Introduction to Marine Spatial Data Infrastructure (MSDI)

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Welcome to the MSDI Module!

- Part 1 - NII, SDI & MSDI Introduction & Data Themes
- Part 2 - Main Issues and Challenges
- Part 3 - Case Studies – MSDI Developments
- Part 4 - MSDI for Marine Cadastre & Marine Spatial Planning
- Part 5 - Homework!
Part 1

NII, SDI & MSDI

Introduction & Data Themes
Implementing a National SDI: Key challenges & opportunities for the marine community

\[ \text{NII} \leftarrow \text{NSDI} \leftarrow \text{Coastal/Marine SDI} \]

The premise: *Government establishes policies for information use at national level (NII) based on perceived needs of government, of businesses, and of civil society.*

Rationale: *To link up the disparate parts of our society more efficiently.*
NII – the National Information Infrastructure

NII as a process, not a ‘thing’:
• identify and ‘value’ information assets (create metadata),
• satisfy legal mandates – data needed by each organisation to do its 'public task',
• evaluate economic benefits of wider use of the data,
• evaluate societal benefits of wider use of the data,
• establish data & information policies that support the benefits,
• evaluate (alternatives) and establish implementation strategies,
• enact legislation to enforce the policies and enact the strategies,
• assess cost-benefit of the NII, sector-by-sector, and make future plans.
NII versus National Spatial Data Infrastructure (NSDI)

NII is all encompassing - embracing and/or impacting upon ALL of society:

• government performance (increase efficiency in executing public tasks),
• economic performance (efficiency of business operations, innovation, employment, ...),
• providing benefits to civil society (quality of life, security, welfare of citizens, ...).

Key point is that NII principles and policies apply to ALL forms of data, i.e. it is sector neutral.
National Spatial Data Infrastructure (NSDI)

• SDI is an Information Infrastructure first, and spatial second – existing within an NII for any data/information that is ‘location based’ – on land, sea or in the air.

• SDI is not only:
  • Maps & digital geo or location-based data (although content is important!)
  • Information Technology (GIS & other ICT, remote sensing, sensor webs, mobile devices, etc.)
  • Web-based Geoportals (although these are important windows for delivering SDI objectives)

• SDI includes: governance, data policies & principles, legislation, monitoring, enforcement, technical standards & infrastructure, capacity building, stakeholder engagement – and people prepared to access and use the data!

• There is no ‘best’ way to implement an SDI – what works best depends upon existing NII objectives, principles, policies - and local information culture.
The key objectives for SDI are data sharing and interoperability (between systems & organizations) in order to:

- reduce duplicated effort (in some cases, not all)
- permit re-use of the same data in new ways and by new users
- may reduce the cost of using geospatial data by original owner(s) through sharing...

But... data sharing has a cost (people + time + ICT)

Integrated information infrastructure helps reduce that cost (proven by many studies) ...

... and increases the value of geospatial information to business, government and society in general (also proven by many studies).

Some successful SDIs start ‘bottom up’ – but ‘top down’ goals, principles and standards help – and are mandatory to achieve national scope at least cost.
**SDI Components**

- **Governance**: gives direction, oversees ownership, plans for sustainability, monitors operational implementation.

- **Data Policies & Principles**: standards, quality, access, sharing, publishing, charging, re-use of data, ownership rules, licensing, restrictions.

- **Legislation**: monitoring and enforcement of data policies, intellectual property rights (IPR), liability issues, privacy rules.

- **Implementation**: creating and managing the infrastructure, monitoring progress, managing technology evolution.

- **Capacity Building**: human resource development, training & professional education, educating institutional users.

- **People!**
Data to Information
Data to Information

Mixing and Matching data with/between workflows is what we would like to do in MSDI.
Implementing SDI the ‘traditional’ way

1. Government sets ‘Information Policy’ and/or ‘Spatial Data Infrastructure Policy’.
2. Identify the datasets you have that are governed by the policy(ies), i.e. your ‘information assets’.
3. Create metadata - using an agreed (and published) open standard.
4. Publish the metadata – electronically (using a standard), i.e. ISO, OGC or national standards.
5. Provide a Data Discovery Service - using a standard, applied to the metadata (OGC web services).
6. Publish the data – prepare and deliver ‘viewing’ & ‘downloading’ services, using standards.
8. Review value of the data/services – conduct CBAs (cost-effectiveness, cost & time savings, performance indicators, etc.) and make changes based on facts discovered, not just presumptions.
SDI Policy Drivers

• **Increase operational efficiency** across (all levels of) government – reduce costs.

• **Share services** underpinned by **shared data** – requires active partnerships – G2G, G2B, B2G, G2C - & today - C2G.

• **Support information society** and **e-Government** goals by enabling more cost effective citizen-based services.

• Help the **information economy** grow by increasing market size (= employment and more tax revenue).

• Enable better, quicker, more reliable **decision** making at **all** levels of society, not just for government.
SDI Policies

‘Information Policy’ is a very broad term – interpreted differently by different people for different purposes.

Key data policies for SDI are:

• access to data (IPR, data protection, privacy, open data ‘by default’?)

• use and re-use of data (the above + competition, 3rd party considerations, potential liability issues, monitoring)

• charging or not for government data - the debate on ‘free or for a fee’ (where philosophy meets practical economics!)

• Role of ‘unofficial’ data sources, e.g. from commercial sources, citizen crowdsourcing, etc.
Other SDI Policy Issues

• custodianship of key reference data sources – topography, geology, hydrography, addresses, cadastre, land use, etc.

• voluntary or mandatory participation in the SDI,

• enforcement measures – ‘light touch’ or strong – for mandatory participation,

• providing financial support or other incentives, i.e. if the SDI is creating a ‘public good’, should it be (at least partially) funded from public funds?
What is Marine/Coastal SDI?

• **A subset of NII** - developed under the umbrella principles and policies of the NII.

• **A subset of NSDI** - involving many different sectors and disciplines where ‘location’ in respect of the marine/coastal environment is especially important or essential – and usually **complex** (coastal).

• Marine is one of the few themes developing today **within** NSDI (geology? transport?).

• **A key ‘People’ question** – who leads and/or how do multiple sectors work together effectively in creating what is a complex, multi-sector SDI, e.g. national topographic agencies, hydrographic agencies, port authorities, transport agencies (marine & land), ...
The Four Pillars of MSDI

- Policy & Governance (People)
- Technical Standards (Standards)
- Information Systems (ICT)
- Geographic Content (Data)
Coastal/Marine SDI Drivers

**Climate change**

*Sea level rise (coastal flooding); Storm surges & more frequent/violent events; Higher wave energy (impact on fixed structures); Beach erosion (and replenishment strategies)*

**Equitable use of scarce resources**

*Urban planning, development & monitoring; Renewable energy (wind farms, tidal power stations); Coastal tourism in developed & developing world; Natural habitat and ecosystem conservation (conventions); Fisheries and aquaculture management*

**Marine, maritime & ocean policies**

*Marine Protected Areas (MPAs); Navigation (SOLAS); Fisheries, esp. in-shore fisheries; Economic value of ocean and coastal resources; Marine Spatial Planning*
Economic Drivers
Norway NSDI with Relevant Coastal/Marine Themes

The NSDI

Base geodata

Properties, buildings
Roads / railways
Hydrography
Admin boundaries
Geodetic points
Elevation
Orthophotos
Etc

The underpinning role of Hydrography

Thematic geodata

Flood areas
Population
Land cover
Biology
Economy
Health
Etc

UNESCO, IOC, Ocean Teacher Academy, Oostende, Belgium
US NSDI data themes relevant to coastal & marine communities

- Baseline (Maritime)
- Shoreline
- Elevation / Bathymetric
- Hydrography
- Marine Boundaries
- Transportation (Marine navigation)
- Cadastre (Offshore, e.g. mineral extraction, energy)
- Climate
- Federal Land Ownership Status
- Flood Hazards
- Offshore Minerals (exploration, environmental)
- Outer Continental Shelf - Submerged Lands
- Watershed Boundaries
- Wetlands
US NSDI data themes relevant to the coast

- **Baseline (Maritime)** - Line from which maritime zones & limits are measured. (27 legal definitions for ‘coast line’ exist depending upon the legal jurisdiction – federal, state, counties, municipal areas)

- **Cadastral (Offshore)** - Land management system for outer continental shelf, extending from the Baseline to the extent of US jurisdiction.

- **Climate** - Data describing the spatial and temporal characteristics of the earth's atmosphere, hydrosphere, land surface system, both model-generated and observed (either in situ or remotely sensed) environmental information.

- **Elevation Bathymetric** - Bathymetric sounding data supports the elevation layer of the geospatial data framework. Bathymetric data for inland and inter-coastal waterways to ensure that federal navigation channels are maintained to their authorized depths. Bathymetric survey activities support the Nation's nautical charting program and is used to create *Electronic Navigational Charts*.

- **Federal Land Ownership Status** - includes the establishment and maintenance of a system for the storage and dissemination of information describing all title, estate or interest of the federal government in a parcel of real and mineral property.
US NSDI data themes relevant to the coast

• **Flood Hazards** – the National Flood Insurance Program has prepared flood hazard data for approximately 18,000 communities.

• **Hydrography** - includes surface water features such as lakes, ponds, streams and rivers, canals, oceans, and coastlines. Each hydrography feature is assigned a permanent feature identification code (Environmental Protection Agency Reach Code) and may also be identified by a feature name. Spatial positions of features are encoded as centrelines and polygons. Also encoded is network connectivity and direction of flow.

• **Marine Boundaries** - depict offshore waters and sea beds over which the US has sovereignty and jurisdiction.

• **Offshore Minerals** - minerals occurring in submerged lands, such as oil, gas, sulphur, gold, sand and gravel, and manganese.

• **Outer Continental Shelf Submerged Lands** - lands covered by water at any stage of the tide, as distinguished from tidelands, which are attached to the mainland or an island and cover and uncover with the tide. Tidelands presuppose a high-water line as the upper boundary; whereas submerged lands do not.
US NSDI data themes relevant to the coast

- **Shoreline** - the intersection of the land with the water surface. The shoreline shown on NOAA (National Oceanic and Atmospheric Administration) Charts represents the line of contact between the land and a selected water elevation. In areas affected by tidal fluctuations, this line of contact is the mean high water line.

- **Transportation (Marine)** - the Navigation Channel Framework consists of highly accurate dimensions for every federal navigation channel maintained by US Army Corps of Engineers. The Navigation Framework provides the basis for the marine transportation theme of the geospatial data framework.

- **Watershed Boundaries** - encodes hydrologic, watershed boundaries into topographically defined sets of drainage areas, organized in a nested hierarchy by size, and based on a standard hydrologic unit coding system.

- **Wetlands** - provides the classification, location, and extent of wetlands and deepwater habitats, with no attempt to define the proprietary limits or jurisdictional wetland boundaries of any federal, state, or local agencies.
Commitment and Governance for US CSDI/MSDI

• The US CSDI is now firmly embedded within the wider national NSDI initiative, for which the Federal Geographic Data Committee (FGDC) has overall authority.

• CSDI is led by the Office for Coastal Management of the National Oceanic and Atmospheric Administration (NOAA) (noaa.coast.gov), which receives specific funding to support the activities required.

• CSC participates in 9 of the 13 FGDC Subcommittees, 7 of the 11 FGDC Working Groups, and chairs the FGDC Marine and Coastal Spatial Data Subcommittee, the Geodetic Control Subcommittee, co-chairs the 3D Elevation Subcommittee and the Marine Boundary Working Group. Visit https://www fgdc gov/organization/working-groups- subcommittees/mcsdsc/index html and https://coast noaa gov/mbwg/

• The vision for the Marine and Coastal NSDI is that current and accurate geospatial coastal and ocean data will be readily available to contribute locally, nationally, and globally to economic growth, environmental quality and stability, and social progress.

• Visit https://coast noaa gov/digitalcoast/ to see what DigitalCoast has achieved.
The EU SDI (INSPIRE) Data Themes

- INSPIRE (Infrastructure for Spatial Information in the European Community – 2007-2021) has 34 data themes – some quite specific (geographic names, coordinate systems, etc.) and some very wide ranging (protected sites, ‘managed units’, habitats) in regard to location, content, stakeholder communities, legislation, etc.

- INSPIRE implementation priorities (spanning 12 years) are determined by where themes appeared in the Directive’s Annexes (I, II and III).

- **Priorities** for the coastal/marine community are different ...
  - Priority 1: Themes in Annexes I, II and III that are *directly related* to most coastal community work.
  - Priority 2: Themes that are *relevant* to coastal stakeholders.
  - Priority 3: Themes covering data that may occur in, or impact on, the coastal zone, generally, but are not otherwise specifically related to coastal zone management.
INSPIRE (EU SDI) Marine/Coastal Data Themes

Themes of direct coastal/marine relevance:

• Hydrography
• Protected sites
• Area management/restriction/regulation zones and reporting units (including coastal zones)
• Agricultural and aquaculture facilities
• Environmental monitoring facilities
• Natural risk zones
• Oceanographic geographical features
• Sea regions
• Energy resources
• Mineral resources
Themes of indirect relevance (i.e. referenced by, or appear in, the coastal zone and marine areas):

- Coordinate reference systems
- Geographical grid systems
- Land cover
- Geology
- Land use
- Human health and safety
- Utility and governmental services
- Production and industrial facilities
- Bio-geographical regions
- Habitats and biotopes
- Species distribution
Data Themes of **direct** interest to Stakeholders (1)

**Annex I**

- **Hydrography** - Hydrographic elements, including **marine areas**.
- **Protected sites** - Area designated or managed within a framework of international, Community and Member States' legislation to achieve **specific conservation objectives**.
  - Many protected sites exist in the near-shore marine environment + new drive for Marine Protected Areas offshore and consideration in Marine Spatial Planning.

**Annex II**

**Elevation** - Digital elevation models for land, ice and ocean surface. Includes terrestrial elevation, **bathymetry** and **shoreline**.
Data Themes of **direct interest to Stakeholders (2)**

**Annex III**

**Area management/restriction/regulation zones and reporting units** – “Areas managed, regulated or used for reporting at international, European, national, regional and local levels. ... regulated fairways at sea ... areas for the dumping of waste, river basin districts ... and coastal zone management areas.”

- Many waste dumping areas are located offshore, river basin districts extend into near-shore coastal waters, etc.

- Agricultural and **aquaculture** facilities
  - Near-shore and off-shore aquaculture facilities will almost certainly have far different data needs (features, location grids, etc.) than on-shore farming.

- **Environmental monitoring facilities** –
  - Coastal environmental monitoring is the focus of numerous actions at the EU level.

- **Natural risk zones**
  - Coastal flood plains are an obvious ‘risk zone’ for which various combinations of data are needed for planning, monitoring and mitigation, e.g. DTMs, bathymetry, meteorological models, etc.
Data Themes of **direct** interest to Stakeholders (3)

**Annex III (continued)**

- **Oceanographic geographical features** – “Physical conditions of oceans (currents, salinity, wave heights, etc.).”
  - *These are especially important in the coastal zone, which is the main geographical location at which they have a direct impact on human populations!*

- **Sea regions** - Physical conditions of seas and saline water bodies divided into regions and sub-regions with common characteristics.
  - *All seas have shorelines!*

- **Energy resources** – “… including depth/height information on the extent of the resource”.
  - *What about the current plan to build thousands of off-shore wind farms?*

- **Mineral resources**
  - *Mineral abstraction is another coastal and off-shore process that has can have serious negative impact on coastal regions.*
Data Themes of **indirect** interest to Stakeholders (1)

**Annex I**

**Coordinate reference systems** - Systems for uniquely referencing spatial information in space as a set of coordinates (x, y, z) and/or latitude and longitude and height, based on a geodetic horizontal and vertical datum. [What about off-shore and near-shore vertical datums pertinent to coastal information?]

**Geographical grid systems** - Harmonised multi-resolution grid with a common point of origin and standardised location and size of grid cells. [What about grid systems needed for off-shore and near-shore information purposes, i.e. meshes]

**Annex II**

**Land cover** - Physical and biological cover of the earth's surface including artificial surfaces, agricultural areas, forests, (semi-) natural areas, wetlands, water bodies. [Terrestrial land cover often has a direct impact on health and use of coastal zones, as is especially true for coastal wetlands and water bodies located near to the coast. Also important is the definition of a ‘water body’.

**Geology** - Geology characterised according to composition and structure. Includes bedrock, aquifers and geomorphology. [What about coastal geomorphology?]
Data Themes of **indirect** interest to Stakeholders (2)

Annex III

- **Land use** - Territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational). *Many of these types of ‘land use’ directly or indirectly impact on, or occur in, the coastal zone.*

- **Human health and safety** - Geographical distribution of dominance of pathologies (allergies, cancers, respiratory diseases, etc.), information indicating the effect on health (biomarkers, decline of fertility, epidemics) or well-being of humans (fatigue, stress, etc.) linked directly (air pollution, chemicals, depletion of the ozone layer, noise, etc.) or indirectly (food, genetically modified organisms, etc.) to the quality of the environment. *Pathogens occurring off-shore, for example in shell fish, have a direct impact on ‘health and safety’, as does general coastal water pollution.*

- **Utility and governmental services** - Includes utility facilities such as sewage, waste management, energy supply and water supply, administrative and social governmental services such as public administrations, civil protection sites, schools and hospitals. *All of the underlined facilities have coastal implications when the facilities occur in coastal zones.*
Data Themes of indirect interest to Stakeholders (3)

Annex III (continued)

• **Production and industrial facilities** - Industrial production sites, including installations covered by Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control and water abstraction facilities, mining, storage sites. *Pollution prevention and control is a serious issue for many coastal regions and managers, especially where heavy industry or dense population centres are situated near to coastlines.*

• **Bio-geographical regions** - Areas of relatively homogeneous ecological conditions with common characteristics.

• **Habitats and biotopes** - Geographical areas characterised by specific ecological conditions, processes, structure, and (life support) functions that physically support the organisms that live there. Includes terrestrial and aquatic areas distinguished by geographical, abiotic and biotic features, whether entirely natural or semi-natural.

• **Species distribution** - Geographical distribution of occurrence of animal and plant species aggregated by grid, region, administrative unit or other analytical unit. *Species distribution in the marine and coastal environment is not only an important topic, but one that is the focus of various national, regional and international biodiversity laws and conventions.*
Data Themes **appearing in the coastal zone (1)**

### Annex I

- **Geographical names** - Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest. *Of concern here should be ensuring that geographical names can be attached to relevant boundaries, even where the named region occurs offshore, i.e. where land-based boundary descriptive means may not apply.*

- **Administrative units** - Units of administration, dividing areas where Member States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries. (Determines who has legal jurisdiction in coastal zones in many countries).

- **Addresses** - Location of properties based on address identifiers, usually by road name, house number, postal code.

- **Cadastral parcels** - Areas defined by cadastral registers or equivalent. (Marine cadastre is only now beginning to be addressed in a very few European coastal states).

- **Transport networks** - Road, rail, air and water transport networks and related infrastructure. Includes links between different networks.
Data Themes appearing in the coastal zone (2)

Annex II

• **Orthoimagery** - Geo-referenced image data of the Earth's surface, from either satellite or airborne sensors. (Where technology now makes it easier to build up views of coastal waters as well as land-sea interface areas generally).

Annex III

• **Statistical units** - Units for dissemination or use of statistical information.

• **Buildings** - Geographical location of buildings.

• **Soil** - Soils and subsoil characterised according to depth, texture, structure and content of particles and organic material, stoniness, erosion, where appropriate mean slope and anticipated water storage capacity.

• **Population distribution - demography** - Geographical distribution of people, including population characteristics and activity levels, aggregated by grid, region, administrative unit or other analytical unit.
Data Themes appearing in the coastal zone (3)

Annex III (continued)

• **Atmospheric conditions** - Physical conditions in the atmosphere. Includes spatial data based on measurements, on models or on a combination thereof and includes measurement locations.

• **Meteorological geographical features** - Weather conditions and their measurements; precipitation, temperature, evapotranspiration, wind speed and direction.
Part 2

Main Issues and Challenges for Implementing SDI/MarineSDI

• Who is in charge or responsible for the MSDI?
• Who coordinates and enforces?
• Who pays and benefits (and how much)?
EU Example for Deployment of CSDI/MSDI

EEA inherits Feature definitions from IOC and IHO catalogues, e.g. coastline, currents, waterlevel.

An example service is based on the Features defined in catalogues managed an authority such as EEA. These Features are bound to the services of data providers.
This is the type of deployment we want to establish to enable user communities harmonised access to information on which to build services.

Central to this is the governance of Feature Catalogues by competent bodies and binding these to data services.
Challenges in the SDI/MSDI Process

- **Consultation, Cooperation, Collaboration and Coordination** – the “4 C’s” for successful SDI implementation.

- Raising **awareness** of benefits, at all levels - continuously.

- Overcoming **skills shortages** among data owners, creators, and users - at all levels of government, businesses and citizens.

- **Convincing stakeholders** that **harmonized geospatial data** has greater value due to its ability to support **interoperable** services – and innovative **new** services.

- **Managing expectations** of all stakeholders in a process that will take **many** years to complete.

- **Measuring success** (identifying early ‘win-win’ cases & using performance indicators) - to combat concerns over cost (time, money, human resources).

- **Adapting to change** – nothing stands still in the information world!
Why the Challenges exist?

• **capacity building** issues – lack of human resources with the right skills and knowledge, lack of adequate ICT infrastructure, lack of funding, ...

• **conflicts** with other departmental or government policies (prioritize SDI?) – and who wants to be the ‘leader’,

• **lack of incentives** to managers and high-level decision makers to make the changes, especially given the potential cost and time scale,

• concern over **data quality** – mistakes & inaccuracies in ‘my’ data,

• use of ‘**official’ data** versus ‘un-official’ data, e.g. crowdsourced?

• **data hoarding** – retaining control over ‘my’ data, and

• ... **institutional inertia** – change of any kind does not come easily!
EU SDI (INSPIRE) Data Challenges

• Embedding relevant and important marine & coastal data themes in the base INSPIRE data model(s) and specification(s).

• Implementation challenges caused by the sequential introduction of different data themes within INSPIRE – timing is a problem, especially for coastal zones.

• Enlisting experts from the marine/coastal community(ies) with relevant experience – not only in their fields of professional expertise, but also in data modelling, standards specification, etc.

• Finding the time and resources to participate proactively in the SDI/MSDI definition, testing and implementation process.

• Getting the message out to the marine & coastal community(ies) – who often see themselves as not involved in these mainly “topographic community driven” initiatives.
Some Lessons Learned

• Human resources are the most difficult challenge, in our experience in Europe, i.e. too few real experts took part in the thematic working groups defining either national or regional (transnational) SDIs.

• Those experts who do take part, come from disparate communities and found it difficult to understand data needs from other disciplines perspectives.

• Identifying and overcoming organizational issues are reported as key problems in nearly all SDI and MSDI initiatives at national level. Getting as many stakeholders on board as soon as possible in the SDI/MSDI creation process is of high importance.

• Identify an SDI/MSDI ‘Champion’ (person and organization) as early as possible, preferably at high government level.

• Communication and information dissemination are key across all stakeholder communities.

Remember ...

“The coastal zone is not a narrow band. It’s the whole country.”

(US Commission on Ocean Policy, 2002).
MSDI Implementation Framework
Strategies to meet the Challenges

• From the UK ACIL Tasman ‘Geovalue’ study* - ‘top barriers’:
  • lack of awareness of benefits,
  • resistance to change among users,
  • implementation costs – or fear of them!
  • inappropriate data pricing,
  • restrictions on access, use and/or re-use.

• Implementation strategies need to define ways to meet and overcome these challenges...
  • within budgets and human resources capabilities
  • Creating realistic CBAs to engage financial people

Strategy Recommendations

• **SDI development strategy** should be **tied to e-Government initiatives** – and goals - now underway in most countries for several years.

• Strategy also **sets the timelines for implementation** – defining **parallel actions** and **serial actions**, e.g. ...
  - harmonized metadata cannot be created until standards have been agreed,
  - but once agreed, metadata creation can proceed independent of, for example, licensing policy development or harmonizing datasets.

• **Implementing early ‘win-win’ scenarios** is important - keeps stakeholders engaged in the process – key themes and issues include: addresses, cadastre, reducing road congestion, disaster mitigation?

• Provide for **continuous awareness raising, training** and related **capacity building** initiatives, with proactive feedback to the stakeholders – including the public.
MSDI – Who Pays and Who Benefits?
Assessing Cost-Benefit (CBA)

- MOTIIVE Project Cost-Benefit Analysis Methodology (M-CBA): Marine Overlays on Topography
- A hybrid Multi-Criteria Analysis (MCA) methodology
- Costs (monetary) versus Benefits (value based)
- Built on SDIGER Project cost analysis & NASA ROI GeoVMM (Geo Value Measuring Methodology) MCA approach
- Spreadsheet(s) that can be used for project-based CBA – but (probably) not for SDI-level work.
Analysing Cost-Benefit (CBA)

➢ Traditional CBA methodologies and metrics are best suited to project justifications - not “infrastructures”.

➢ The more complex is the target (an infrastructure versus a project), the greater are the number of assumptions made in performing the analysis.

➢ Therefore, the less ‘believable’ is the result – especially by funding agencies.

➢ Traditional CBA best for project work, where monetary figures can be assigned to costs & benefits.

➢ CEA (Cost-Effectiveness Analysis) often used if traditional CBA is not suitable due to inability to monetarize all costs and/or benefits.

➢ MCA is much more flexible, more subjective, invites wider stakeholder participation.
CBA using GeoVMM

- GeoVMM – Geospatial Value Measuring Method – Developed by Booz Allen Hamilton (US consultancy) - used by NASA specifically for investigating Interoperability Return on Investment for very large projects ($10 million +).

- Methodology is approved by US Government (recognized as “best practice” by OMB).

- Captures expert input, as well a stakeholder input.

- Allows for 'weighting' of value factors and benefits.

- Takes account of risk factors.

- NASA (Booz Allen Hamilton) study focused specifically on added costs and benefits of introducing interoperability technology to existing/new projects. Results were ‘normalized’.
GeoVMM – Measuring Value

- Direct user value: data availability, ease of use, data sharing capabilities
- Social value: better decision making across society, improved governmental coordination, minimize barriers, institutional effectiveness, efficient use of taxpayer resources
- Government financial value: Total cost savings, Total cost avoidance
- Strategic/Political value: Closer working relationships, supports improved decision making
- Government Foundation/Operational value: Ease of integration, better intra-governmental collaboration, increased public participation and accountability, better interagency collaboration, re-use, adaptation and consolidation
GeoVMM Drawbacks

- An expensive methodology to follow – use of experts plus lots of stakeholder time is required if the weighting factors, etc. are to be acceptable to stakeholders and funders.

- Doesn't overcome problem with assigning monetary values to intangible benefits – this is still required by many financial agencies and leads to assumptions (which can be challenged by those providing the finance).

- As presented by NASA (BAH), GeoVMM looks mainly at the IT issues relating to interoperability – this seems not to interest many (most?) of the stakeholders in the marine/coastal research and management community or wider SDI communities.

- Concerns cost:benefit of project activities, not interoperability issues, i.e. cost of beach nourishment (easy to determine) versus benefit to tourism industry (less easy and often intangible), not how the data was collected or harmonised.
Example 1 - Croatia SDI (1)

SDI goals

• Raising social awareness of the importance of spatial data, and managing better coordination and cooperation between all included subjects,

• Customization of the existing spatial data to the appropriate standards and technologies,

• Design of metadata that will describe the existing sets of spatial data,

• Creation of a data catalogue and the necessary infrastructure.
Example 1 - Croatia SDI (2)

Types of costs considered

• spatial data collection and/or maintenance,
• material infrastructure (hardware and net resources),
• customization of data to the appropriate standards, creation of metadata and a catalogue,
• human resources,
• “other” costs.
Example 1 - Croatia SDI (3)

Benefits were grouped into three categories

• Reducing redundancy, reducing costs, and increasing the range of products and services for spatial data producers.

• Reducing costs and increasing the range of products and services for spatial data users.

• Direct and indirect benefits for the whole society through improvement of the public information services.
Example 2 – Catalan SDI (IDEC) (1)

Assumptions made/used in Catalan IDEC CBA (2004-2005):

• “IDEC has a specific line of activity, and related funding, to disseminate SDI concepts and technologies to local municipalities with a view to modernise public administration and improve services to citizens and local businesses.”

• “IDEC is not directly involved in the production and maintenance of topographic data, which is the responsibility of the ICC (the regional cartographic agency), but focuses solely on the added value of an SDI.”
Example 2 – Catalan SDI (IDEC) (2)

• Used actual costs over 5-year period.
• Does not include creation and updating of topographic data (would happen regardless of the development of the SDI) nor the indirect costs associated with the physical and technological infrastructure.
• Does include:
  • metadata creation and maintenance,
  • geoservices (including geoportal, catalogue, WMS client),
  • preparation of data for publication,
  • applications,
  • hardware and software, and
  • management.
Example 2 – Catalan SDI (IDEC) (3)

Benefits were assumed to be:

• **efficiency benefits** internal to the public administrations (time saved in internal queries by technical staff, time saved in attending queries by the public, time saved in internal procedures and the redesign of internal processes), and

• **effectiveness benefits** (time saved by the public and by companies in dealing with public administration).

• **Efficiency benefits** accounted for over 500 hours per month per commune = savings exceeded 2.6 million euro/year.

• **Effectiveness savings** were approximately 480 hours per month per commune = 2.5 million euro/year.
Example 2 – Catalan SDI (IDEC) (4)

Investment decision?

• Study indicated that initial **investment** to set up the IDEC SDI was **recovered in just 4 months**.

• If the operating costs for 2004-05 were included, the payback period increases to **just over 6 months**.

The question is – would you make the investment needed based on the CBA results and underlying assumptions, especially in regard to **measured benefits**?
Some Recommendations for CBA (1)

Conduct a study looking at the ‘value of geospatial data’ as perceived by different stakeholders (government, business, citizens), for different uses and in different pricing, charging and dissemination scenarios, taking account of the eGovernment environment and information culture.

This is necessary to underpin the conduct of a cost-benefit study, since, without a better understanding of the value of geodata, how can one properly assign a benefit to its use?
Some Recommendations for CBA (2)

• Prepare a proper **business case** within a framework acceptable to those who will fund the infrastructure.

• The business case should analyse the demand for an SDI (recognizing the indirect nature of demand), having first defined ‘SDI’ operationally.

• Identify and involve all major classes of stakeholders, by properly conducted survey techniques, in determining both demand and the value that stakeholders put on geospatial information and its use, possibly via use case studies.

• The CBA could be performed as part of this exercise, during which specific implementation targets and strategies would be developed, debated and costed.

• Strategy, assumptions and financial targets (IRR, ROI, C:B ratio) would be discussed with the funding agencies prior to and throughout the work.
Some Recommendations for CBA (3)

• Whatever mechanism is followed to justify creation of an SDI - CBA or business case or other - it should contain **specific targets** and **concrete benefits** which can be monitored over a period of many years, spanning decades, if necessary, since that is the actual time span needed to develop comprehensive information infrastructures.

• Consider using the **cost-effectiveness approach** to CBA in investigating the investment needs and options for the SDI, as this methodology is suited to situations where commitment to the overall level of investment funding is already established, to broad guidelines, versus the traditional CBA approach.

• Consider combined methodologies – traditional CBA for costs combined with MCA (Multi-Criteria Analysis) for benefits.
Some Recommendations for CBA (4)

• **Information audits** are needed for all departments in the government to know what (geospatial) data and metadata they have already, and what is still needed, especially for metadata.

• If your national SDI initiative offers – or requires – that cost-benefit studies be conducted using **specific methodologies**, then be sure to use them – otherwise the entire study may be rejected.

• In any event, ensure that all **assumptions** made in conducting the study are well and transparently stated – and justified where possible.

• **Audits** should indicate **what** data is held, **why**, **how** it is used and **how often**, with user’s own estimates of the cost and benefit of **having**, versus **not having**, that information readily available.
Some Recommendations for CBA (5)

• Complexity does not always yield much better results than adopting a simpler approach that will ensure greater stakeholder ‘buy in’ to both the methodology and inputs/outputs.

• Don’t be afraid to request - demand - rigour from the experts conducting your cost-benefit analyses. Too many unfounded assumptions will destroy the value of, and trust in, any CBA results produced by the ‘experts’. (US The National Map CBA as an example)
Crowdsourcing and MSDI?

• General Bathymetric Chart of the Oceans (GEBCO) project was initiated in 1903 to provide the most authoritative, publicly-available bathymetry of the world’s oceans.

• The GEBCO project is now jointly overseen by the IHO and the Intergovernmental Oceanographic Commission of UNESCO.

• Obtained depth measurements (‘passage soundings’) from vessels as they journey across the oceans, enabling creation of progressively more-detailed seafloor maps and digital data grids.

• Systematic surveys have been used to improve these maps and grids.

• Yet, since 1903, less than fifteen percent of the world’s ocean depths have been directly measured.

• IHO “Guidance on Crowdsourced Bathymetry”, 2018 (draft) developed by IHO Crowdsourced Bathymetry Working Group.
Diagram showing the extent of publicly available bathymetric data for the ocean.  
Source: Hydro International, May/June 2017
The IHO Data Centre for Digital Bathymetry (DCDB) currently accepts crowdsourced bathymetry (CSB) contributions through a network of Trusted Nodes, which are organizations or individuals that serve as data liaisons between mariners (data collectors) and the DCDB.
A schematic of the flow of CSB data from the mariner, to the IHO DCDB, to the public.
The IHO CSB Data Viewer, which enables discovery of, and access to, crowdsourced bathymetry.
# Required Information for delivery to the DCDB

<table>
<thead>
<tr>
<th>Data Field</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitude</td>
<td>The vessel's longitudinal geographic position, in WGS84 decimal degrees, to a precision of six decimal places. This can be extracted from the NMEA RMC, GGL or GGA String.</td>
<td>-19.005236</td>
</tr>
<tr>
<td>Latitude</td>
<td>The vessel's latitudinal geographic position, in WGS84 decimal degrees, to a precision of six decimal places. This can be extracted from the NMEA GGA, GLL or RMC String.</td>
<td>40.914812</td>
</tr>
<tr>
<td>Depth</td>
<td>The distance from the echo-sounder to the seafloor. Should be collected as a positive value, in metres, with decimetre precision. This can be extracted from the NMEA DBT, DBK or DBS data string.</td>
<td>7.3</td>
</tr>
<tr>
<td>Date &amp; Timestamp</td>
<td>The date and UTC time stamp for the depth measurement. This can be extracted from the NMEA RMC string.</td>
<td>2015-08-06T22:00:00Z</td>
</tr>
<tr>
<td>Course over Ground (COG)</td>
<td>The course over ground of the vessel, as reported by the GNSS RMC string, to the nearest degree.</td>
<td>187</td>
</tr>
</tbody>
</table>
Requested Metadata for DCDB

- Vessel Type
- Vessel Name
- Vessel Length
- ID Type
- ID Number
- Sensor Type Sounder
- Sounder Make
- Sounder Model
- Sounder Transducer
- Sounder Draft
- Uncertainty of Sounder Draft

- Sounder Draft Applied
- Reference point for Depth
- Sensor Type GNSS
- GNSS Make
- GNSS Model
- Longitudinal Offset from GNSS to Sounder
- Lateral Offset from GNSS to Sounder
- Position Offsets Applied
- Issues with uncertainty
Required Additional Metadata from Trusted Nodes for DCDB entry

• Provider Contact Point Organization Name
• Provider Email
• Unique Vessel ID
• Convention
• Provider Logger
• Provider Logger Version
Sources of Uncertainty

Example of estimating depth with a simple echo-sounder (left), and illustration (right) of the potential for blunders (e.g., the echo-sounder detecting the depth of a school of fish, rather than the seafloor).
Legal Considerations for CSB

Those considering taking part in the IHO crowdsourced bathymetry programme should be aware of the following potential legal considerations:

• Mariners proposing to collect bathymetric data as a “passage sounding” activity should be aware of conditions that may be associated with collecting such environmental information within waters of national jurisdiction.

• Those involved in the IHO CSB programme, whether as a data collector, a Trusted Node or a user, should be aware of the conditions of the licensing regime under which the bathymetric data will be made available.

• Those using data obtained from the IHO DCDB must carefully consider the nature and the uncertainty of the data and whether it is fit for the purposes intended by the user.
Part 3

Case Studies

Identified Good Practice in Marine/Coastal SDI
Australian Marine SDI (AMSIS)

• Elevation and depth are in the national Foundation Spatial Data Framework, under custodianship of the Intergovernmental Committee on Surveying and Mapping (ICSM).

• Bathymetry dataset includes a 50m multibeam dataset of Australia to provide an understanding of the nature of the seafloor plus various representations of the coast, ranging from lowest to highest tide, to aid in coastal planning and monitoring.

• This data underpins safe hydrographic navigation, definition of maritime and administrative boundaries, emergency management, natural hazard risk assessment, water management, natural resource exploration and exploitation and national security.

• Started ‘bottom up’ in early 2000’s – now supported from within NSDI.
Australian Marine Spatial Information System (AMSIS)

• Web based **interactive mapping** and **decision support system** that improves access to integrated government and non-government information in the Australian Marine Jurisdiction.

• Contains many layers of information displayed in themes of Maritime Boundaries, Petroleum, Fisheries, Regulatory, Environment, Native Title and Offshore Minerals.

• Data is sourced from Geoscience Australia, other Australian government agencies and some industry sources.

• Contains offshore mineral locations data that was used to create the **Offshore Minerals Map**.

Australian Marine Spatial Information System (AMSIS)

• Information in this application should not be relied upon as the sole source of information for commercial and operational decisions. **AMSIS should not be used for navigational purposes.**

• Legacy AMSIS contains data from 2006-2014 is being migrated to the current AMSIS.

• Interactive Maps is a discovery and exploration view of Geoscience Australia's geospatial services. Each map has queries and functions with linked access to OGC web services and metadata.

• Visit AMSIS Interactive Maps here:

Australian Marine Spatial Information System (AMSIS)

Legacy AMSIS data

Australian Ocean Governance and Related Legislation

<<<- Fisheries Act(s) Related ->>>
Good Practice in Marine/Coastal SDI – USA

USA Coastal SDI

• The Coastal Services Center of NOAA (now the Office for Coastal Management) published in 1999 definitions and goals for the Coastal National Spatial Data Infrastructure within the US NSDI initiative.

• Coastal SDI supported establishing metadata standards within remit of the Federal Geographic Data Committee (FGDC) work on the national Content Standard for Digital Geospatial Metadata (CSDGM) - first published in 1998.

• Today, Coastal/Marine SDI developments are under the FGDC Marine and Coastal Spatial Data Subcommittee. Visit: https://www.fgdc.gov/organization/working-groups-subcommittees/mcsdsc/index_html
USA Coastal SDI

• “The vision of the US Marine and Coastal NSDI is that current and accurate geospatial coastal and ocean data will be readily available to contribute locally, nationally, and globally to economic growth, environmental quality and stability, and social progress.”

• NOAA’s DigitalCoast is one of the most-used resources in the US coastal management community.

• Visit: http://coast.noaa.gov/digitalcoast/

• Stakeholders are KEY to success of MSDI/CSDI – and any SDI! See the US coastal/marine stakeholders at: https://coast.noaa.gov/digitalcoast/contributing-partners/
• **Topics** — This section provides quick links to the top Digital Coast holdings that communities use to address common coastal management issues.

• **Stories from the Field** — See how communities throughout the coastal zone use Digital Coast products.

• **Digital Coast in Your State** — These reports showcase usage statistics and top products for each state. The **Return on Investment** report is also helpful. Digital Coast costs are compared to the efficiencies gained by the user community.

• **Top Products** — Top **data sets** include lidar, economic, and land cover data. Most used **tools** include the Sea Level Riser Viewer, Land Cover Atlas, and a do-it-yourself visualization tool.

• Have a look at **Contributing Partners** at [https://coast.noaa.gov/digitalcoast/contributing-partners/](https://coast.noaa.gov/digitalcoast/contributing-partners/)
Canadian Marine GDI

• Canadian Marine Geospatial Data Infrastructure (MGDI) guide was published in **1999**.

• Comprehensive ‘Marine Use Requirements for Geospatial Data’ report in **2001**.
  • Canadian **CGDI (NSDI)** Guidelines (for the national SDI) were not published until **2004**.

• One of the challenges noted 14 years ago was:
  • “*Capacity building (training) will be needed to create demand for MGDI and to create the capacity to use MGDI to the fullest*” - a challenge that remains today.
Canadian Marine GDI

• Marine SDI work in Canada now includes **marine cadastre** within the national SDI programme, **GeoConnections**, and development of the **Arctic SDI**, which involves many nations with Arctic borders.


• MSDI work in eastern Canada is led by the **Coastal and Ocean Information Network Atlantic (COINAtlantic)**, a hub for coastal and ocean information in Atlantic Canada for **ACZISC**, the Atlantic Coastal Zone Information Steering Committee.
The Coastal and Ocean Information Network Atlantic (COINAtlantic) is the ACZISC's (Atlantic Coastal Zone Information Steering Committee) website, a hub for Coastal and Ocean Information in Atlantic Canada. This includes the geospatial tools:

- COINAtlantic Search Utility
- COINAtlantic GeoContent Generator
- COINAtlantic Data Accessibility Self-Assessment Tool

The ACZISC is working to provide open access to data, information and applications relevant to Atlantic Canada through COINAtlantic. COINAtlantic promotes: Reliable Access, Best Information, and Informed Decisions.
Developing a Coastal Characterization Information Service for the Island of Newfoundland
The Irish SDI is implementing the INSPIRE Directive for a pan-European SDI.

The **Irish Spatial Data Exchange (ISDE)** is a data discovery tool allowing you to find spatial data and services hosted across multiple government and academic organisations.

Online data access options are available.

Assess whether data exist that are suitable for your purpose through the detailed metadata.

**Partnerships:** The ISDE was developed by the Marine Institute with partners Geological Survey of Ireland, EPA, Department of Environment, Community and Local Government (DECLG) and Coastal and Marine Research Centre (UCC), with initial funding from multiple sources.

• Aim of the study - International Web survey to assess the worldwide developments of existing national marine and coastal geoportals of SDIs or similar Web services.

• Geoportal: central web gateway ➔ way to assess the processes implemented by the country.

• Scope: geoportals implemented by national public bodies enabling the access and the use of geographic data specifically related to marine and/or coastal zones.
• Geoportals **inventory**: October 2014
  – Browsing of the Internet with monitoring tools (e.g. Google alert, Mention, Netvibes).
  – Scanning various international networks and events (GSDI, CoastGis, IHO, IODE, INSPIRE).
  – Geoportals were **revisited in 2015**
Study Methodology General Overview

• Geoportals characterization: November 2014 and March 2015
  – **20 Characteristics** sourced from the geoportal Web pages
    • **7 characteristics**: first elements that the user can discover online ➔ typology
      – general description of the geoportal,
      – information on the discipline and the topic of the data accessible on the geoportals + means to discover and access these data.
    • **13 characteristics**: detailed description of the five SDIs components.
Geoportals Assessed

120 geoportals assessed

- 20% not operational (24)
- 23% out of the scope (28)
- 57% part of the survey (68)
Geographic Distribution
Identified Geoportal Typology

Comparison of the characteristics:

• Data thematic
• Data access policy inventoried
• Search data mechanisms
• Access data mechanisms

Typology of the Geoportals

- 35%: National Oceanographic Data Centre geoportal (24)
- 26%: Hydrographic Office geoportal (18)
- 24%: Atlas-like geoportal (16)
- 15%: Hybrid geoportal (10)
## Geoportals by Typology

<table>
<thead>
<tr>
<th>Geoportal Class</th>
<th>Number</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas-Like</td>
<td>16</td>
<td>ICAN</td>
</tr>
<tr>
<td>Hydro. Office</td>
<td>18</td>
<td>IHO</td>
</tr>
<tr>
<td>NODC</td>
<td>24</td>
<td>NODC</td>
</tr>
<tr>
<td>Hybrid</td>
<td>10</td>
<td>-</td>
</tr>
</tbody>
</table>
Characteristics Reviewed/Assessed

- Name of national geoportal
- Year of first implementation
- Languages used
- Data themes
- Number of datasets
- Level of openness for data access
- Licensing
- Data searching mechanisms
- Data access services
- Monthly number of users
- Number of data suppliers
- Standard metadata
Results - Year of Implementation

- Atlas-Like (16)
- Hydro. Office (18)
- NODC (24)
- Hybrid (10)
Number of Datasets – Nov 2014/March 2015

- Atlas-like Nov 2014 (16)
- Atlas-Like March 2015 (16)
- Hydro. office Nov 2014 (18)
- Hydro. Office March 2015 (18)
- NODC Nov 2014 (24)
- NODC March 2015 (24)
- Hybrid Nov 2014 (10)
- Hybrid March 2015 (10)

27/11/2018
UNESCO, IOC, Ocean Teacher Academy, Oostende, Belgium
No evolution between October 2014 and March 2015
Number of data suppliers

No evolution between October 2014 and March 2015
No evolution between October 2014 and March 2015.
Access Mechanisms

No evolution between October 2014 and March 2015
Levels of Openness

No evolution between October 2014 and March 2015

- Atlas-Like (16)
- Hydro. Office (18)
- NODC (24)
- Hybrid (10)
No evolution between October 2014 and March 2015

FGDC
INSPIRE
ISO
IHO S57
Other
Variable
n/a

Atlas-Like (16)
Hydro. Office (18)
NODC (24)
Other
Variable
n/a

27/11/2018
UNESCO, IOC, Ocean Teacher Academy, Oostende, Belgium
Results: Characteristics

• Atlas-Like geoportals: Open License or Specific Data Use Agreements (78%).

• Hydrographic geoportals: General Conditions of Sale of the distribution agents

• NODC geoportals: IOC Oceanographic Data Exchange Policy
Worldwide developments for marine geoportals accessible online are underway – but…

There was little evidence of real dynamics in development.

Important information is not available for the user (e.g. licensing terms, data suppliers, etc.).

Despite the integrated approach promoted by ICZM/MSP, access to the wide range of marine data needed for these applications is not frequent.

➔ Lesson: There is still the need for true data harmonisation and services interoperability globally – as could be provided by well-established Marine SDIs.
International Hydrographic Organization (IHO)

- Marine SDI Working Group (MSDIWG) – visit

- Meets physically annually in locations around the world.
- Interim meetings held electronically.
- Develops and progresses a multi-annual workplan focussing on many different aspects of Marine SDI development, mainly from the point of view (and participation) of national Hydrographic Offices (HOs).
- Was main driver for the IHO’s Marine SDI publication C-17, released in January 2017.
- Interacts closely with the IHO’s standards development group for the new S-100 standards.
IHO C-17 Publication on MSDI


Table of Contents

1. Introduction
2. What is a Spatial Data Infrastructure (SDI?)
3. The Current Landscape
4. The traditional role of HOs
5. From Data to Information to
6. Data Duplication and Conflict
7. Why is MSDI important to a HO?
8. MSDI – Some Important Drivers
9. What role should a HO have in MSDI?
10. Business Planning
11. Steps required to be taken by HOs to make MSDI happen
12. The Challenges for Hydrographic Offices
13. A look into the Future!
IHO C-17 Publication on MSDI


Table of Contents

Annex A - SDI Best Practice
Annex B – Example Conceptual Model for a National SDI
Annex C – Frequently Asked Questions (FAQs) about SDI
Annex D – Hydrographic Data Policy
Annex E – Fundamentals of a Marine Spatial Data Infrastructure (MSDI)
Annex F – Example Uses of Hydrographic Data for Purposes Other Than Navigation
Annex G – How HOs might engage in SDI
Annex H – Stakeholders to be considered by IHO member states
Annex I – SDI Business Plans – Links to examples
IHO S-100 Marine Data Standards

(New) S-100 Framework Data Structure for Hydrographic and Related Data

- broad geospatial framework structure
- not specific to navigation or charting
- capable of accommodating other requirements
- based on ISO 19100 series of geographic information standards
- will support development of Marine SDIs globally
- marine cadastre is one of the first sub-components to be developed
IHO S-100 Marine Data Standards
IHO S-100 Marine Data Standards
S-100 Components

Figure 1 IHO S-100 Work Packages and ISO Standards
Objectives of the IHO S-100 Working Group

• maintain, develop and extend S-100 - Universal Hydrographic Data Model; S-99 - Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry;

• supervise the management and development of the S-100 Geospatial Information Registry;

• advise and support the development and maintenance of S-100-based product specifications in liaison with the relevant IHO bodies and non-IHO entities;

• monitor the development of other relevant international standards.

See https://www.iho.int/srv1/index.php?option=com_content&view=article&id=626&Itemid=978&lang=en
S-100 to S-199 Product Specifications

- **S-101 ENC**
- **S-102 Bathymetric Surface - *Surface bathymétrique***
- **S-103 Sub-surface Navigation - *Navigation sous la surface***
- **S-104 Water Level Information for Surface Navigation - *Information de hauteur d'eau pour la navigation de surface***
- **S-111 Surface Currents - *Courants de surface***
- **S-112 Dynamic Water Level Data Transfer - *Transfert de données dynamiques de hauteur d'eau***
- **S-121 Maritime Limits and Boundaries - *Limites et frontières maritimes***
- **S-122 Marine Protected Areas - *Aires marines protégées***
- **S-123 Radio Services - *Services radio***
- **S-124 Navigational Warnings - *Avertissements de navigation***
- **S-125 Navigational Services - *Services de navigation***
- **S-126 Physical Environment - *Environnement physique***
- **S-127 Traffic Management - *Gestion du trafic***
- **S-128 Catalogues of Nautical Products - *Catalogue de produits nautiques***
- **S-129 Under Keel Clearance Management (UKCM) / *Gestion de la profondeur d'eau sous quille***
- **S-1xx Marine Services - *Services maritimes***
- **S-1xx Digital Mariner Routeing Guide - *Guide numérique du navigateur sur l'organisation du trafic***
- **S-1xx Harbour Infrastructure - *Infrastructure portuaire***
- **S-1xx (Social/Political) - *(Social/Politique)***
S-100 Product Specifications

• **S-101** – ENC – Electronic Nautical Charts  
  • One of the first standards on which work began - draft specification is here  
    https://www.iho.int/mtg_docs/com_wg/S-100WG/S-101PT/S-101%20Main%20Document%20Edition%201.0.0_201810.zip

• **S-102** – Bathymetric Surface  
  • draft still under development after nearly 4 years.

• **S-121** – Maritime Limits and Boundaries  
  • Final draft nearing approval stage in 2019
S-121 Example Dataset

- **S-121 Maritime Limits and Boundaries** - See http://www.s-121.com/w/index.php/Document#S-121_Standard_Components
- **S-121 Draft product specification** is at: http://www.s-121.com/w/images/6/6b/3-S121_Product_Specification_05_Apr_2018.docx
OGC Marine Domain Working Group

- Develops open specifications/standards for the global geospatial community.
- More than 520 members from government, industry, academia, research institutes and individual experts.
- Standards development is membership led.
- Many (most?) ISO geo-related standards in the 19XXX series begin life as OGC specifications.
- Has 39 ‘Domain Working Groups’ across wide range of topics and sectors – of which the Marine DWG is one of the newest (June 2016). Visit http://www.opengeospatial.org/projects/groups/marinedwg
OGC Marine Domain Working Group

• The DWG will ensure that evolving IHO standards (e.g. S-100) are brought to the attention of the OGC members, and the evolving OGC standards are brought to the attention of IHO members in an effort to ensure best practices are being used and the latest technical approaches considered.

• The DWG will **work closely with the IHO MSDI Working Group** and potentially its adjacent groups/commissions/committees under the IHO Inter-regional Coordination Committee and the IHO Hydrographic Services and Standards Committee and other related organizations.

• The **mission** of the Marine DWG is to broaden the use of marine data through the understanding of the interoperability-related requirements for relevant use cases.

• The **role** of the Marine DWG is to serve as a forum within OGC for marine data issues; to present, refine and focus interoperability-related issues to the Technical Committee; and to serve where appropriate as a liaison to other industry, government, independent, research, and standards organizations active within the marine domain.
Some (More!) Good Practice & Lessons Learned

- Marine/Coastal SDI development takes place within existing national SDI (and NII) initiatives/programmes, not in isolation – be represented on NSDI committees, councils and implementing bodies.
  - Marine/Coastal SDI developers need to be fully aware of these initiatives and the requirements these may place on MSDI development plans and work.

- Identify a key organisation (or consortium) to be the formal MSDI leader...
  - Not easy in the marine/coastal world where there are many disparate sectors involved, typically led by many different government departments.
  - Many departments do not see the need to cooperate as part of their legal ‘public tasks’.
  - Requires compromise, cooperation and collaboration at all stages!

- Adopt international standards wherever possible (ISO or national profiles).

- Prepare to adapt to change from the outset – nothing stands still over the periods of time it will take to implement an SDI.
Part 4

MSDI in Marine Cadastre and Marine Spatial Planning
Challenges for MSP

- **Multiple themes** required in Marine Spatial Planning
- **Multiple Jurisdictions & Multiple Agencies**
- **Data Issues** – Cost, Governance, Access (Openness), Management
- **EU Responses** – MSFD & MSP Directive
Marine Spatial Planning

EU Marine Spatial Planning Directive (July 2014)

- Article 3 - (2) ‘maritime spatial planning’ means a process by which the relevant Member State’s authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives;

- Article 4 - 2. In doing so, Member States shall take into account land-sea interactions.

USA Executive Orders 2005 (Energy Policy Act incl. marine cadastre) and National Ocean Policy 2010

- 2005 – Outer Continental Shelf – authoritative sources
- 2010 – coast & Great Lakes for alternative energy and marine spatial planning

“... in the marine environment, the terminology of cadastre is still unclear because there are problems like discontinuity between land and marine cadastre, standards, technical and legal institutional aspects.”

“Marine cadastre and spatial data infrastructures in marine environment” (2002)
The concept of tenure does not exist at sea or varies in different marine locations.

It is not possible to use classical means of boundary demarcation offshore.

The marine environment is three dimensional – classical 2D simplifications will not suffice.

It is common for multiple, overlapping rights to exist in a single location.

Rights can vary with time, adding a fourth dimension to the spatial data.

The baseline to which many maritime boundaries are related is ambulatory.

“A marine cadastre should be considered as part of spatial data infrastructures (SDI), considering its importance for coastal and marine stakeholders. Then, these spatial data should be easily accessed to get the basic dynamic information.”

(Williamson et al, 2002)
Multiple Jurisdictions & Agencies - USA

“Regional planning bodies are not regulatory bodies and have no independent legal authority to regulate or otherwise direct Federal, State, tribal, or local government actions. All activities will continue to be regulated under existing authorities.”

USA - https://www.whitehouse.gov/administration/eop/oceans/marine-planning

US Office for Coastal Management – Digital Coast - Contributing Partners* (> 400)
• Non-governmental (77)
• Academia (59)
• Private (42)
• Federal (92)
• State (81)
• County (43)

Introduces the concept of (non-authoritative) Trusted Data (http:marinecadstre.gov)
• Rigorous process of data quality examination and metadata (includes compilations from authoritative source).

*See the full list here: https://coast.noaa.gov/digitalcoast/contributing-partners/
EU Marine Spatial Planning Themes

- aquaculture areas
- fishing areas
- installations and infrastructures for the exploration, exploitation and extraction of oil, of gas and other energy resources, of minerals and aggregates, and for the production of energy from renewable sources
- nature and species conservation sites and protected areas
- maritime transport routes and traffic flows
- submarine cable and pipeline routes
- raw material extraction areas
- military training areas
- scientific research
- tourism
- underwater cultural heritage

*from the EU Marine Spatial Planning Directive*
Marine Data Challenges – Many Themes

EU MSP Themes:

- aquaculture areas
- fishing areas
- oil, of gas and other energy resources
- minerals and aggregates
- production of energy from renewable sources
- nature and species conservation sites and protected areas
- maritime transport routes and traffic flows
- submarine cable and pipeline routes
- raw material extraction areas
- military training areas
- scientific research
- tourism
- underwater cultural heritage
Marine Data Challenges - Legal Basis

• EU Maritime Policy has no explicit legal basis in the Treaty of Rome as exists in other sectors, such as agriculture, transport, etc., so...
  • ... implementation of different elements of the EU Marine Strategy Framework Directive (MSFD) and Marine Spatial Planning (MSP) Directive rely on specific Treaty provisions that most closely relate to the proposed policy initiatives.
  • The data components (data, tools, management, etc.) are then enacted (typically) via Regulations – but not always in detail and with multiple enforcement regimes (whether EU-wide or national).
• USA – “regional planning bodies are not regulatory bodies and have no independent legal authority to regulate or otherwise direct Federal, State, tribal or local government actions.” (EO 2010)
MSP Directive - Article 10 - Data use and sharing

1. Member States shall organise the use of the best available data, and decide how to organise the sharing of information, necessary for maritime spatial plans.

2. The data referred to in paragraph 1 may include, inter alia:
   (a) environmental, social and economic data collected in accordance with Union legislation pertaining to the activities referred to in Article 8;
   (b) marine physical data about marine waters.

3. When implementing paragraph 1, Member States shall make use of relevant instruments and tools, including those already available under the IMP, and under other relevant Union policies, such as those mentioned in Directive 2007/2/EC (INSPIRE).
1. Marine Cadastre components are critical for implementation of marine spatial plans.

2. Data, jurisdictions and legal issues all overlap with MSP requirements.

3. Integrated spatial data infrastructures (SDI) encompassing both marine and terrestrial data are key enablers for both marine cadastre and MSP.
1. Marine Spatial Planning (MSP) requires far more data from far more data sources (creators, owners, custodians, public and private) than is provided within marine cadastre initiatives, programmes, systems – and legal mandates alone.

2. Yet marine cadastre provides one of the most important underpinning data sources to enable MSP implementation.  
   • How do you plan without boundaries, ownership, tenure and related cadastre information?

3. The very complexity of MSP, involving land-sea interactions, significantly complicates the legal, jurisdictional and data management requirements for both marine cadastre and MSP.
Marine Cadastre & MSDI in Europe


• 19 out of 28 EU Member States participated in the survey.
• 13 Member States out of 19 have developed some kind of MIS (either in stage of operation or on pilot basis/project).
“Review of the existing literature and implemented projects revealed that the geomatics community (government organizations, professionals and academia) has demonstrated a growing interest to apply land administration techniques to the marine environment in several countries (i.e. Australia, USA, Canada etc.) quite earlier than Europe.”

“... several sophisticated web mapping services have been developed based on open and re-use data policies and the concept of the Multipurpose Cadastre.”

“However the majority of the existing projects present a lack of a real marine cadastral registration component appropriate for secure process for transfer of titles, establishment of mortgages etc. (Balla, 2016).

“... widely accepted that the Marine Cadastre is considered as a base layer of the MSDI, offering fundamental information relating to maritime boundaries and associated rights and responsibilities, regularly updated and maintained.”
Marine Cadastre & MSDI in Europe

• Marine Cadastre is **not** Maritime Spatial Planning (MSP).

• **MSP** is a **process** determining where and when human activities happen in the sea.

• The Marine Registry and **Cadastre** is a **system** providing all the necessary information (who, how, where) about the 3R’s (Rights, Restrictions, Responsibilities) associated with human activities in the marine environment.

• “… there is no reference to the notion of ‘Marine Cadastre’ in the EU’s marine/maritime regulatory framework…”

27/11/2018
UNESCO, IOC, Ocean Teacher Academy, Oostende, Belgium
Part 5

Now for some homework (at your desk and/or for later)!

• The Data FUD Test – or ‘Do You Know your Data’

• SDI Readiness Checklist (8 pages - to test student’s knowledge of SDI in their own countries and/or to take back to their organisations for further assessment of SDI in those organisations).

• Introduction to the IHO Marine SDI Questionnaire (for students to take back to home countries to further interest in, and development of, MSDI locally/nationally).

• Data Accessibility Benchmark Organisational Self-Assessment (students to complete from viewpoint of their own organisations – which is the purpose of this Canadian-developed and tested methodology).