situation, sometimes the most important data needed to understand those situations is hidden by less relevant data. In fact, this

can actually reduce situational awareness. For example, a navigator may overlook a dangerous shoal because of the amount of depth points presented or a potential collision risk may not be recognized due to the overwhelming amount of AIS targets being visible.

TURNING DATA INTO GIS VISUALISATION FOR INCREASED SITUATIONAL AWARENESS

The terms data and information are often used interchangeably. But looking at them in deeper detail, there are distinct differences between the two. And that difference is essential for understanding digitalisation and its effects on Maritime 4.0.



Data is the source of information. If data is not processed, made available and communicated in a meaningful way for an audience, it has no value.

Transforming data into information is one of the most important features of today's information and communication tools and technologies. As part of their data processing and analysis capabilities, these technologies increasingly use logic aspects like machine learning, AI, and other analyses to turn data in valuable information. The second critical feature many information and communication technologies offer are in presentation and visualisation of information to a target audience. Here human-centred design is essential to ensure the presentation is understandable, hence create information rather than confusion.

Most situations maritime operators need to manage have a geographic component. For example, weather or other ships approaching a port or location. In this situation, a geographic information system (GIS) can be used to perform a geo-analysis to better understand the weather or vessel data and then visualise that data's geo location in a map-based view that is relevant to the port's location. For port call processes an Estimated Time of Arrival (ETA) is always related to a certain position. This is an example where GIS analysis, and the background logic, is increasingly important because it is essential for the situational awareness that maritime operators understand which geo-location the ETA is related to. With GIS analysis (e.g., geofencing) any approaching dangerous situation can be detected and addressed.

Besides supporting the background logic, GIS visualisation greatly improves the consumption and understanding of relevant information by the users. Humans can understand more easily pictures or graphic depictions than alpha numerical descriptions. Because of this, GIS solutions have become an indispensable component of a modern human machine interface (HMI).

A good use case with tangible results is the HORIZON 2020 – Maritime Integrated Surveillance Awareness (MARISA) Project. The MARISA toolkit is a set of services (data services, processing services) provided by various partners with the goal of improving maritime surveillance knowledge and capabilities.

In this European Union-based research project, Hexagon's Luciad platform is responsible for the HMI components and the visualisation of the various services. Based on LuciadRIA and LuciadFusion, the services offer direct support for maritime charts and enable visualisation of large data sets needed for efficient surveillance.

Another use case that highlights the benefits of GIS analysis and visualisation is Huelva, Spain's, port management system, which uses Hexagon's GeoMedia WebMap with custom developed features. The implementation offers specific consoles based on user roles and administration rights to provide a complete enterprise GIS solution.

The geoportal offered to Huelvas' port authority is enhanced with different roles, restricted data access, enhanced vector printing and export capabilities. Everything is configured through an administration console that is an extended capability on top of Hexagon's GeoMedia WebMap console.

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“THE NEED FOR DATA HARMONISATION AND STANDARDISATION HAS NEVER BEEN MORE CRITICAL FOR PORT AUTHORITIES.”

ABOUT THE AUTHOR

With a software engineering background, Michael Bergmann is a maritime consultant and is a regular contributor at the International Maritime Organization (IMO), International Hydrographic Office (IHO), International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), International Electrotechnical Commissions (IEC) and others. He is a fellow at the Royal Institute of Navigation, an associated fellow at the Nautical Institute and is the secretary for the International PortCDM Council.

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Hexagon's Safety, Infrastructure & Geospatial division improves the performance, efficiency and resilience of vital services. Its Safety & Infrastructure solutions enable smart and safe cities. Its Geospatial software leverages the power of location intelligence.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 21,000 employees in 50 countries and net sales of approximately €3.8 billion.

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