



Technical Expert Group - MSP Data

TEG face to face working session

Marseille, 21 October 2024

Digital Twins of the Ocean for MSP

Introduction to the topic



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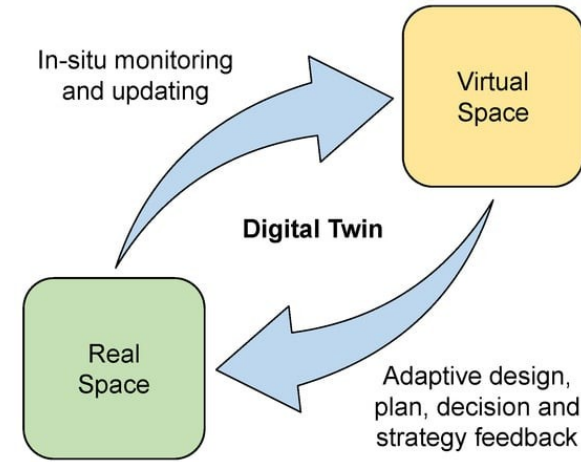
Definitions: Digital Twins

Digital Twins are a **virtual replica** of the physical world. Changes in the real system are reflected in the digital twin and the twin can be used to modify the real system (**feedback**).

Brönnert et al., 2023

Applications:

- Manufacturing
- Transportation and logistics
- Urban planning
- Supply chain optimization
- ...



Inamdar et al., 2024



Virtual Singapore

Wired, 2017

Definitions: DTO, DOT

DTO - Digital Twins of the Ocean:

are virtual representations of the ocean with its **physical, chemical and biological properties**, **based on ocean observations and ocean models** with the purpose of **what-if scenarios** for decision making. The feedback of DTO is the implementation of decisions based on the DTO.

DOT - Digital Ocean Twins:

are the combination of DTO with digital twins of assets and **activities in the ocean** for purpose to study their interaction and importance for operational decision making, protection of the marine environment and a sustainable ocean economy that includes **marine spatial planning** and marine protected areas.

Digital Twins

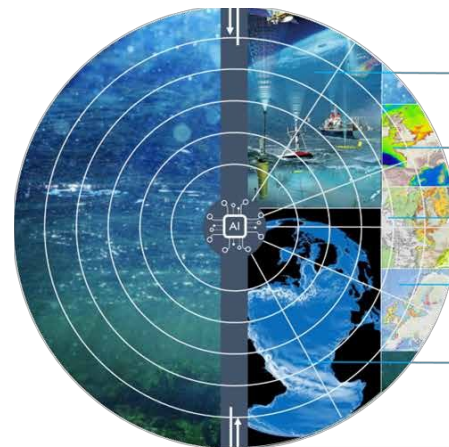
Local domain



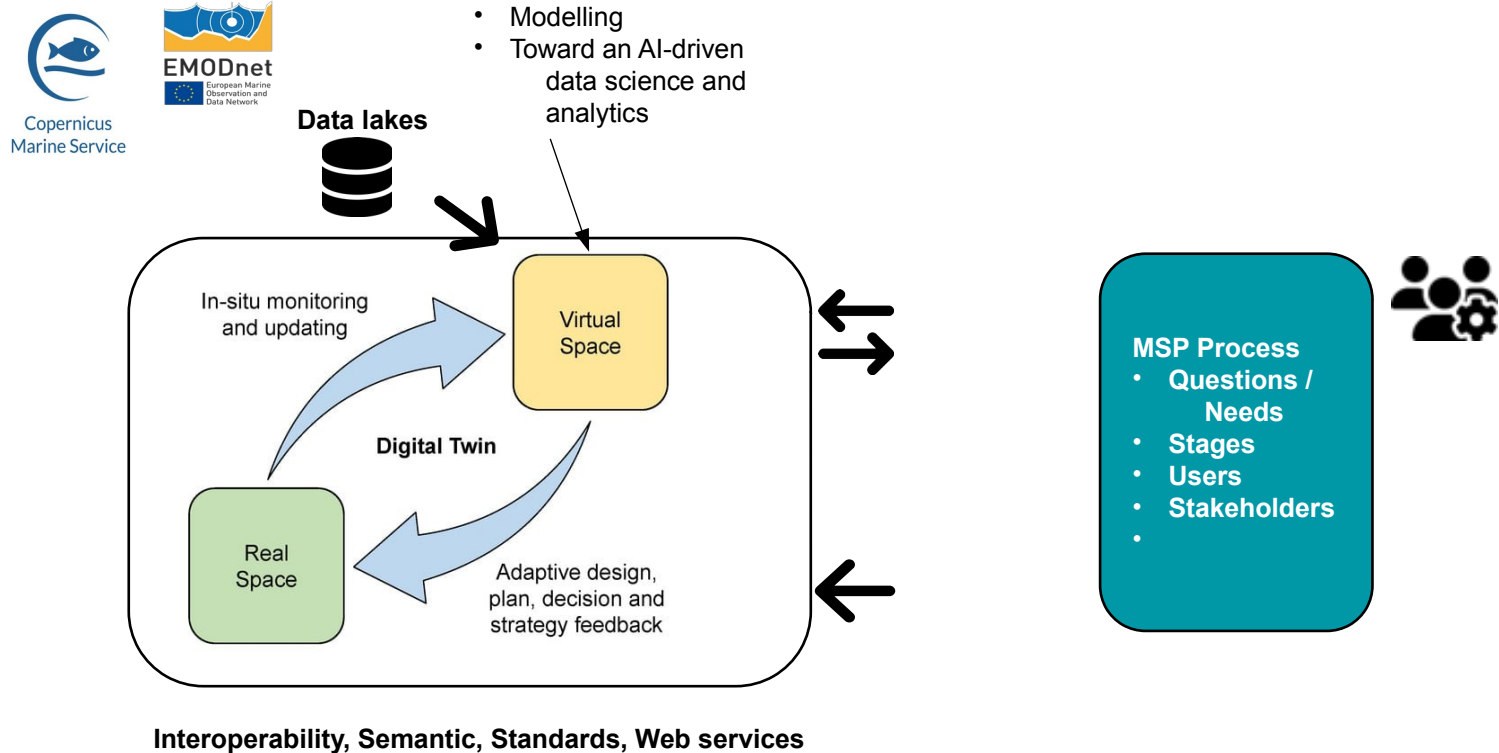
Geospatial
& temporal
Gradient

DTO, DOT

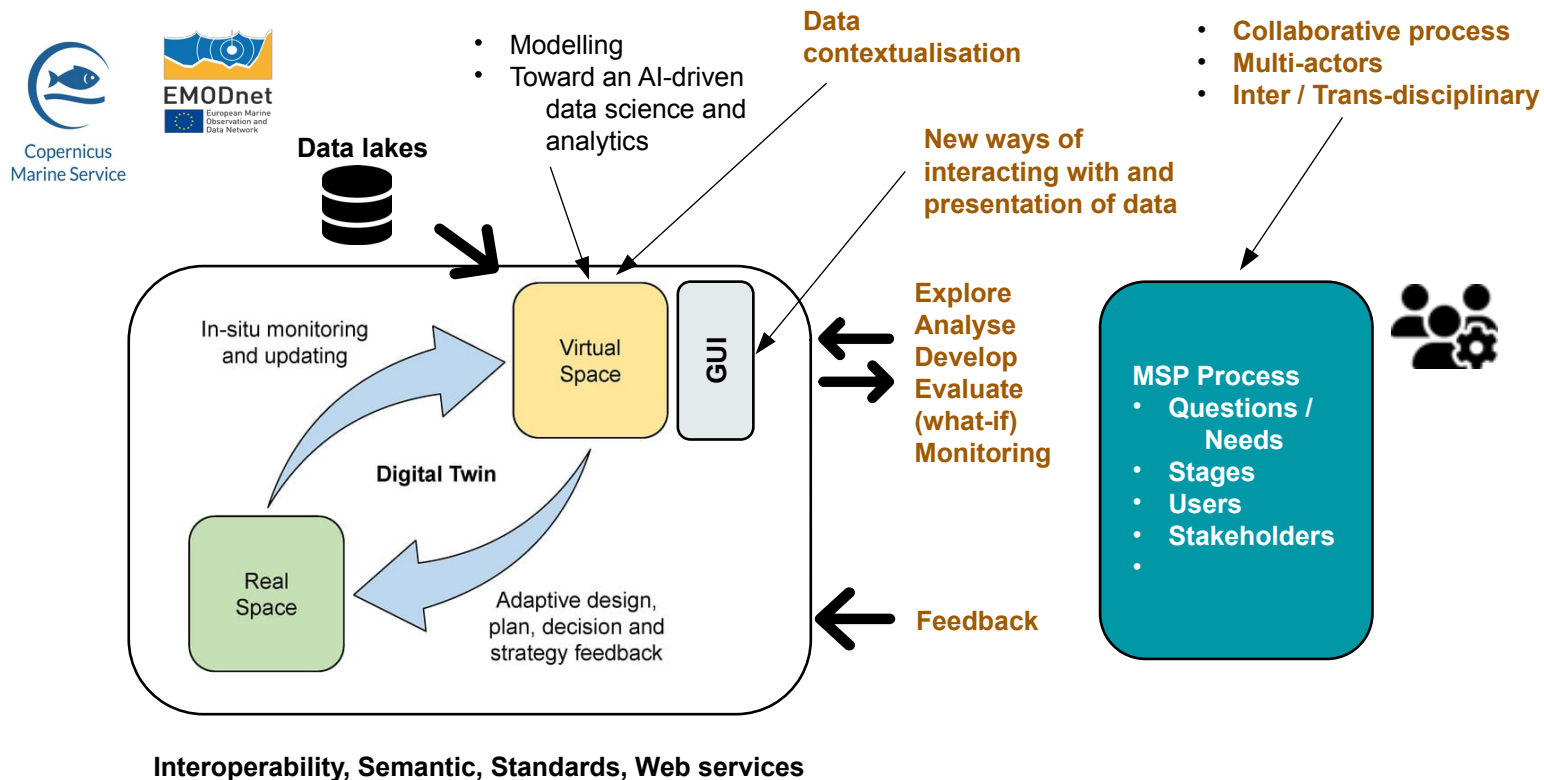
Geospatial domain



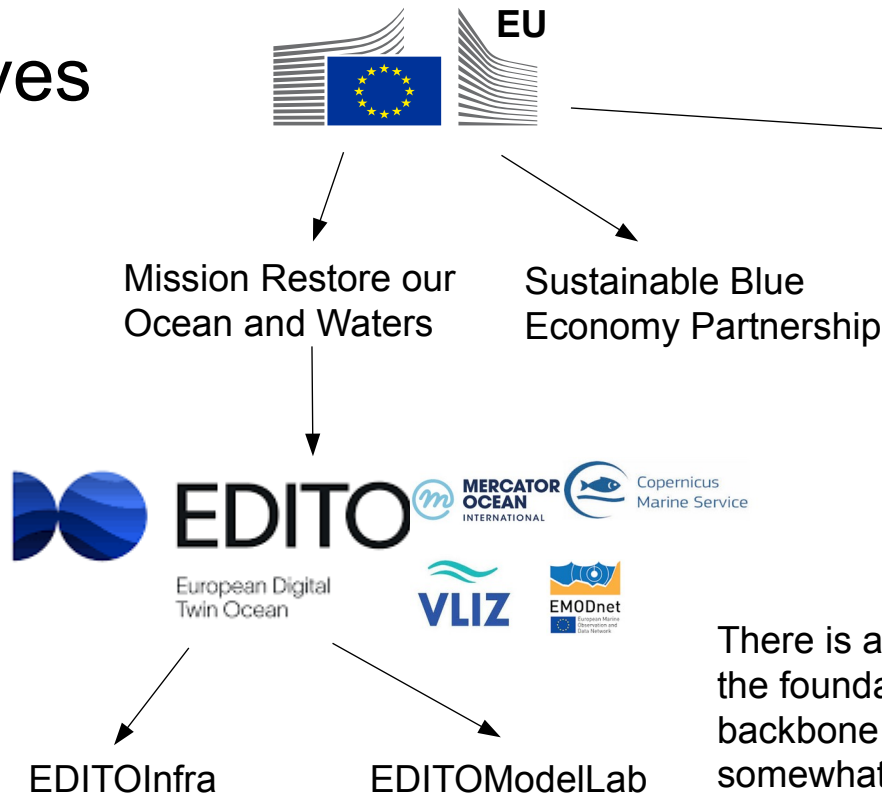
DTO-DOT for MSP



DTO-DOT for MSP



Main initiatives



There is a stronger emphasis on building the foundational elements, such as the backbone infrastructure and AI models, but somewhat less attention is being given to how these tools can be used to activate and support collaborative processes that involve multiple actors and transdisciplinary approaches

TEG topic: Digital Twins of the Ocean for MSP

Objective

- Understand how DTO initiatives can enhance **participatory and collaborative** decision-making, policy development, and sustainability in Maritime Spatial Planning.

Key Questions

- How can DTOs improve data availability and quality for MSP?
- What are the current gaps in MSP that DTOs could address?
- What real-time feedback and simulation capabilities (what-if scenarios) can DTOs provide to optimize spatial planning?
- What innovative applications or features of DTOs could be developed to address emerging challenges in MSP, such as climate change adaptation, biodiversity conservation, and sustainable resource management?

TEG activity proposal: Tasks

- Identify and review the existing DTO initiatives (case studies)
- Monitor upcoming projects / calls related to DTOs
- Organize an (Online) event (workshop / roundtable) where some selected initiatives / projects are presented and discussed together:
 - Inviting representatives from the selected initiatives / projects
- Gap analysis, challenges and solutions
- Finalize the document / paper

Duration: 1 year (December 2025)

TEG topic: Digital Twins of the Ocean for MSP

Review details: metric for evaluation

Map DTO Capabilities to MSP Needs (MSP-centered perspective)

- Support MSP requirements & needs and MSP process stages
- Support key Users and Stakeholders (and a collaborative process)
- Support What-if scenarios analysis and exploration

DTO Functions

- Data integration and contextualization, data accessibility and interoperability
- Simulation: climate change and what-if scenarios
- Plan / measure development, conflict resolutions
- User and Stakeholder collaboration
- Monitoring & Feedback mechanisms

Effectiveness, Efficiency, Sustainability and Scalability of the proposed solutions
(including the Graphical User Interfaces for DTO – User interactions)

TEG activity proposal: Expected outcomes

- TEG Report (or maybe a paper)
 - Review method and results
 - A compilation of lessons learned, challenges and new ideas on integrating DTO in MSP.
- Portfolio / Catalogue of DTO applications for MSP

Capitalization

TEG on Data for MSP:

- MSPdF as main semantic framework: to review linked Data lakes and DTO outcomes
- MSP & MSFD: synergies in data usage
- Socioeconomic impacts in MSP
- MSP and Common EU Data Spaces

ReMAP Project:

- MSP input data: relevance for MSP, FAIR principles, Spatial & Temporal coverage, Spatial Data Quality Framework
- MSP output: MSP-oriented statistics
- MSP-MSFD relationships: compare approaches, synergies, align measures / feedback

References

- Brönner et al. (2023). Digital Twins of the Ocean can foster a sustainable blue economy in a protected marine environment. *The International Hydrographic Review*, 29(1), 26–40. <https://doi.org/10.58440/ihr-29-a04>
- Bahurel et al. (2023) Digital Twins of The Ocean (DITTO) Programme White Paper. UN Decade. https://ditto-oceandecade.org/wp-content/uploads/2023/07/DITTO-Whitepaper_FIN_AL-July-2023.pdf
- Inamdar et al. (2024). Digital Twin Technology—A Review and Its Application Model for Prognostics and Health Management of Microelectronics. *Electronics* 2024, 13, 3255. <https://doi.org/10.3390/electronics13163255>
- Report on the Digital Ocean Forum (2024). Scientific & Technical Workshop, High-Level Legacy Event link

Digital Twins of the Ocean for MSP

by TEG on Data for MSP

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