Development of Spatial Data Infrastructures (SDI) for Marine Data Management

IHO-OGC Marine SDI Concept Development Study (MSDI-CDS)

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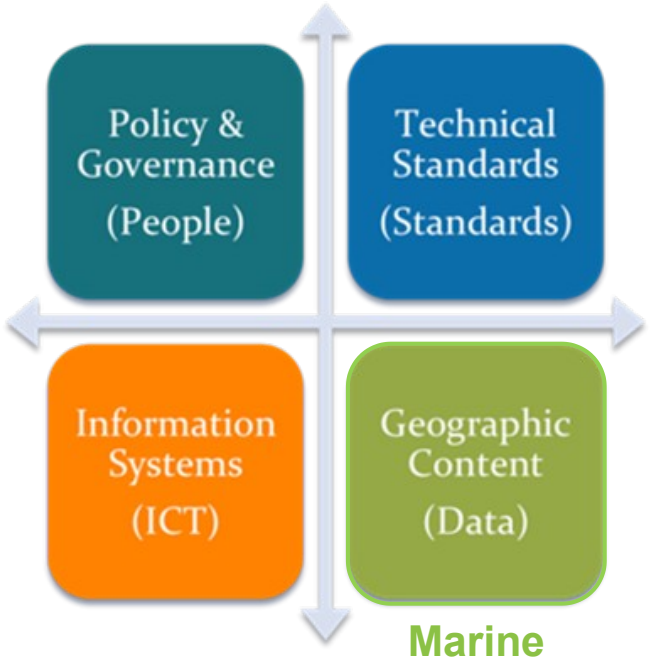
Marine Spatial Data Infrastructure (MSDI)

- MSDI
  - Element of SDI focused on the marine input.
  - A MSDI is not a collection of hydrographic products, but an infrastructure that promotes interoperability of data at all levels (e.g., national, regional, international).
    - Discoverability
    - Accessibility
    - Interoperability
    - Data-centricity (Hydrographic Offices)
  - Supports wider, non-traditional user-base of marine data typically used for navigation.
  - MSDI Working Group (MSDIWG)
    - International Hydrographic Organization (IHO) working group to deliver IHO MSDI-related policy objectives.[1]

MSDI Pillars/Components



1 - *https://www.iho.int/mtg_docs/com_wg/MSDIWG/MSDIWG8/MSDIWG8-01.4.4b-MSDIWG_white_paper.pdf*
Slide information and Image Credit *- (DRAFT) IHO Publication C-17, Spatial Data Infrastructures: "The Marine Dimension" - Guidance for Hydrographic Offices, Ed 2.0, April 2016*

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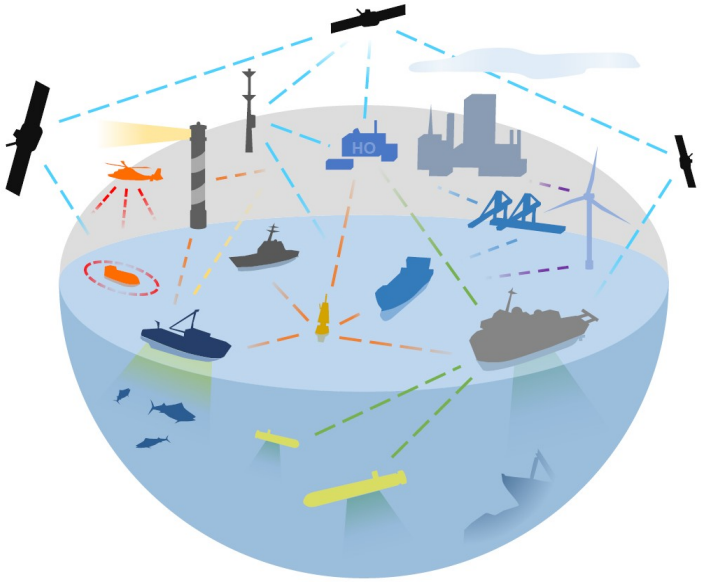
“Marine” Spatial Data

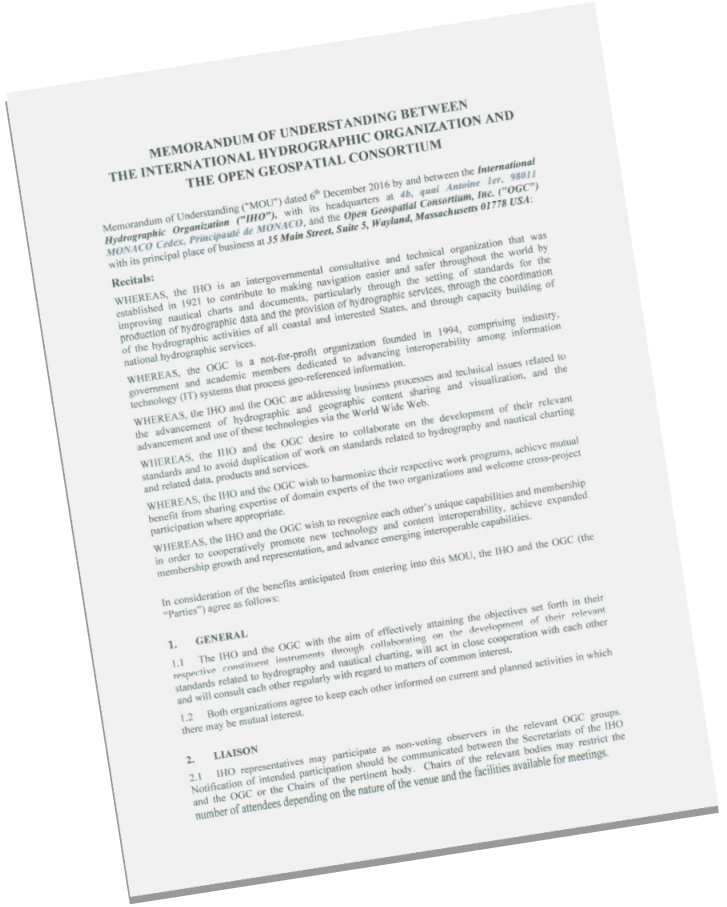
- “Marine” used as the more generic and encompassing word to describe a variety of data types which might be combined for efficient analysis by a **wide range of disciplines and user groups**, for example:
  - **Hydrography**
  - **Oceanography**
  - **Marine Biology & Scientific Research**
  - **Ecology and Environmental**
  - **Maritime Governance**
  - **Transportation**
  - **Infrastructure (physical)**
  - **Industrial and Commercial**
  - **Tourism, Recreation, Cultural Use**
- “Marine” Data must be held in a generic way, rather than for a particular product for a limited user group or for a specific purpose. An MSDI is not a collection of hydrographic products, but an infrastructure that promote interoperability of data at all levels.



Images Credit *– S. Carisio, International Hydrographic Organization Marine Spatial Data Infrastructures Working Group, OGC-TC 099, Dublin, 2016*

IHO & OGC Memorandum Of Understanding

- WHEREAS, the IHO and the OGC wish to **harmonize their respective work programs**, **achieve mutual benefit** from sharing expertise of domain experts of the two organizations and welcome **cross-project participation** where appropriate.
- WHEREAS, the IHO and the OGC wish to recognize each other's unique capabilities and membership in order to cooperatively **promote new technology and content interoperability, achieve expanded membership growth and representation, and advance emerging interoperable capabilities.**



MEMORANDUM OF UNDERSTANDING BETWEEN
THE INTERNATIONAL HYDROGRAPHIC ORGANIZATION AND
THE OPEN GEOSPATIAL CONSORTIUM

Memorandum of Understanding ("MOU") dated 6th December 2016 by and between the ***International Hydrographic Organization ("IHO")***, with its headquarters at *4b, quai Antoine 1er, 98011 MONACO Cedex, Principauté de MONACO*, and the ***Open Geospatial Consortium, Inc. ("OGC")*** with its principal place of business at ***35 Main Street, Suite 5, Wayland, Massachusetts 01778 USA***:

Recitals:

WHEREAS, the IHO is an intergovernmental consultative and technical organization that was established in 1921 to contribute to making navigation easier and safer throughout the world by improving nautical charts and documents, particularly through the setting of standards for the production of hydrographic data and the provision of hydrographic services, through the coordination of the hydrographic activities of all coastal and interested States, and through capacity building of national hydrographic services.

WHEREAS, the OGC is a not-for-profit organization founded in 1994, comprising industry, government and academic members dedicated to advancing interoperability among information technology (IT) systems that process geo-referenced information.

WHEREAS, the IHO and the OGC are addressing business processes and technical issues related to the advancement of hydrographic and geographic content sharing and visualization, and the advancement and use of these technologies via the World Wide Web.

WHEREAS, the IHO and the OGC desire to collaborate on the development of their relevant standards and to avoid duplication of work on standards related to hydrography and nautical charting and related data, products and services.

WHEREAS, the IHO and the OGC wish to harmonize their respective work programs, achieve mutual benefit from sharing expertise of domain experts of the two organizations and welcome cross-project participation where appropriate.

WHEREAS, the IHO and the OGC wish to recognize each other's unique capabilities and membership in order to cooperatively promote new technology and content interoperability, achieve expanded membership growth and representation, and advance emerging interoperable capabilities.

In consideration of the benefits anticipated from entering into this MOU, the IHO and the OGC (the "Parties") agree as follows:

1. **GENERAL**

1.1 The IHO and the OGC with the aim of effectively attaining the objectives set forth in their respective constituent instruments through collaborating on the development of their relevant standards related to hydrography and nautical charting, will act in close cooperation with each other and will consult each other regularly with regard to matters of common interest.

1.2 Both organizations agree to keep each other informed on current and planned activities in which there may be mutual interest.

2. **LIAISON**

2.1 IHO representatives may participate as non-voting observers in the relevant OGC groups. Notification of intended participation should be communicated between the Secretariats of the IHO and the OGC or the Chairs of the pertinent body. Chairs of the relevant bodies may restrict the number of attendees depending on the nature of the venue and the facilities available for meetings.

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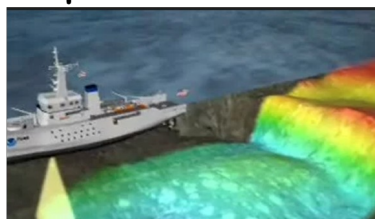
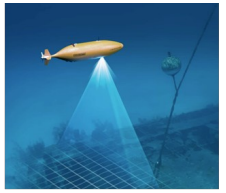
Marine CDS Background

- At the MSDIWG meeting in Vancouver 2017, the MS discussed the possibility to **create an IHO/OGC study that could establish the framework for future development of MSDI**.
  - Rapid advancement of technologies, diversity of data collectors, and increased data collection from non-traditional sources (e.g. corporate, citizens)
  - Expanding body of data collected for non-navigational applications (e.g. Ocean science, energy exploration, UN sustainable development goal 14)
  - Opportunities related to integration of diverse data sources & capabilities.

Shipboard





Autonomous Underwater Vehicle (AUV)

Crowdsource (IoT)

Slide information and Images Credit *- OGC / IHO Marine Spatial Data Infrastructure (MSDI) Concept Development Study, UN-GGIM 9th Session, August 2019*

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MSDI-CDS Objectives

- Engage different stakeholders across the Marine community (providers, developers, users) to understand the most important challenges.

- Document findings and provide recommendations on:
  - Scalable, interoperable MSDI reference architectures
  - Requirements that can be addressed in a follow-on Pilot initiative that focuses on MSDI best practices.

MSDI-CDS Progression

- Started MSDI-CDS (Summer 2018)
  - http://www.opengeospatial.org/projects/initiatives/msdi-cds-2018/
- MSDI-CDS Workshop (23 OCT 2018), US CMTS at the US Department of Transportation (USDOT).
- Request For Information (RFI) (07 FEB 2018)
  - RFI posted on OGC's website and distributed broadly throughout the international marine community.
  - Responses were gathered to help build the final technical report.
  - https://portal.opengeospatial.org/files/?artifact_id=81715
- MSDI-CDS Roundtable (27 MAR 2019)
  - Group of OGC members to review study findings and a draft of the final report.
- **Engineering Report published (05 AUG 2019).**
  - *19-025r1, Development of Spatial Data Infrastructures for Marine Data Management*
  - https://www.opengeospatial.org/docs/er

MSDI-CDS Contributors

- National Geospatial-Intelligence Agency (sponsor)
- Arctic Spatial Data Infrastructure (Arctic SDI)
- British Oceanographic Data Centre (BODC)
- Canadian Hydrographic Service (CHS)
- Cooperative Institute for Research in Environmental Sciences (CIRES)
- Danish Geodata Agency, Danish Hydrographic Office
- Directorate of Hydrography and Navigation (BRAZIL)
- Esri
- Geographic Information System Service (GISS)
- Geoscience Australia - Marine Geoscience Group
- The HDF Group
- Helyx Secure Information Systems Ltd
- Hexagon Geospatial
- International Hydrographic Organization (IHO)
- IIC Technologies
- Italian Hydrographic Institute (IIM)
- Land Information New Zealand (LINZ)
- Marine Environmental Data and Information Network (MEDIN)
- National Geospatial-Intelligence Agency (NGA), Maritime Safety Office (MSO)
- National Oceanic & Atmospheric Administration (NOAA), Office of Coast Survey (OCS)
- National Technical University of Athens (NTUA)
- Natural Resources Canada: GeoConnections and Fisheries and Oceans Canada (DFO)
- Naval Research Laboratory (NRL)
- Navy Hydrographic Center
- Netherlands Hydrographic Service
- Norwegian Mapping Authority (Kartverket)
- OceanWise Limited
- OGC Marine Domain Working Group (OGC Marine DWG)
- Portuguese Hydrographic Institute
- Sounding Science LLC & Geopoint Solutions
- Teledyne CARIS
- United Kingdom Hydrographic Office (UKHO)
- U.S. Army Engineer Research and Development Center
- U.S. Coast Guard Navigation Center
- U.S. Committee on the Marine Transportation System (CMTS)
- U.S. Department of Transportation (DOT)
- U.S. Energy Information Administration (EIA)
- University Of Colorado Boulder
- University of Southern Mississippi (USM)
- White House Office of Science and Technology Policy

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RFI Respondents

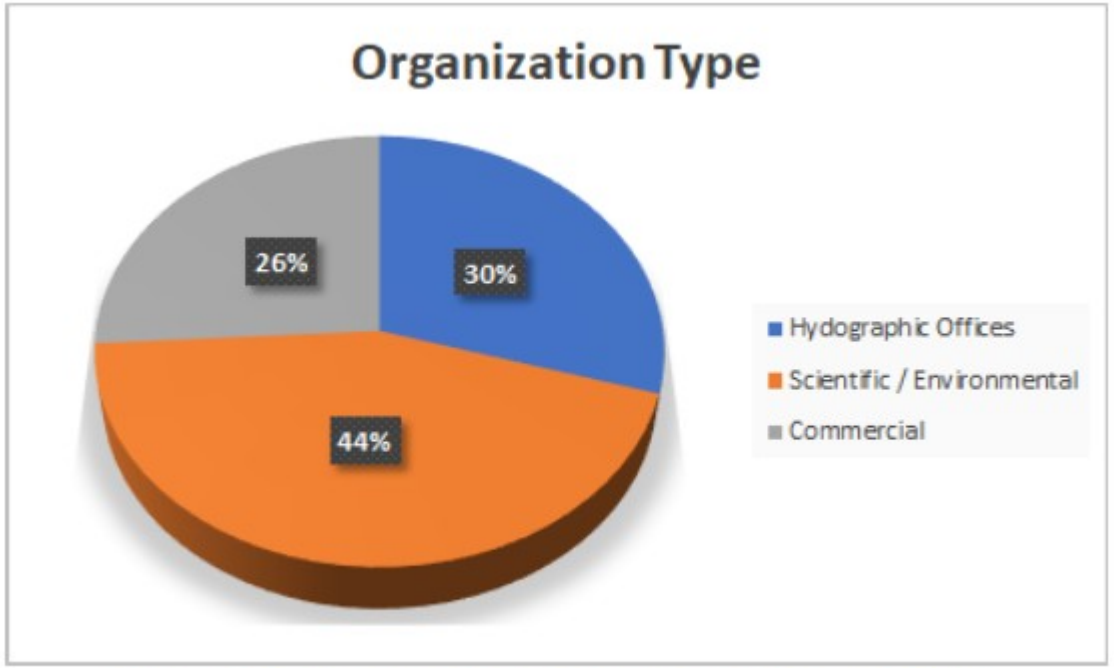
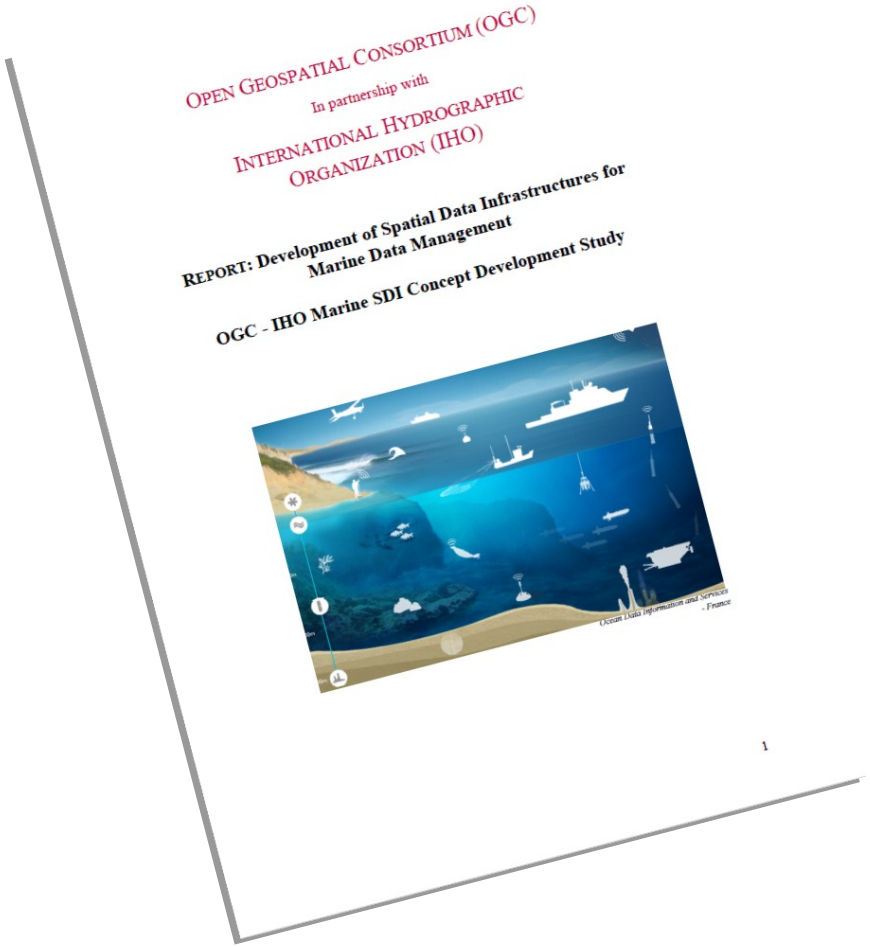


Figure 1.3: Organization Type of RFI Respondents (Source: OGC)

Engineering Report (ER)

- Introduction
- MSDI Definition and Stakeholders
- Currently Used and Emerging Standards
- Marine Data Themes in a MSDI
- Data and Governance
- MSDI Interoperability Reference Architecture
- Portals, Applications and Scenarios
- Other Factors and Conclusion
- Appendix A: Data Identified
- Appendix B: Marine Data Portals



Chapter 2: Marine SDI Stakeholders

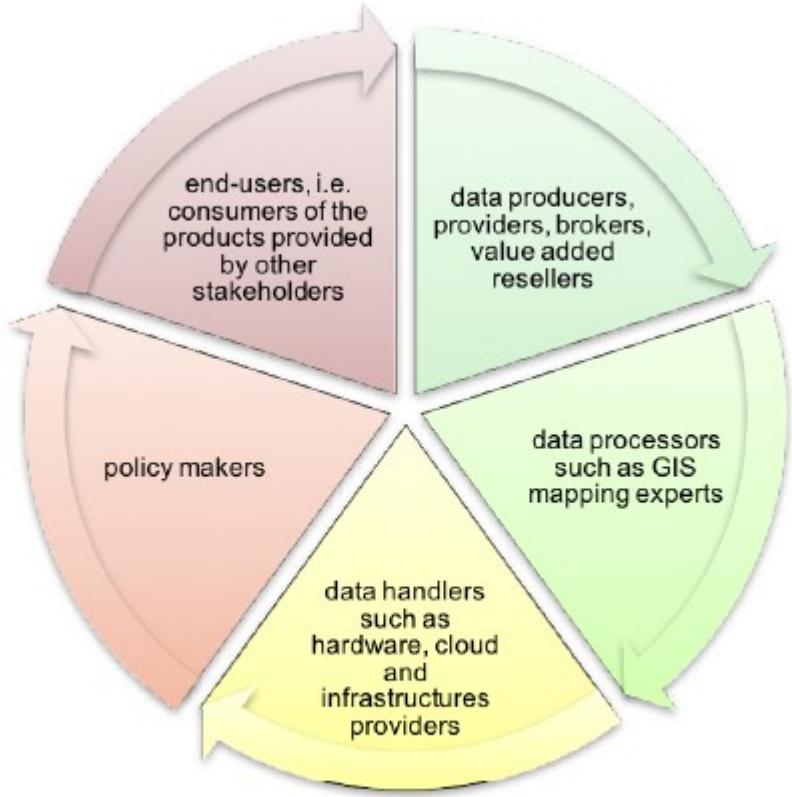
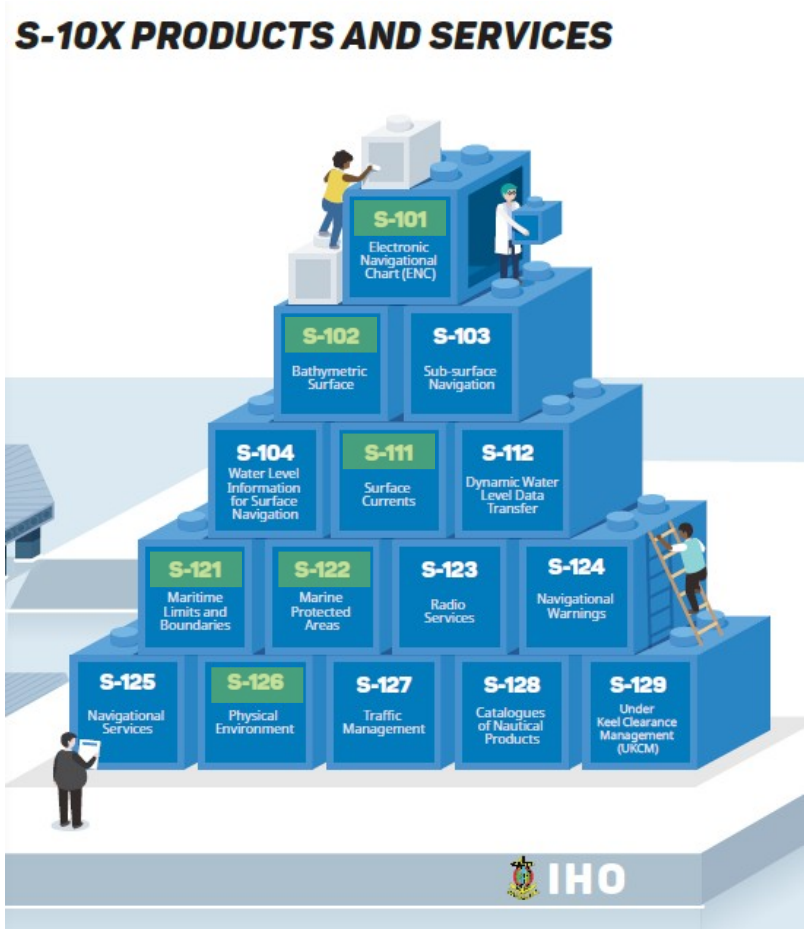


Figure 2.2: Classes of Stakeholders

Chapter 3: Currently Used and Emerging Standards

- **Content Standards** - For understanding the contents of different data themes by providing a data model of spatial features, attributes, relationships, and a data dictionary.
- **Management Standards** - For handling spatial data involving actions such as discovery of data through metadata, spatial referencing of data, collection of data from the field, submission of data by contractors to stakeholders, and tiling of image-based maps.
- **Portrayal Standards** - For structured visual portrayal of spatial data.



Chapter 4: Marine Data Themes

Example Themes:

- Hydrography
- Oceanography
- Marine Biology & Scientific Research
- Ecology and Environmental
- Maritime Governance
- Transportation
- Infrastructure (physical)
- Industrial and Commercial
- Tourism, Recreation, Cultural Use

Ontologies

- A major goal of a MSDI is to develop a multi-domain and multilingual ontology of marine data and services to provide semantic interoperability within the system.

Chapter 5: Data and Governance

Figure 5.2: High Level Governance Goals

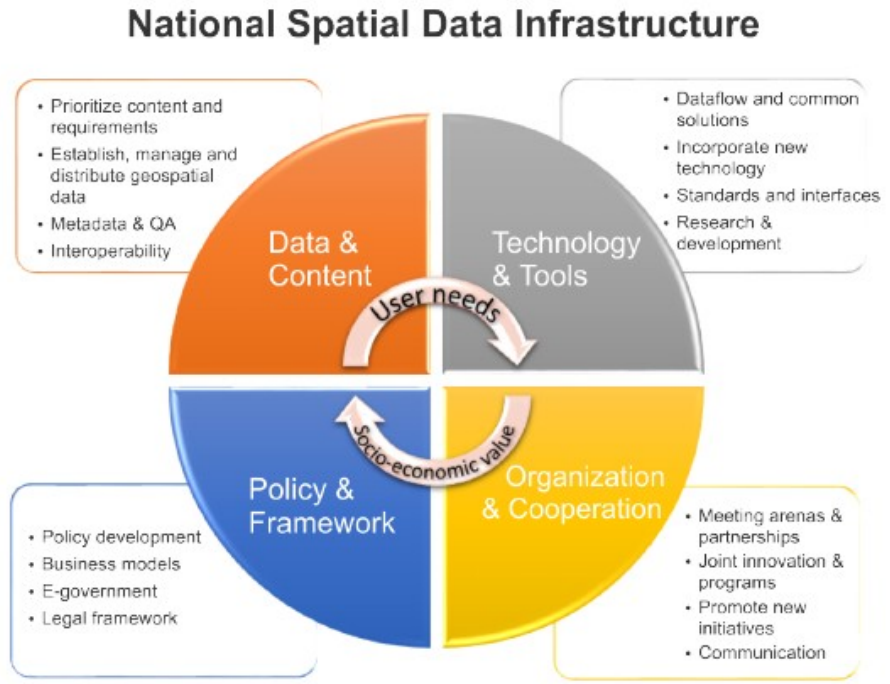


Figure 5.3: National Spatial Data Infrastructure Model, source: Norwegian Mapping Authority (modified)

Chapter 6: Marine SDI Requirement Categories

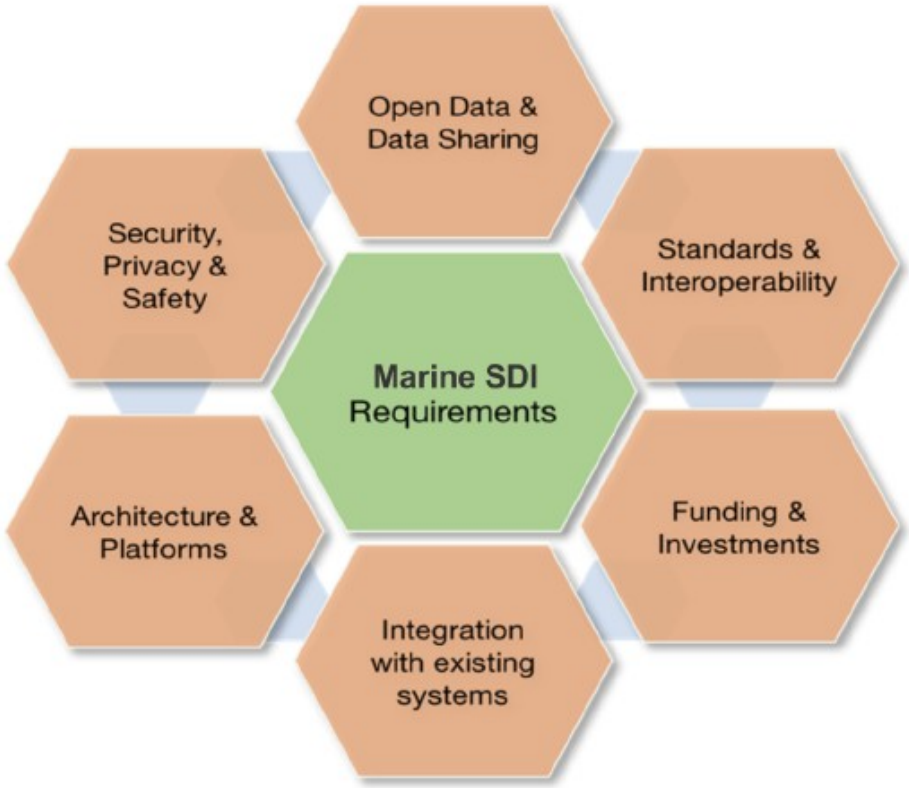


Figure 6.3: High level requirement categories

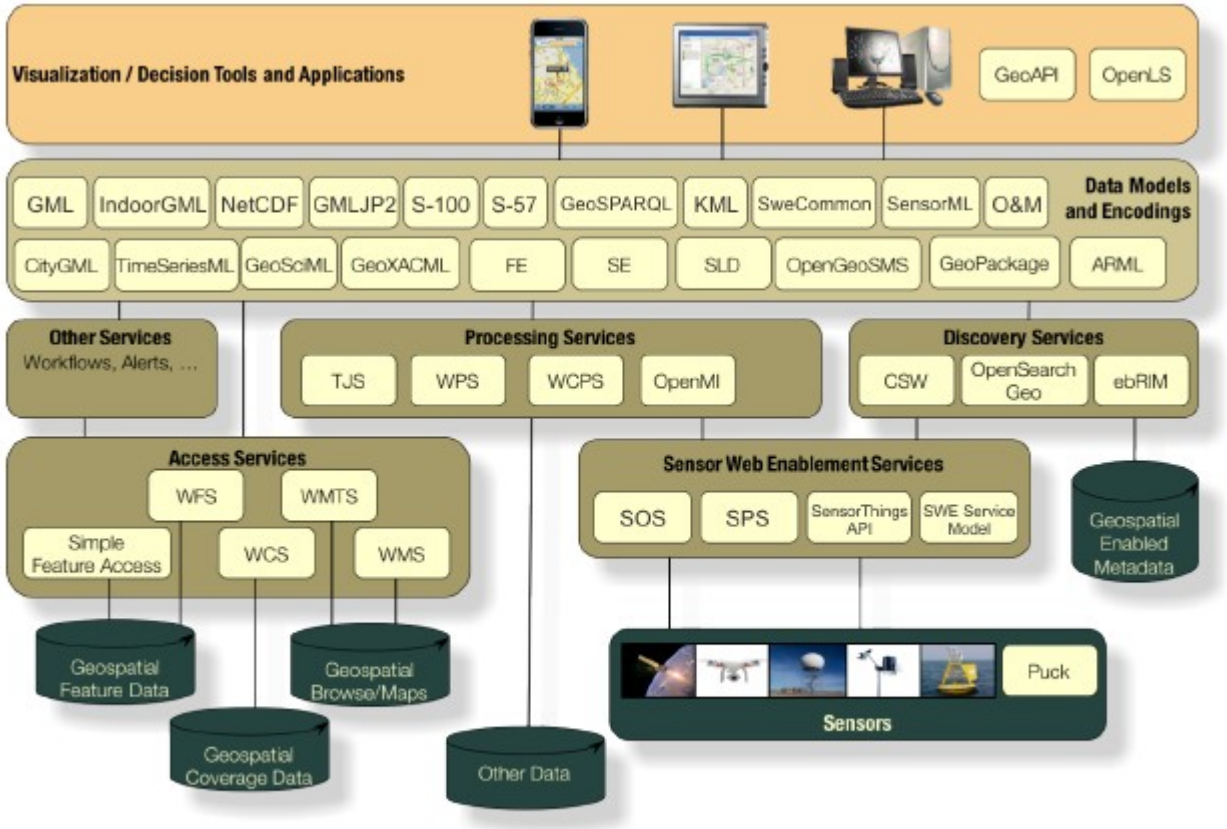


Figure 6.5: Federated Approach, source: OGC

Chapter 7: Portals, Applications and Scenarios

- Portals and Software Applications
  - List of reported data portals provided in Appendix B
- Potential MSDI Scenarios (described)
  - Offshore Wind Power Site Selection
  - Land / Sea boundary

Chapter 8: Other Factors and Conclusion

- Coordination of SDI related activities and collaboration among the various organizations involved is a critical success factor for a Marine SDI.
- It was found that a MSDI Reference Architecture must find the right balance between being prescriptive while remaining agile to allow for easy integration of upcoming technologies.
- The majority of respondents considered that an MSDI should be community-driven.
- Building on the CDS results and the suggestions for future MSDI development, e.g., pilot actions, the OGC will produce a strategy to achieve this goal.

Chapter 8: Other Factors and Conclusion

Four overarching requirements of any Marine SDI (from contributors):

1. Provide stakeholders with appropriate access to the spatial data they need.
2. Allow different stakeholders, at different locations, to access the SDI.
3. Allow for data exchange, especially the dynamic data, in an appropriate, efficient and secure way.
4. To achieve one, two and three above, will require the continued and increasing use of OGC and other open standards.

Chapter 8: Other Factors and Conclusion

- In the future, integration of near real-time observations from both satellites and in-situ sensors will be of increasing importance in the marine environment.
- To help in remediating issues due to limited bandwidth in much of the marine environment, a significant portion of the base or core data can be prepared in advance and pre-loaded on mobile devices for field use (GeoPackage).
- All data should be accompanied by metadata. Exploration into minimizing the need for manually generated metadata should be continued.

Conclusions are not to be regarded as a definitive list, but could provide a focus for a future Pilot initiative.

Link to Engineering Report

- The ER is posted to OGC's website here:

https://www.opengeospatial.org/docs/er

- Direct link to download PDF here:

https://portal.opengeospatial.org/files/?artifact_id=88037