REPORT

Meeting: **SEADITO/ MSP Research Network webinar "Digital Twin Oceans for coastal management and marine planning: Challenges, Opportunities and Future Needs"**
Parties: **stakeholders**
Date: **15 October 2026**
Location: **MS Teams**
Rapporteur: **NSAC Secretariat**

1. Introduction

The meeting had two main objectives:

- To introduce the concept of Digital Twin of the Ocean (DTO) and present ongoing developments and applications, particularly those emerging from the SEADITO project.
- To facilitate a structured discussion on the wider implications of DTO development, including the factors driving their development, their added value, implementation barriers and potential impacts.

The second objective was addressed through an interactive discussion based on the **DABI** framework: **Drivers, Added Value, Barriers and Impacts**.

The webinar mixed introductory presentations, practical demonstrations of emerging applications, a guest presentation on a national-scale Spanish coastal digital twin, and a discussion.

2. Main outcomes from presentations

- **DTOs can support more integrated marine management.** Combining environmental, ecological and socio-economic data can provide a more comprehensive understanding of marine and coastal systems and support better-informed decisions.
- **Socio-ecological information needs to be better integrated.** Digital twins should go beyond physical and ecological processes to include human activities, coastal community vulnerability, economic dependence and adaptive capacity.
- **DTOs offer practical decision-support opportunities.** The SEADITO case studies demonstrated their potential for ecosystem service mapping, marine socio-ecological vulnerability assessment and coordination of temporary fishing closures. The ATALAYA project (A national-scale digital twin for climate-resilient coastal management in Spain) illustrated how digital twins can support coastal risk assessment and adaptation planning at national scale.
- **Scenario analysis is an important added value.** Digital twins can help users explore alternative futures, assess the potential consequences of management choices and compare possible interventions before implementation.

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- **Stakeholder co-design is essential.** One of the presentations informed participants on co-designing digital support with stakeholders for coordinated fisheries closures on the Costa Brava, Spain. This case study showed that applications should respond to clearly identified user needs. Engagement with stakeholders can change the original design and lead to simpler, more relevant and usable tools.
- **Data limitations remain a major challenge.** Data availability, quality, spatial resolution, interoperability and uncertainty affect the reliability and transferability of DTO applications.
- **Long-term sustainability needs to be addressed.** Digital twins require continuous data updates, technical maintenance, financial resources and clear institutional responsibilities beyond the duration of individual research projects.

3 Discussion with participants

The interactive discussion used the DABI framework to identify four dimensions of DTO development:

Dimensions	Main points raised
Drivers	Increasing volumes of marine data; growing complexity of environmental and socio-economic challenges; policy and governance needs; technological advances; demand for improved decision support.
Added Value	Better data integration and accessibility; more accessible scientific knowledge; scenario testing; reduced duplication of work; dynamic information; stronger cross-sectoral collaboration.
Barriers	Infrastructure and maintenance costs; data gaps and inconsistent resolution; interoperability challenges; institutional and governance constraints; uncertainty; mismatch between technical solutions and user needs.
Impacts	Potential for more informed and sustainable decisions, but also risks of increased resource exploitation, data confidentiality breaches, cybersecurity threats, misleading outputs and overreliance on digital tools.

A key message was that DTOs should support decision-making rather than replace expert judgement, stakeholder knowledge or political responsibility. Transparency about data sources, assumptions, uncertainty and limitations is therefore essential.

4 Conclusions & key messages

Three particularly important conclusions emerged:

1. The integration of socio-ecological dimensions is crucial.

DTOs should not focus exclusively on physical and ecological processes. Understanding human activities, community vulnerability, stakeholder behaviour and adaptive capacity is necessary to support decisions that reflect the complexity of marine and coastal systems.

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2. Digital twin development should be driven by real user needs.

The Costa Brava case study demonstrated that stakeholder engagement can fundamentally change the direction of technological development. Applications should respond to clearly identified management and planning needs rather than being developed simply because particular technical capabilities are available.

3. Long-term sustainability must be considered from the beginning.

DTOs require continuous data updates, technical maintenance, institutional support and financial resources. Their long-term operation should therefore be an integral part of their design and development.

More generally, the discussion showed that the added value of DTOs lies not only in technological innovation but also in their capacity to improve access to information, connect different knowledge systems and facilitate more transparent and integrated decision-making.

At the same time, their development must address data limitations, uncertainty, confidentiality, cybersecurity, governance and the risk of overreliance on digital outputs.

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