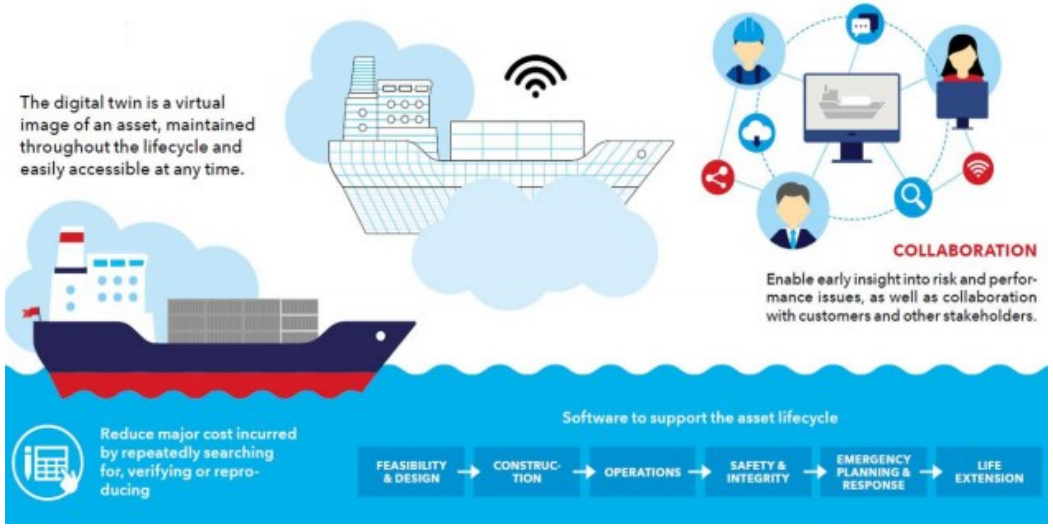
13th MEETING OF THE IHO MARINE SPATIAL DATA INFRASTRUCTURES WORKING GROUP

IHO MSDI WG13

Hybrid – Singapore, 9 – 13 May 2022

Digital Twin.



what is a digital twin?

“A digital twin is a virtual representation of an object or system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making.”

It provides a framework for creating the digital truth about the physical environment. Through simulations that show the cause and effect of an event happening, it can help policymakers and decision-makers make informed decisions to prevent incidents from occurring or mitigate the event’s impacts.

A digital twin is a digital replica of a living or non-living physical entity. By combining the physical and the virtual world, data is provided enabling the virtual entity to exist at the same time with the physical entity.

Digital twin?

The digital twin functions like the real thing it represents, allowing users to simulate and learn from it and apply these learnings to the actual assets or objects.

This means creating a highly complex virtual model that is the *exact* counterpart (or twin) of a physical thing. The ‘thing’ could be a car, a building, a bridge, or a jet engine. Connected sensors on the physical asset collect data that can be mapped onto the virtual model.

Anyone looking at the digital twin can now see crucial information about how the physical thing is doing out there in the real world.

A digital twin is a vital tool to help operators understand not only how products are performing, but how they will perform in the future. Analysis of the data from the connected sensors, combined with other sources of information, allows us to make these predictions.

Many actors are involved in the shipping industry, the digital twin can benefit the wider sector:

For ship owners, digital twins will provide a tool for visualisation of ship and subsystems, qualification and analytics of operational data, optimisation of ship performance, improved internal and external communication, safe handling of increased levels of autonomy and safe decommissioning.

For equipment manufacturers, the digital twin will provide a tool to facilitate system integration, demonstrate technology performance, perform system quality assurance and promote additional services for monitoring and maintenance.

For authorities, the digital twin will offer a systematic framework that can be set up with applications to feed live information and generate required reports from each ship. This can ensure higher quality reporting on critical issues without putting extra burdens on crew.

For universities, the digital twin offers a new platform on which to increase system understanding and facilitate knowledge exchange enhancing research and development and education in a range of technological disciplines.

For maritime academies, the digital twin can act as a platform for training that can increase each candidate's understanding of the whole ship and train them in systems thinking to see the integrated consequences of actions taken.

Digital twins will require **specialised consultancy services**. Their role will be to accelerate efficient generation of the digital twin concept, e.g. with regard to state-of-the art requirements and standards for model exchange and handling of large scale data.

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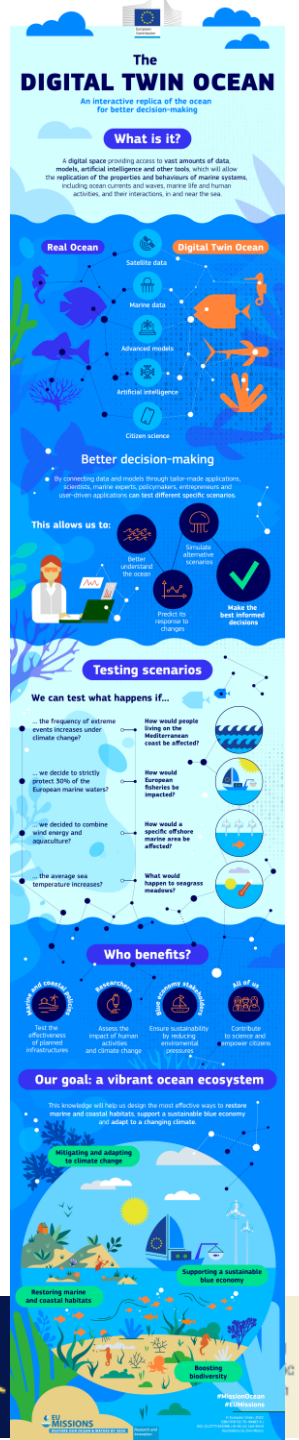
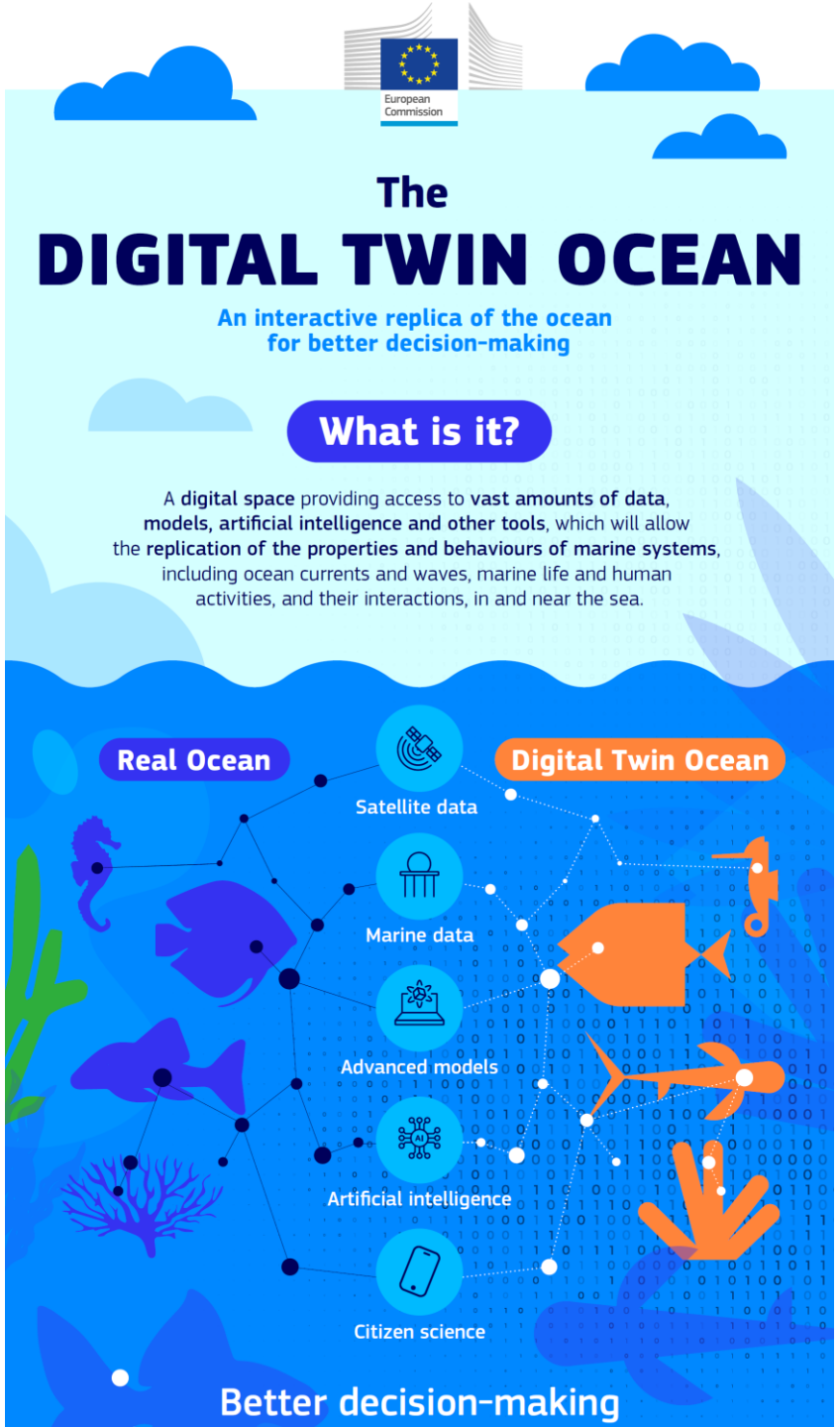




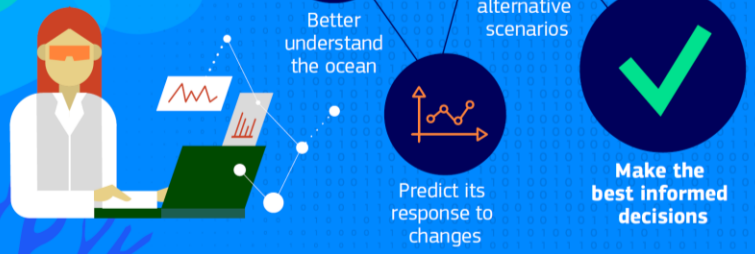
What is it?

A **digital space** providing access to **vast amounts of data, models, artificial intelligence and other tools**, which will allow the **replication of the properties and behaviours of marine systems**, including ocean currents and waves, marine life and human activities, and their interactions, in and near the sea.

Better decision-making

By connecting data and models through tailor-made applications, scientists, marine experts, policymakers, entrepreneurs and user-driven applications **can test different specific scenarios.**

This allows us to:



Testing scenarios

We can test what happens if...

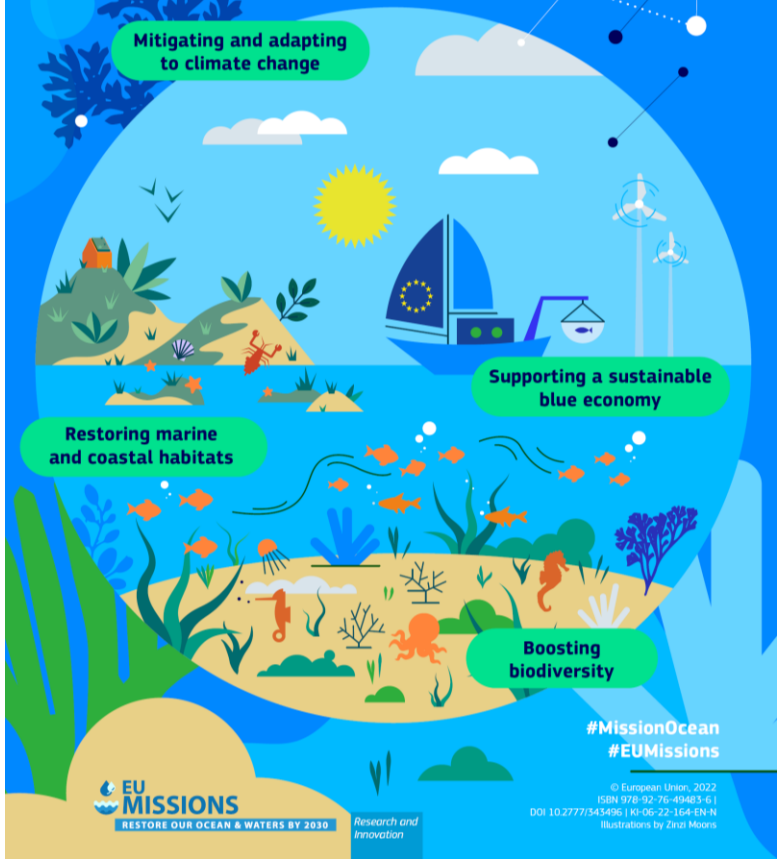
- ... the frequency of extreme events increases under climate change? → **How would people living on the Mediterranean coast be affected?**
- ... we decide to strictly protect 30% of the European marine waters? → **How would European fisheries be impacted?**
- ... we decided to combine wind energy and aquaculture? → **How would a specific offshore marine area be affected?**
- ... the average sea temperature increases? → **What would happen to seagrass meadows?**

Who benefits?

- **Marine and coastal policies** — Test the effectiveness of planned infrastructures
- **Researchers** — Assess the impact of human activities and climate change
- **Blue economy stakeholders** — Ensure sustainability by reducing enviromental pressures
- **All of us** — Contribute to science and empower citizens

Our goal: a vibrant ocean ecosystem

This knowledge will help us design the most effective ways to **restore marine and coastal habitats, support a sustainable blue economy** and **adapt to a changing climate.**



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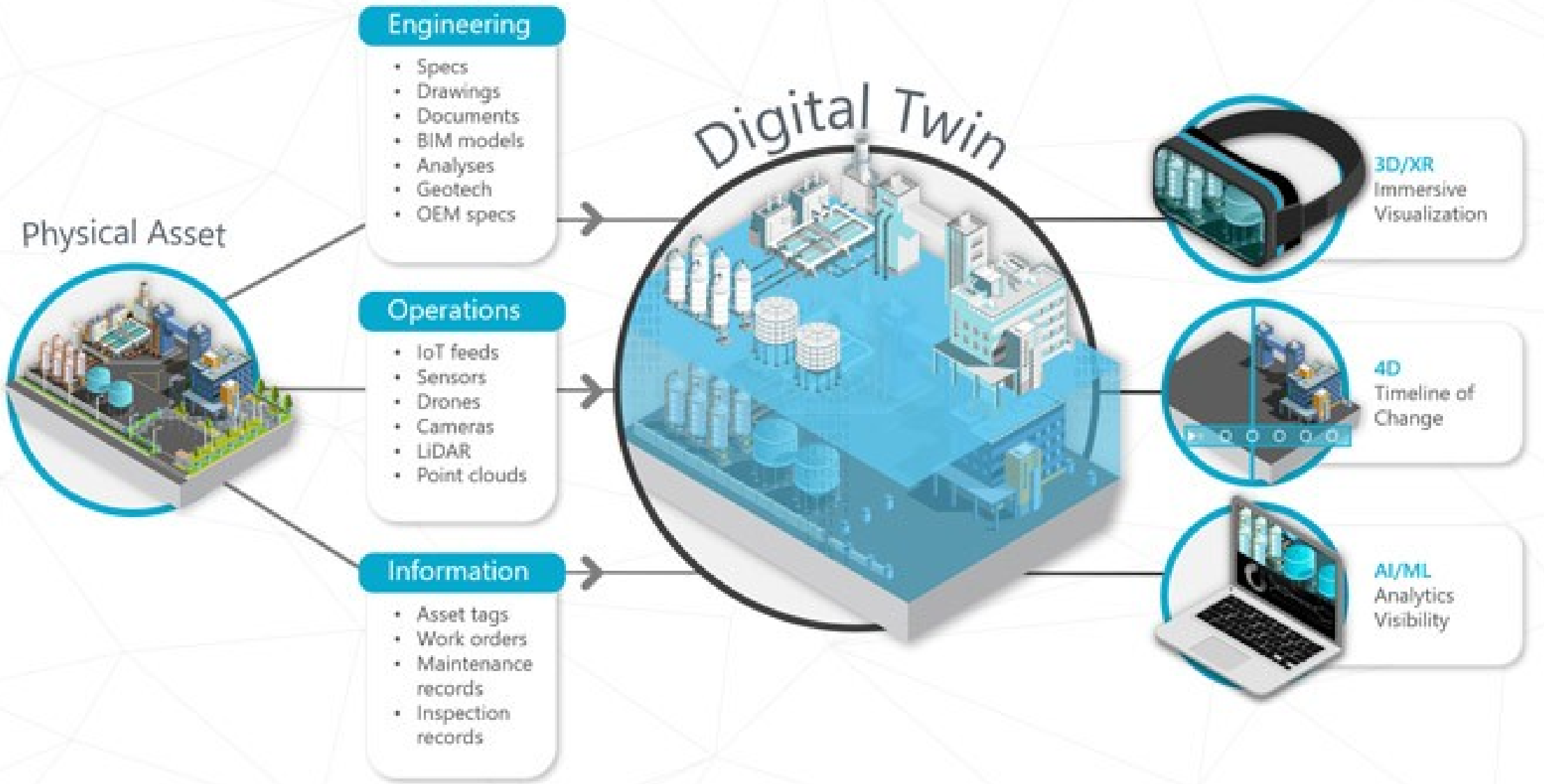
IHO International Hydrographic Organization


Physical Asset
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Operations
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Cameras
LiDAR
Point clouds
Information
Asset tags
Work orders
Maintenance records
Inspection records
Digital Twin
3D/XR
Immersive Visualization
4D
Timeline of Change
AI/ML
Analytics
Visibility
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What is a Digital Twin from a MSDI perspective?

Is Digital Twins relevant from a HO perspective?

Should the MSDIWG investigate the possibilities from a HO perspective?