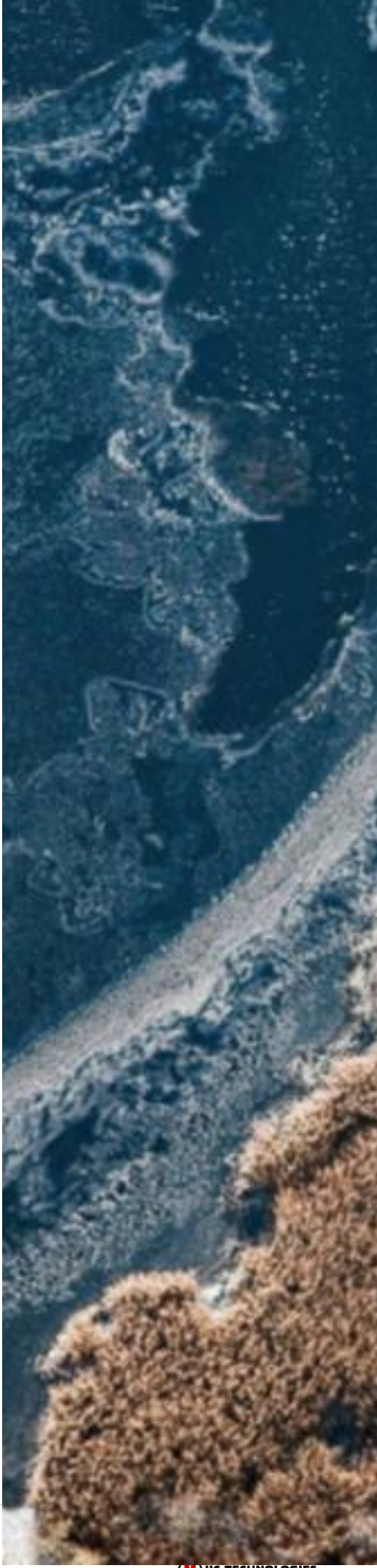
Marine Spatial Data Infrastructures

Training Material

MSDI Fundamentals



Danish Geodata Agency

IHO International Hydrographic Organization

IIC TECHNOLOGIES

Version 1.0 – July 2019

Revision History

V0.76 December 20th 2018	First Edition. Compiled by IIC Technologies
V0.82 January 2019	Minor edits. First presentation.
V1.0 February 2019	Review Edits following DGA feedback
v1.1 July 2019	Updates following rebranding of sponsor organisations

This course has been prepared by IIC Technologies at the instruction of the MSDIWG and the Danish Geodata Agency. It is published through the IHO and is aimed at spreading knowledge and awareness of MSDI globally. This publication is available through the IHO MSDIWG website at:

https://www.iho.int/srv1/index.php?option=com_content&view=article&id=483&Itemid=370&lang=en

Introduction

The material in this booklet is aimed at students who are marine geospatial professionals but who have little experience of marine spatial data infrastructures (MSDI). It is designed as an introductory one day course in the fundamentals of MSDI concepts, theory and practice and can be led or self-taught.

The material is all based on sources in the public domain and contains much information about MSDI available. The slides include key messages and narrative text which explain the content for participants.

A set of slides is included in an annex which explain selected aspects of the content further.

There are exercises included for further study after the main sections of the material and it is hoped these would be useful in a group context in the delivery of workshops.

There are two main uses for this document in conjunction with the slides themselves.

1. A participant who wishes to download and self-learn from the materials provided.
2. A participant who wishes to deliver the materials in a group setting with other stakeholders.

Content

This material is modelled on the IHO MSDIWG MSDI Fundamentals syllabus and is aimed at marine geospatial data professionals who may be marine cartographers, hydrographic specialists, surveyors or other related professionals.

The material covers definitions and applications necessary to understand the core concepts of MSDI, the essential understanding of the global drivers and organisations involved in MSDI and a more detailed examination of some of the most vital concepts in the MSDI ecosystem..

Structure

The following list is a brief breakdown of the individual sections.

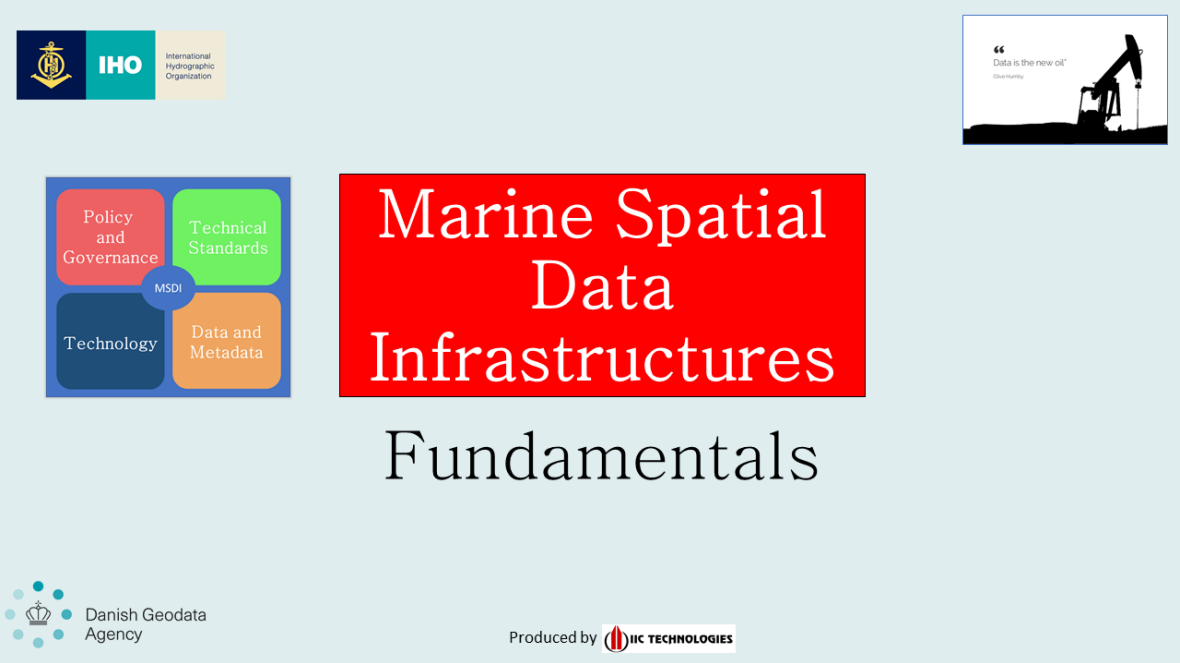
1. Introduction, background and history
2. Spatial Data Infrastructures.
    a. Core definitions
    b. Additional Definitions
    c. Types of SDI infrastructure
3. The four elements of MSDI
    a. Policy and Governance
    b. Technology
    c. Standards
    d. Data and Content
4. Wider Uses of marine geospatial data
    a. The MSDI ecosystem – global drivers and important organisations
    b. What MSDI means for end users
    c. What MSDI means for participants
5. What Next?
6. Annexes – extra material
7. Selected Exercises

Glossary of Terms used.

The glossary contains useful definitions taken from the many sources consulted in the creation of these materials.

Spatial data	Data which has a spatial component to it. A spatial thing is something that can be drawn on a map, or something that can be given in reply to a 'where?' question (ISO)
MSP	Maritime (or Marine) Spatial Planning
Hydrography	…the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defence, scientific research, and environmental protection
SDI	Spatial Data Infrastructure - "the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data."
Marine / Maritime	Marine and Maritime are used interchangeably. Marine tends to refer to the branch of earth science dedicated to the oceans whereas maritime refers to use and exploitation of the seas including the context of Safety of Life At Sea (SOLAS).
MSDI	Marine Spatial Data Infrastructure. "that element of an SDI that focuses on the marine input [to an SDI] in terms of governance, standards, ICT and content" [IHO C-17]
API	Application Programming Interface
Interoperability	a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, at present or in the future, in either implementation or access, without any restrictions.
Governance	The means for achieving direction, control, and coordination of wholly or partially autonomous individuals or organizations on behalf of interests to which they jointly contribute
Metadata	Metadata is data "about" data.
Standards	Reusable agreements that make it easier for people and organisations to publish, access, share and use better-quality data [UK ODI]
Open Standards	A standard available for anyone to access, use or share at little or no cost.
ENC	Electronic Navigational Chart. The primary output of most hydrographic offices globally. A vector based data format.
OGC	Open Geospatial Consortium http://www.opengeospatial.org
IHO	International Hydrographic Organization http://www.iho.int
ISO	International Standard Organisation http://www.iso.org
UN	United Nations
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management http://ggim.un.org

1 Introduction



Key Messages:

- Key Messages during the course are contained in a box like this.
- In this booklet each slide is presented along with any further notes that may be useful.
- Space permitting there is room at the bottom of each page for participant's notes.

The learning objectives of this material are as follows. When complete the participant should be able to:

1. Confidently identify the definition of a spatial data infrastructure (SDI), a Marine spatial data infrastructure (MSDI) and the core elements defining them.
2. Understand the layout of a typical MSDI, the benefits for its end users and the global organisations which support it
3. Clearly describe the interaction between the defining elements of an MSDI and how they contribute to broader use of marine geospatial data by MSDI end users
4. Describe how greater re-use of marine geospatial data is enabled by
    a. A migration to more data-centric working practices
    b. The adoption of open, interoperable standards

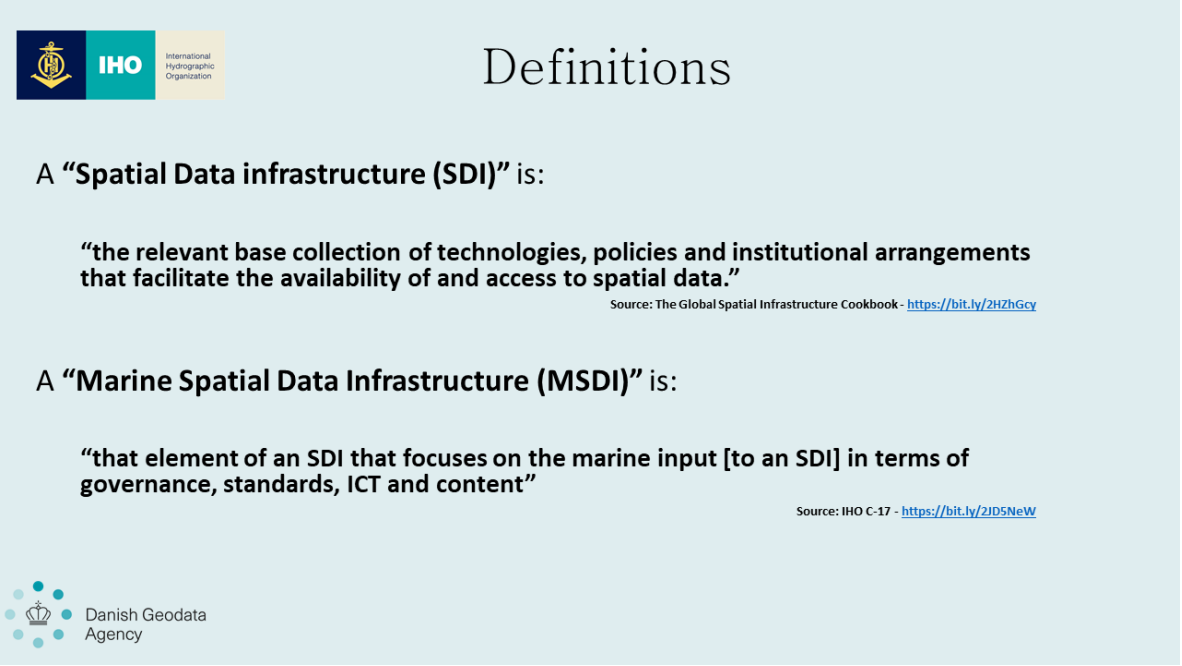
Notes:

Key Messages:

- Many participants may have heard of MSDI and have seen existing promotional or media articles
- There is a lot of information about MSDI in the public domain. This material is intended to:
  - Give a solid grounding in the core MSDI concepts
  - To explain the wider value of MSDI to its users and to participants through initiatives such as data-centric working
  - Provide some guidance for steps to take towards MSDI engagement and implementation

Notes:

2 What is MSDI



This section defines the core concepts of MSDI. Note that these definitions are quite old now (SDI – 1993, MSDI 2007) so some of the wording should be understood with some flexibility. For instance "ICT" is a (now) little used term for "Technology" (i.e. infrastructure) and the importance of global digital technical standards was not as strong when SDI was conceived. Their importance in MSDI are paramount, hence their inclusion in the MSDI definition alongside technology, governance and "content" (data)

Key Messages:

- These definitions are at the core of SDI and MSDI
- SDI is a more general term than MSDI.
- MSDI is the "marine elements" of an SDI
- MSDI is broken down into named focused components which, considered together, form the marine input to the SDI

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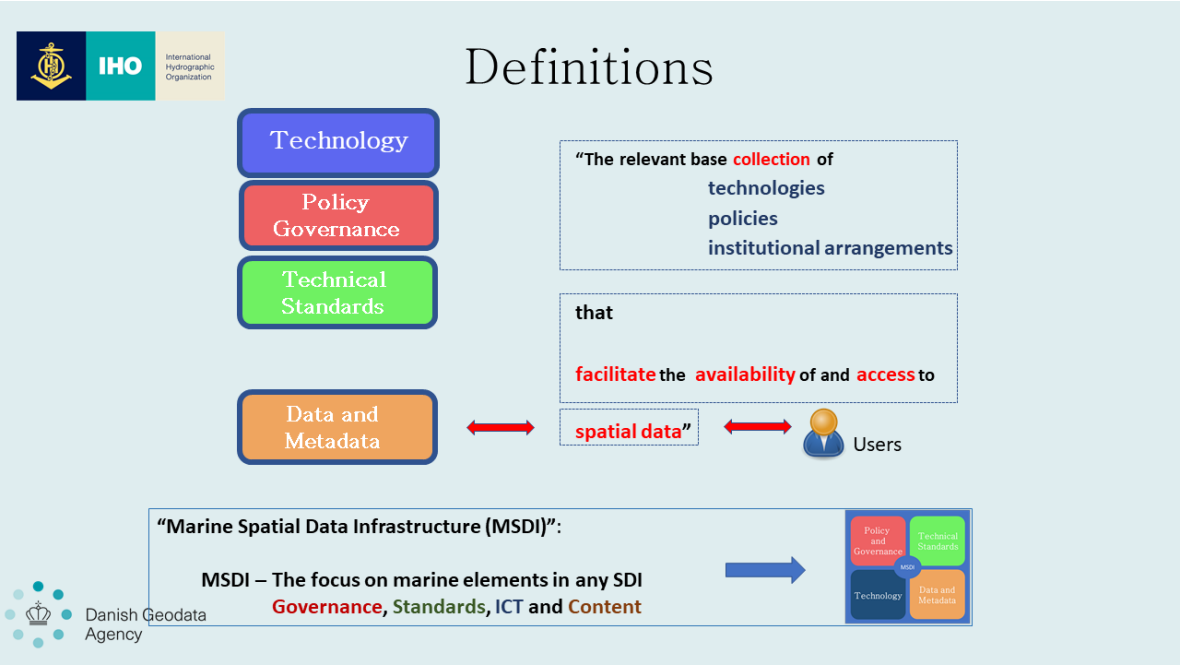

This slide shows how the core definitions of SDI are broken down and the core elements used in the explanation of MSDI are defined from them. The elements of the SDI definition have had their language modernised and encapsulated in the coloured boxes labelled "Technology", "Policy and Governance", Technical Standards" and "Data and Metadata"

The object of this material is to examine these elements of MSDI and demonstrate how they are used to implement MSDI.

Key Messages:

- MSDI is the marine input to any SDI
- The focus on marine in an SDI is broken into four elements which follow from the SDI definition.

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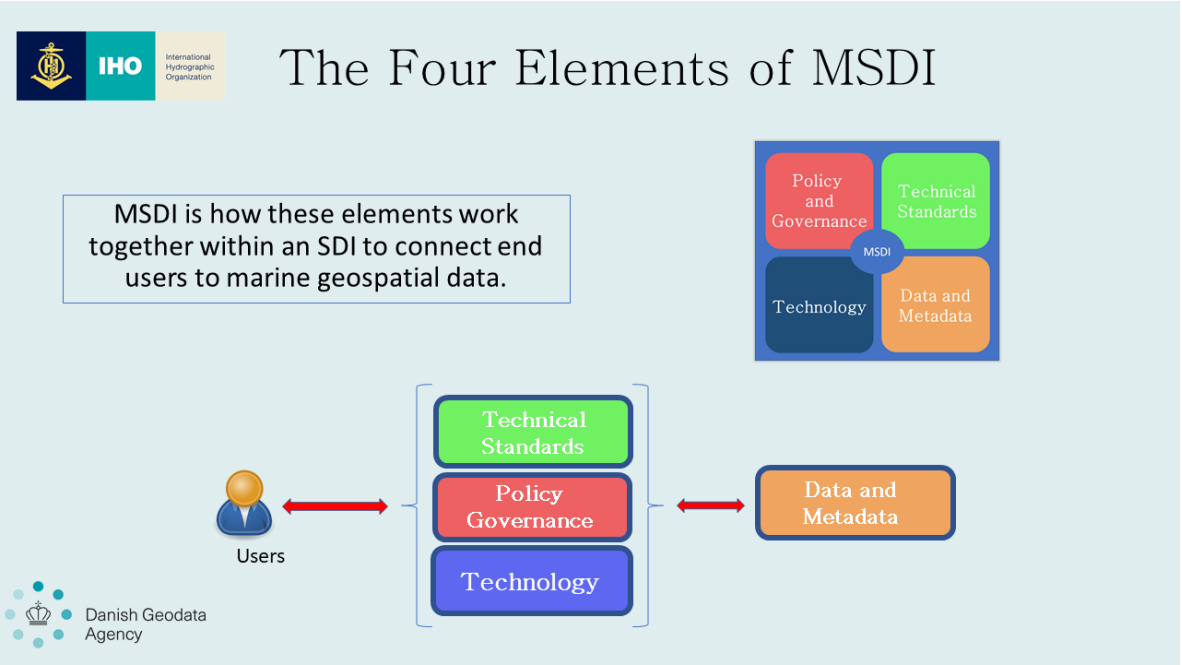

The four elements of MSDI which are defined within this Orientation course are

1. Policy and Governance ("Policies" in the original SDI definition)
2. Technology ("Technologies")
3. Technical Standards
4. Data and Metadata ("Content" in the original MSDI definition)

Each of these elements are examined in the next section. This slide illustrates the core definition of MSDI as the marine elements which connect Users with marine content, in the form of Data and Metadata.

Key Messages:

- The coloured elements are used in the material to show the MSDI elements
- The core concept of MSDI is the use of these elements to connect Users to marine geospatial data
- Users – MSDI users, here, can be anyone with a need for marine geospatial data.

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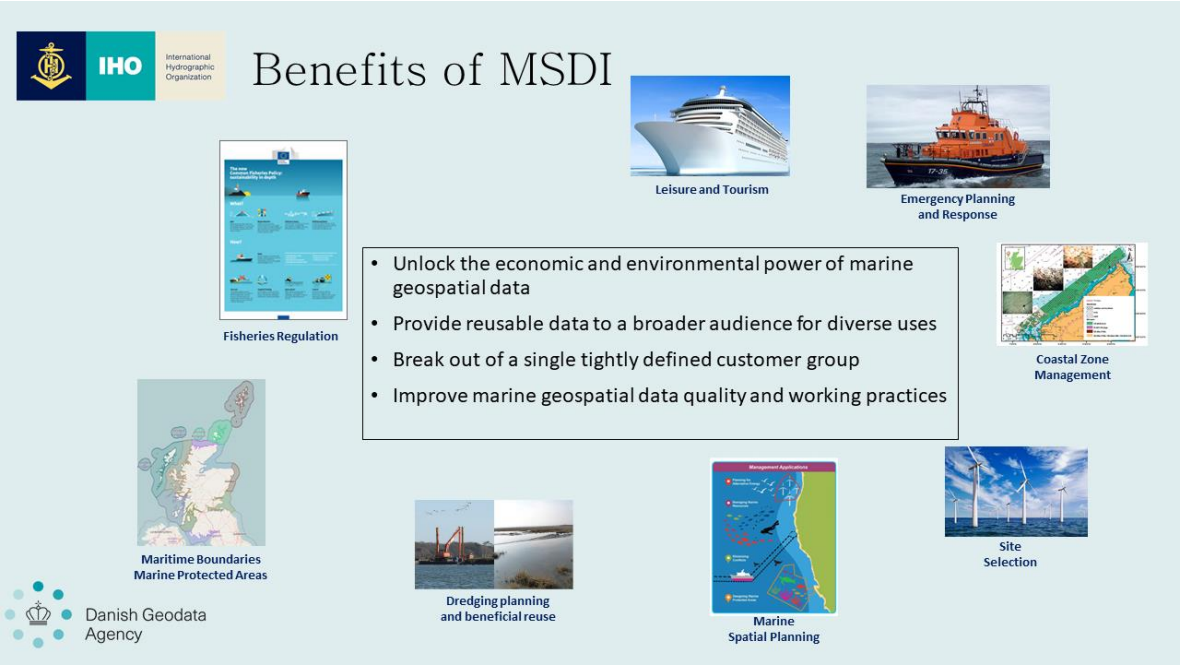

This slide shows high level examples of how marine geospatial data may be re-used. The benefits of MSDI can be realised in both economic and environmental terms and also have many positive benefits for the institution implementing it.

Key Messages:

- MSDI concerns the re-use of marine geospatial data by a wide range of end users
- Marine geospatial data is used in many fields of human activity and often has uses far beyond its primary use case and traditional market boundaries
- The benefits of opening up marine data to wider uses can increase data quality and benefit working practices by placing data at the heart of the enterprise.

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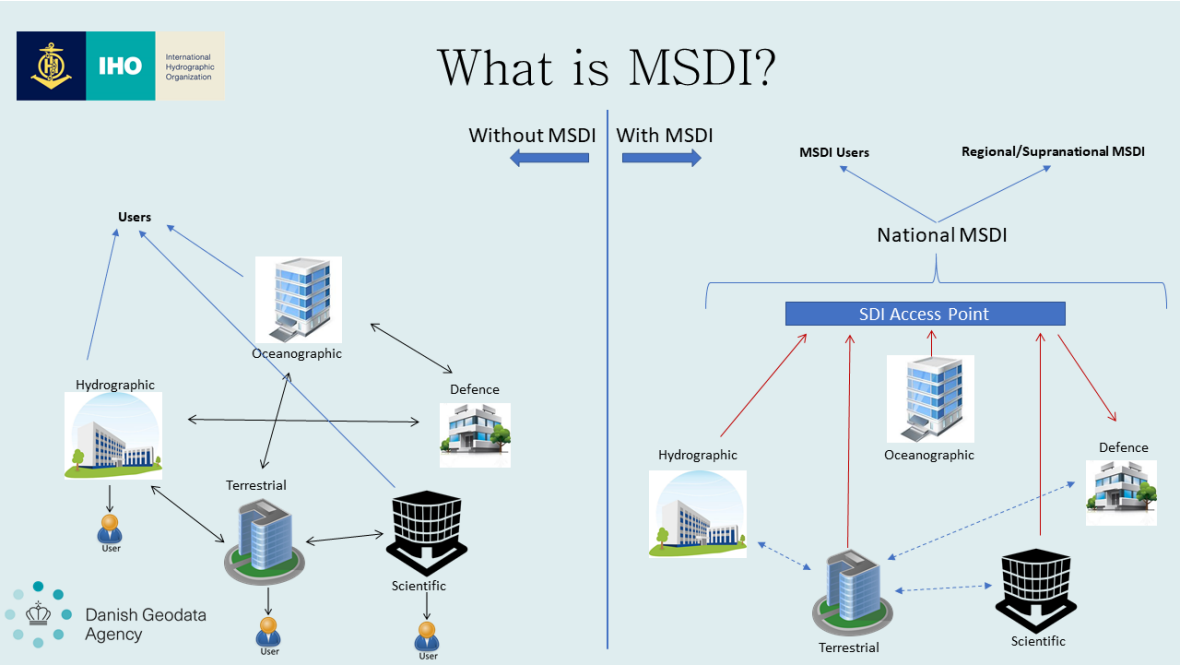
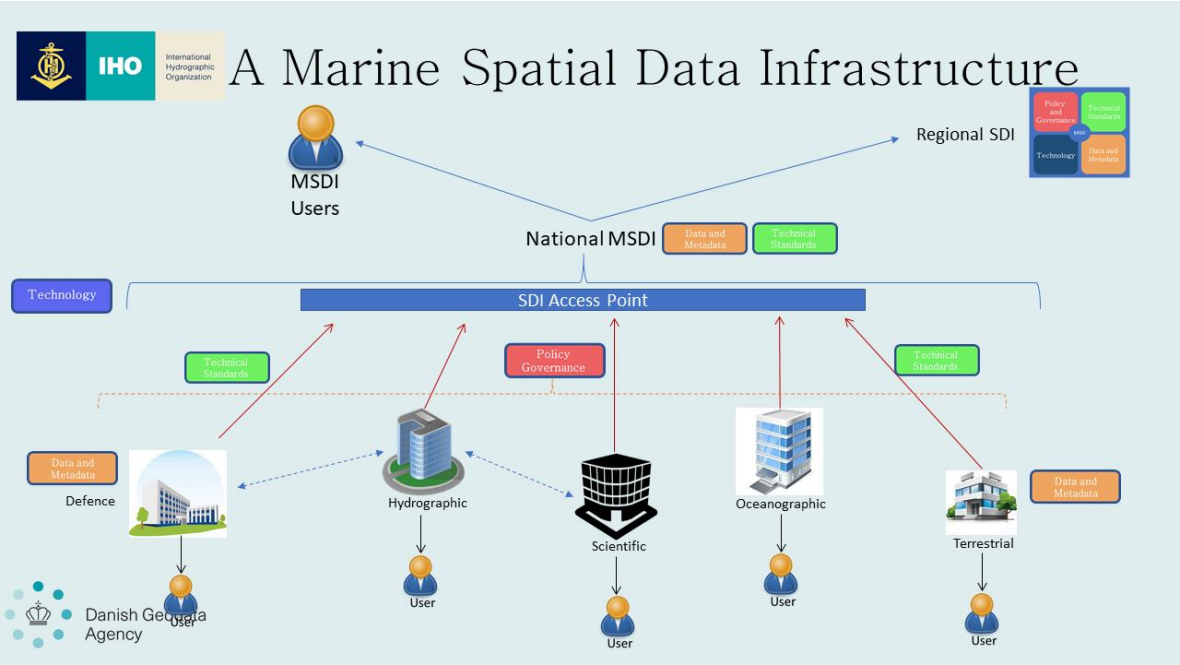


This slide shows a typical national geospatial infrastructure without any MSDI (or SDI) capabilities on the left. Each agency has a single remit and is authoritative for data within its own domain. They may have data exchange relationships with other agencies.

The right half of the slide shows how an MSDI implementation changes the relationships and communications between the participating organisations and MSDI users. The national MSDI introduces an Access Point for data and all participating agencies feed data (either through direct copies or by interface) into it. This data is then made available to MSDI users as well as, potentially, into regional MSDI implementations

Key Messages:

- Without MSDI individual organisations act in “silos” operating purely within their own parameters. Inter-agency communication is complex and data users need to harmonise and integrate data themselves.
- Agencies can be “Authoritative” for data in their own domains.
- MSDI implementations collect marine geospatial data from participating institutions and make it available to a broader user community.
- Data for the MSDI is gathered and distributed via one or more access points
- A national MSDI can feed into a regional MSDI



This slide shows a more complete description of the MSDI implementation with a focus on the MSDI elements. As can be seen:

- The individual institutions supply data (and metadata) to the MSDI through the access point.
- Participating institutions work within a single policy and governance framework which gives them a remit to produce data which is suitable for reuse and which conforms to a framework of common standards. This is all supported by a common technical infrastructure
- Participating organisations continue to work between each other or they may use the MSDI infrastructure for their own use as well. They may also individually retain their primary customers
- A national MSDI can feed into a regional MSDI. This pattern of elements existing at national, regional and global level is repeated in various aspects of MSDI such as technical standards and metadata

Key Messages:

- MSDI connects MSDI users with data content provided by participating geospatial organisations.
- The MSDI elements can be identified in the layout of the MSDI implementation
- There is no set arrangement or prescribed form for an MSDI. Each may have a different layout.

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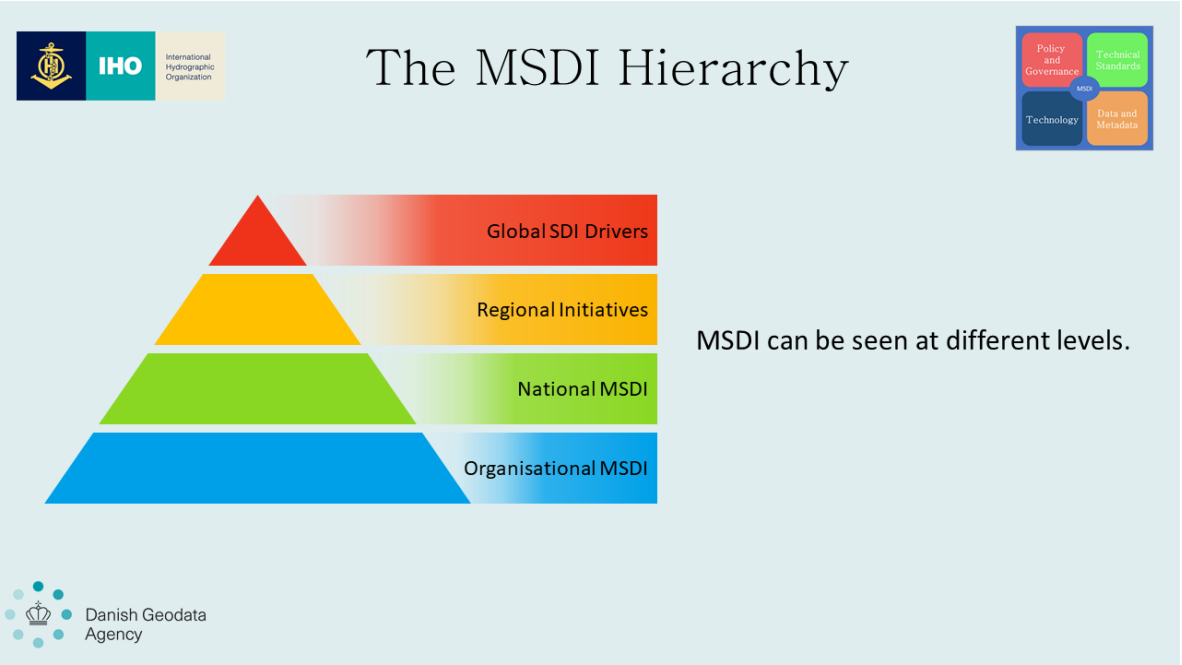

The slide here shows how MSDI (and many of the MSDI concepts) can be seen at many levels. Normally these are global, regional, national and organisational. Standards, drivers, SDI and MSDI all can be broken up into these categories and influence all other levels.

Key Messages:

- Like many concepts, MSDI is present at many different levels.
- Organisational MSDI can form part of a national MSDI driven by national policy and governance structures
- Neighbouring MSDI can collaborate to form regional MSDI interest groups or Regional MSDI.
- Global Drivers influence the development of MSDI through various means.
- Technical Standards and data content often follow similar hierarchies

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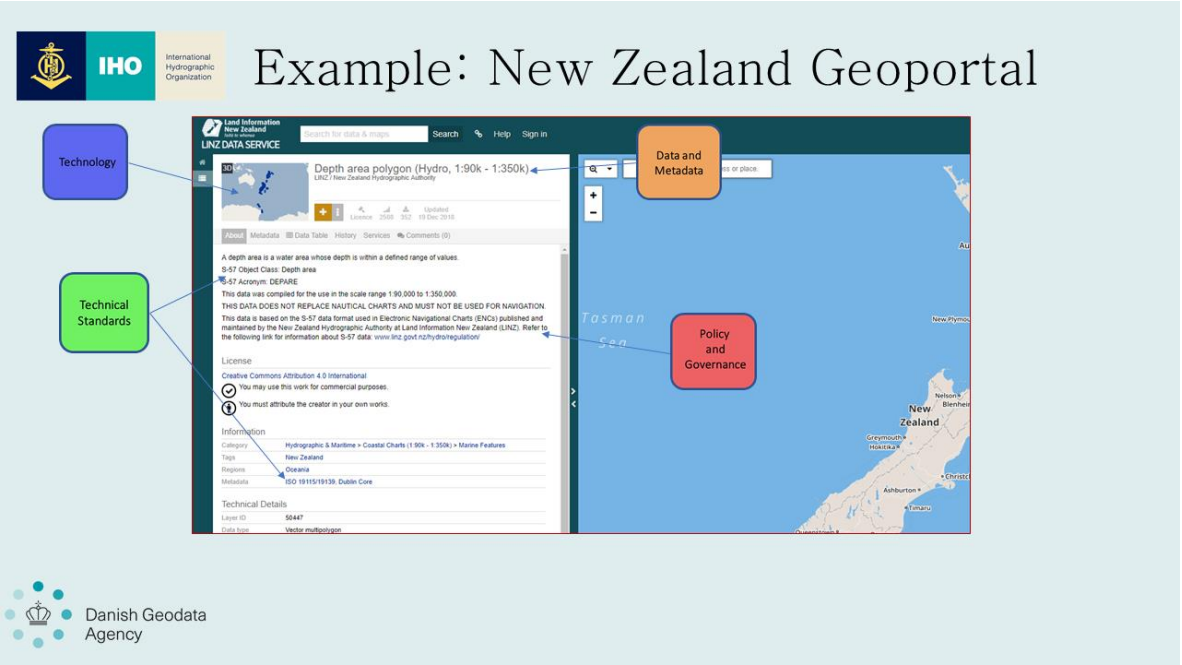

In this slide an example of an MSDI access point is shown, generally these are web portals with an interface which allows data to be searched and accessed. In this slide we have highlighted the defined MSDI elements (which we will consider in detail later). All MSDI access points are different and the existence of all the elements can sometimes be hard to establish.

Key Messages:

- It is possible to identify the elements of MSDI in existing national and regional implementations.
- MSDI elements are not always obvious from an inspection of an MSDI access point

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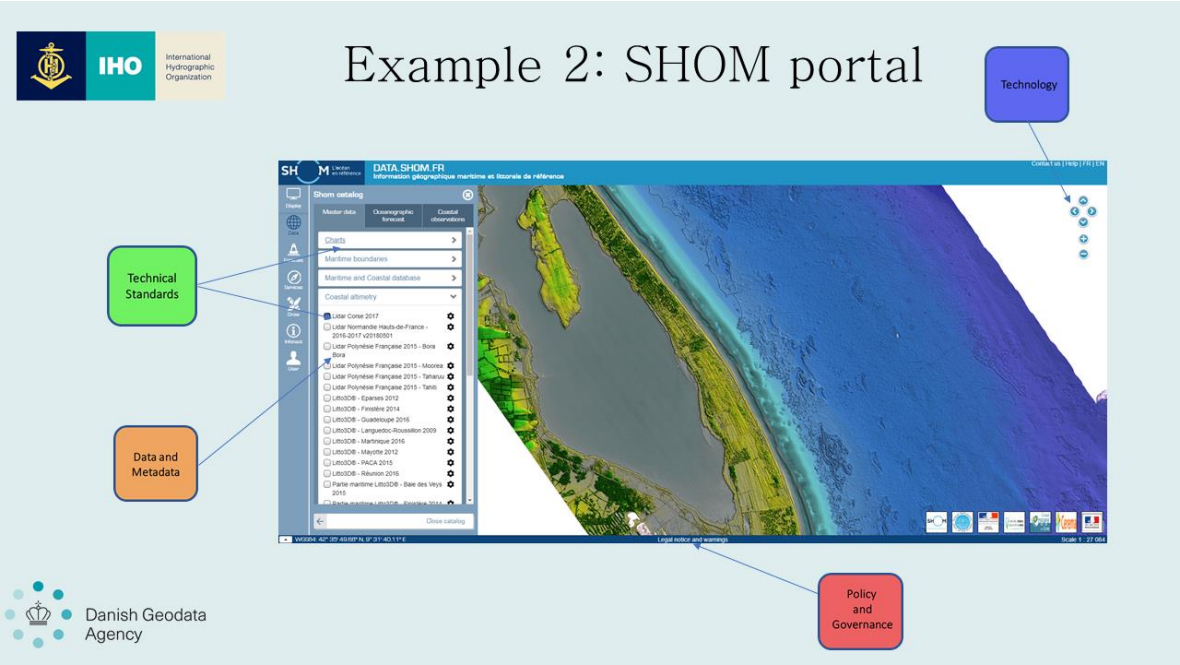

Key Messages:

- Another example of a National Portal for search and access to datasets.
- Although different technology, standards and metadata are contained the individual categories are still present.

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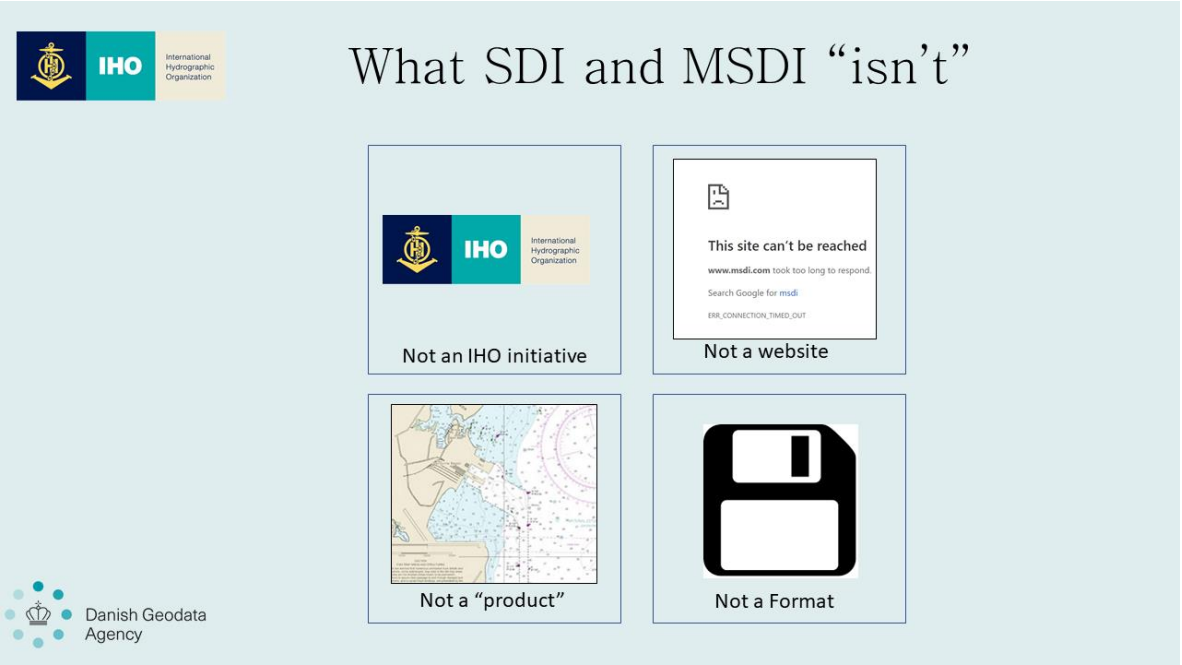


When we talk about MSDI there can be many misconceptions and here we try to use the previous slides to clarify what MSDI "isn't". MSDI is not an IHO initiative. The IHO is one of the foremost organisations promoting it, MSDI is embedded firmly within the fabric of many member states' institutions and governmental policies. MSDI is more of an observation of a global phenomenon – the rise of geospatial information, within communities of all sizes, local, national, regional and global and the observation that there are common factors which contribute to its success in effecting economic and environmental change.

MSDI is not a website – there's no http://www.msdi.com – it is not a single global "thing" which is accessed by all stakeholders. It is the sum total of all the MSDI activities of the individual participants globally, some of which act within a regional or national infrastructure and some of which act in isolation. It's certainly not a product which can be purchased (although tools and technologies can be purchased to assist). It's not just a case of saving data in an MSDI "format" and putting it on a website!

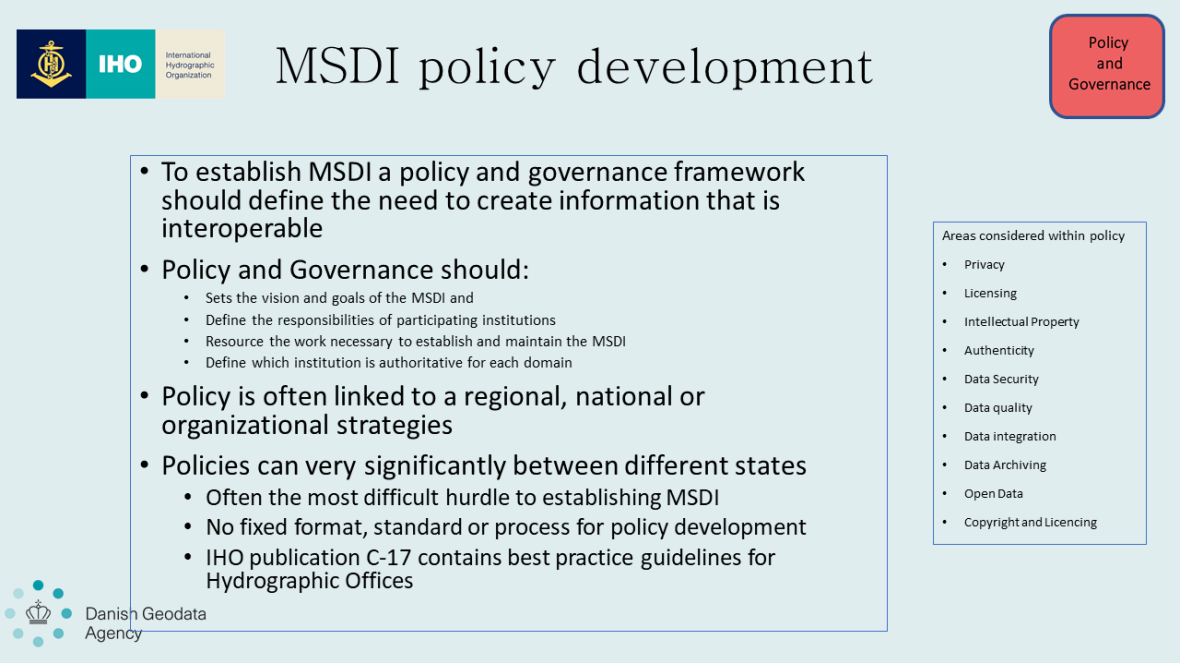
Key Messages:

- There are many misconceptions about the definition of MSDI and many participants have difficulty understanding the wide range of concepts involved.
- This is because MSDI is not just a technical implementation and spans many different areas of an organisation's activities.

Notes:

3 The Four Elements of MSDI

3.1 Policy and Governance



The first of the MSDI elements to be defined is “policy and governance” . This is a collection of policy and governance instruments which together enable the various MSDI participants to create the necessary content data, in the appropriate standards, to input to the MSDI. There are many aspects to policy formulation identified in the slide and, like many other elements, they can exist at different levels i.e. at a national, regional and global level

Key Messages:

- Policy and Governance tell participating data providers what to do and establishes the remit for the MSDI.
- Policy and Governance is of key importance, affects all aspects of MSDI and is a critical success factor in making an MSDI implementation successful.
- Policy and Governance differ more than any other element of MSDI between states and regions.

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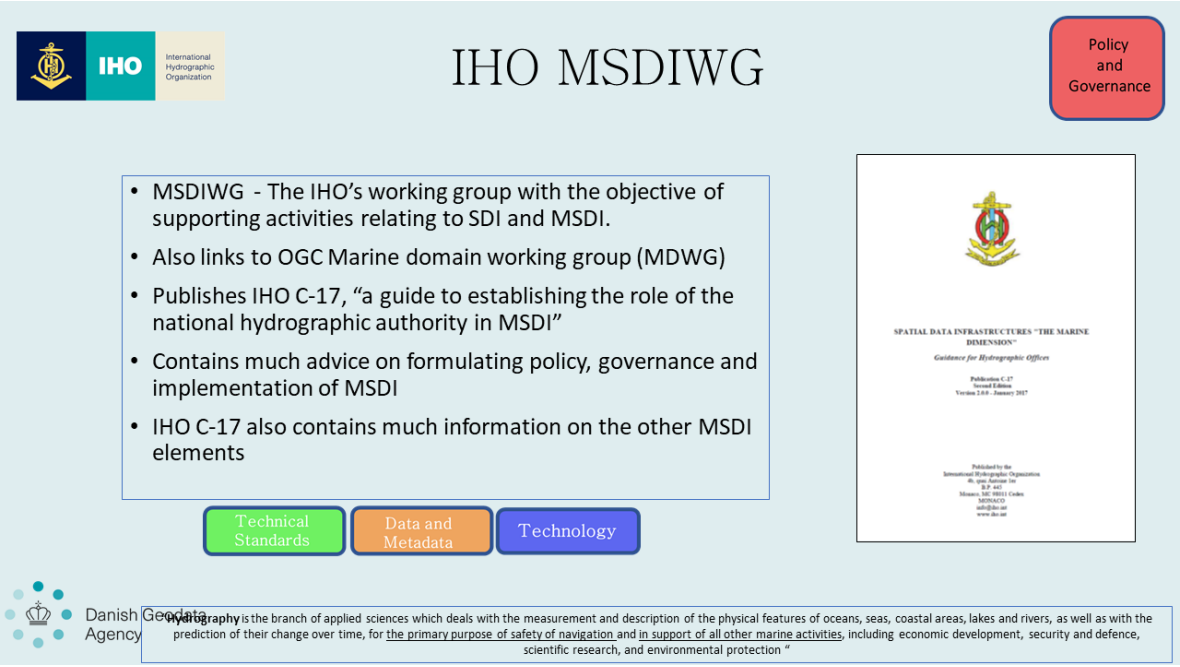

As part of the IHOs commitment to capacity building an MSDIWG has been established since 2007 to assist member states in aspects of MSDI and formulation of appropriate policy and governance within the hydrographic community is a key area.

The MSDIWG web pages, hosted by the IHO are at the following link: https://bit.ly/2IvGGpY

The MSDIWG publishes a model policy for MSDI implementation on its website.

Key Messages:

- The IHO has a long standing commitment to assist member states in establishing their MSDI capabilities through the MSDI Working group (MSDIWG)
- This helps with policy and governance as well as advice on the other MSDI elements.
- The IHO publication C-17 summarises guidance to member states. Additionally MSDIWG has its own global meetings and many regional Hydrographic Commissions have their own MSDI groups for exchange of best practice and implementation plans.

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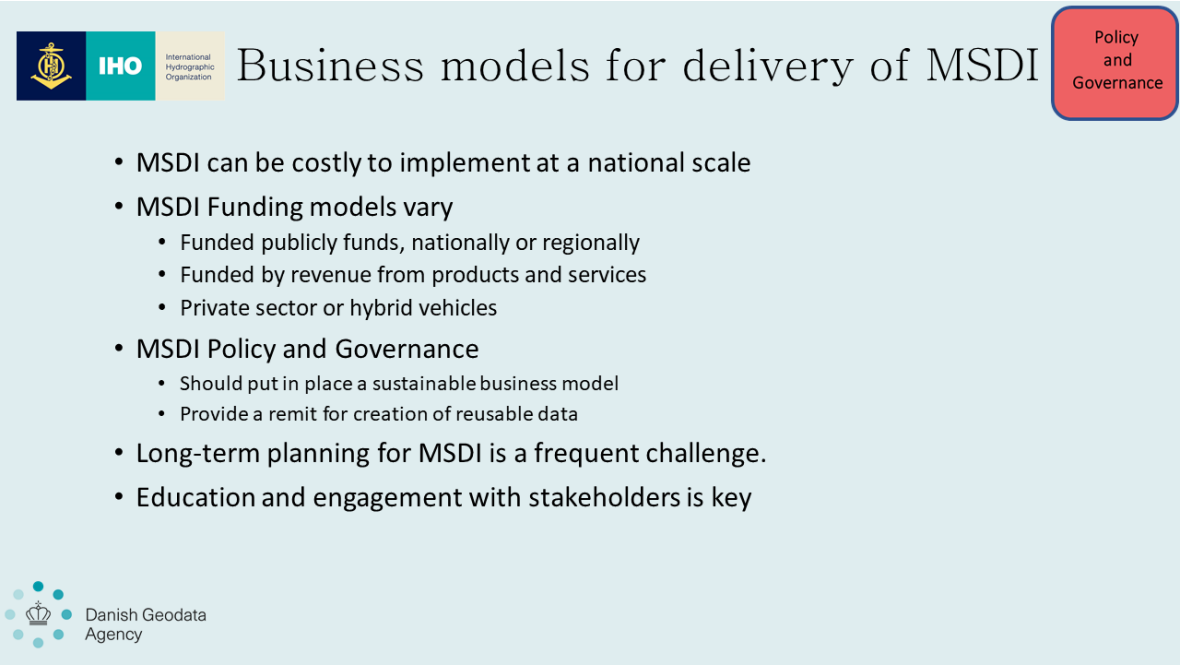


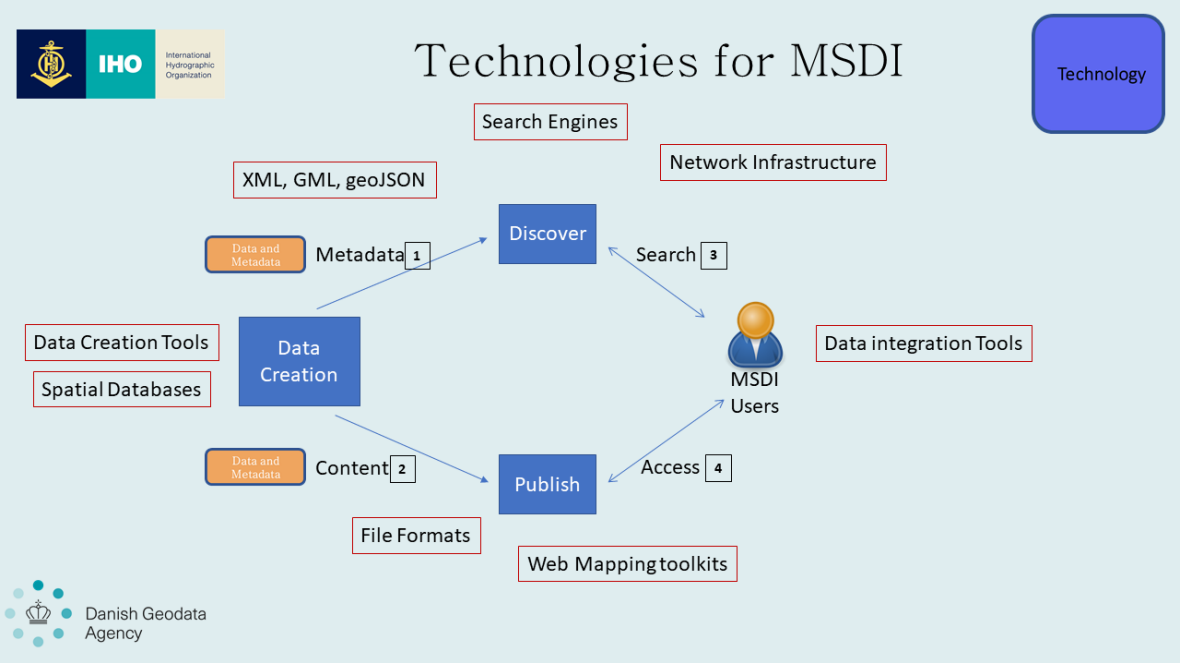
The issue of sustainable business models for MSDI is a frequent topic. Business models should give an institution the remit to create data for reuse and ensure adequate resources are given to development, implementation and maintenance of MSDI. This, in itself, can be a big impact on existing operations and require a large degree of organisational and cultural change to implement.

Key Messages:

- A business model defines how an MSDI (whether organisational or national) functions and is funded
- Implementing a business model to support creation of reusable data within an MSDI is crucial for successful implementation
- This can require fundamental re-thinking of organisational responsibilities

Notes:

3.2 Technology



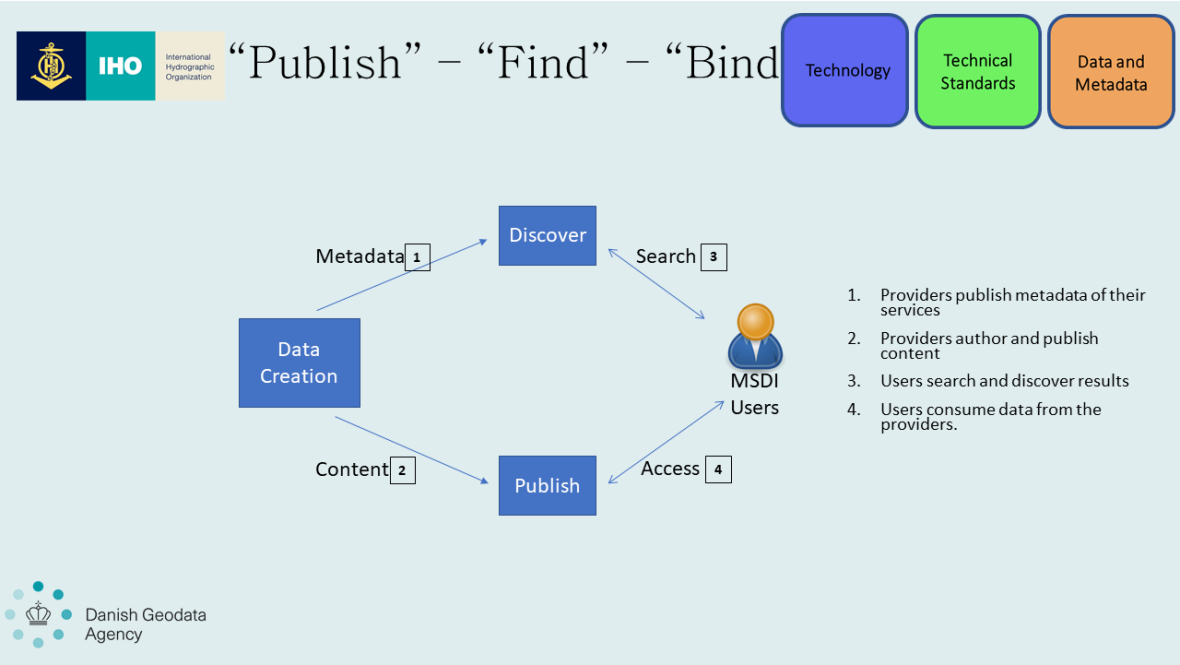
The technology element consists of all the technology and tools specific to MSDI. The slide shows a typical user interacting with an MSDI:

1. Metadata is published which advertises the available content
2. Data is created and published.
3. Metadata is searched to establish the right content
4. The data itself is accessed

This process describes most interactions with MSDI systems and there are many technology components required to work together to make this happen. Some key examples of technology underpinning MSDI systems are shown. Some may be familiar and others may not but the idea is to understand the large variety of specific technologies required to implement MSDI and the important role it has.

Key Messages:

- A large variety of technology components are required to establish and maintain MSDI systems and infrastructure
- Some of these components are generic technology, some are specific to geospatial data and some are specific to marine geospatial data.
- Technical standards have a great bearing on the types of technology adopted. Policy and Governance also can set standards for MSDI infrastructure



To understand the most popular models of MSDI implementations it is necessary to understand the most frequent "pattern" of how end users consume data. Publish-Find-Bind describes a user searching and retrieving published content (and metadata) most frequently through one or more web services. MSDI access points implement the necessary interfaces to allow end users (whether human or automated) to enable access to the MSDI data.

Key Messages:

- MSDI concerns re-use of marine geospatial data by many participants
- MSDI users need technology to search and retrieve suitable data for their purposes and data creators need to be able to publish content and also metadata which enables searching.
- This activity occurs within the MSDI access point

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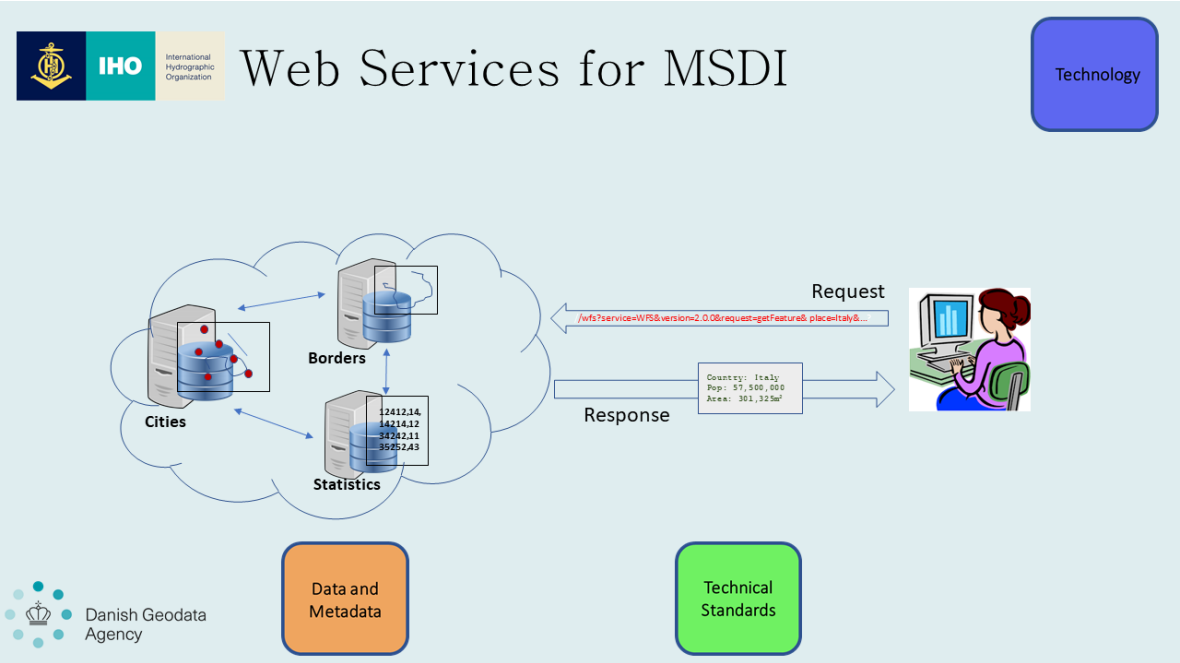


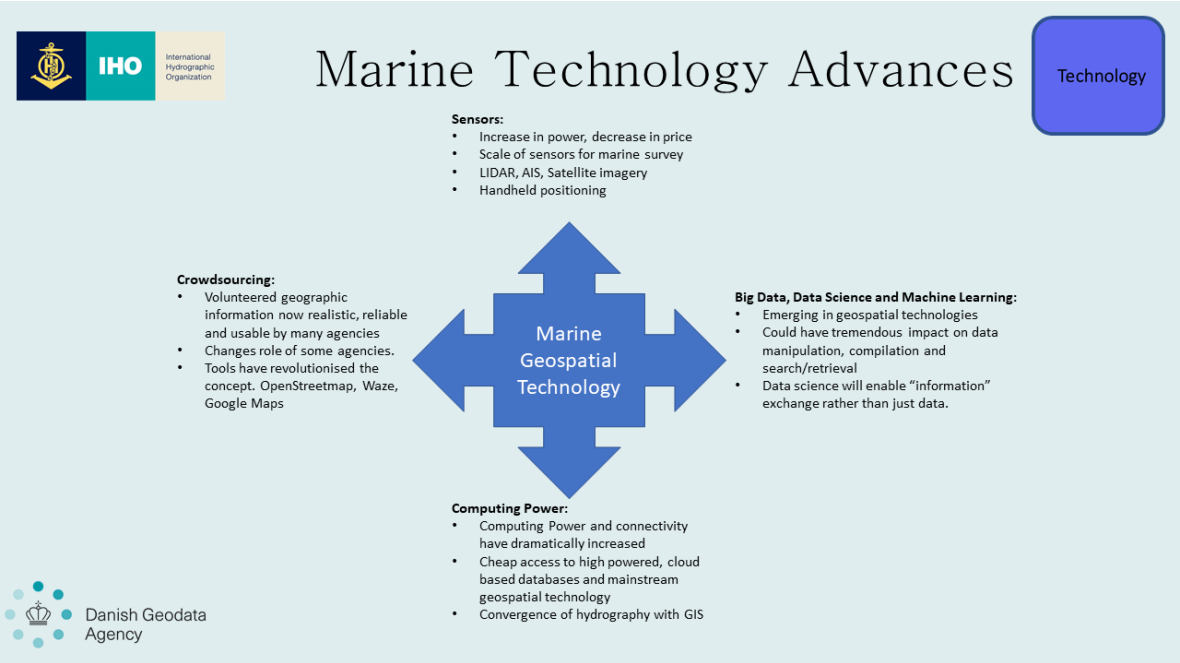
One of the fundamental technologies for MSDI interaction with users, and one which implements the Publish-Find-Bind pattern through a variety of technical standards is web services. This technology enables users (whether they are human or computer) to access data held in a structured store (such as a spatial database hosted by an MSDI access point) through a known Application Programming Interface (API). These interactions are standardised by a family of technical standards, most notably from the Open Geospatial Consortium (OGC) so that users are able to use a common toolset to interact with many different MSDI infrastructures (and so that the individual participants making up the MSDI can speak a "common language" when contributing their data.

Web Services are "request and response" process where the MSDI user submits a request for data (or metadata) through a standardised API and receives a structured response which can be processed automatically. OGC standards provide the ability to return either structured XML data or images rendered from MSDI data according to flexible portrayal rules.

These technologies are fundamental for MSDI because they allow data to be interoperable – they ensure that MSDI users and participants speak a common language across the whole MSDI infrastructure and bespoke tools and system do not have to be written by participants as the MSDI evolves.

Key Messages:

- Web Services are a key technology component for MSDI.providing a common mode of communication for all MSDI participants. Web Services have their own family of technical standards.
- Web Services provide a common model driving all interactions between entities in an MSDI and ensuring a base level of interoperability. This is vital for re-use of data by MSDI end users who may come from diverse domains.



It is of vital importance when implementing MSDI to keep the technology components up to date and to stay abreast of new developments. Four examples of key technology innovations specific to marine geospatial data are listed in this slide.

Key Messages:

- Just like any other technology infrastructure advances can be rapid and any MSDI implementation should make sure the ability to upgrade and maintain infrastructure are in place. MSDI policy and governance should provide a process for "technology watch".
- Some examples of cutting edge technology in the marine geospatial field are listed. These are not exhaustive.
- Many innovations may require parallel developments in policy and governance and technical standards.

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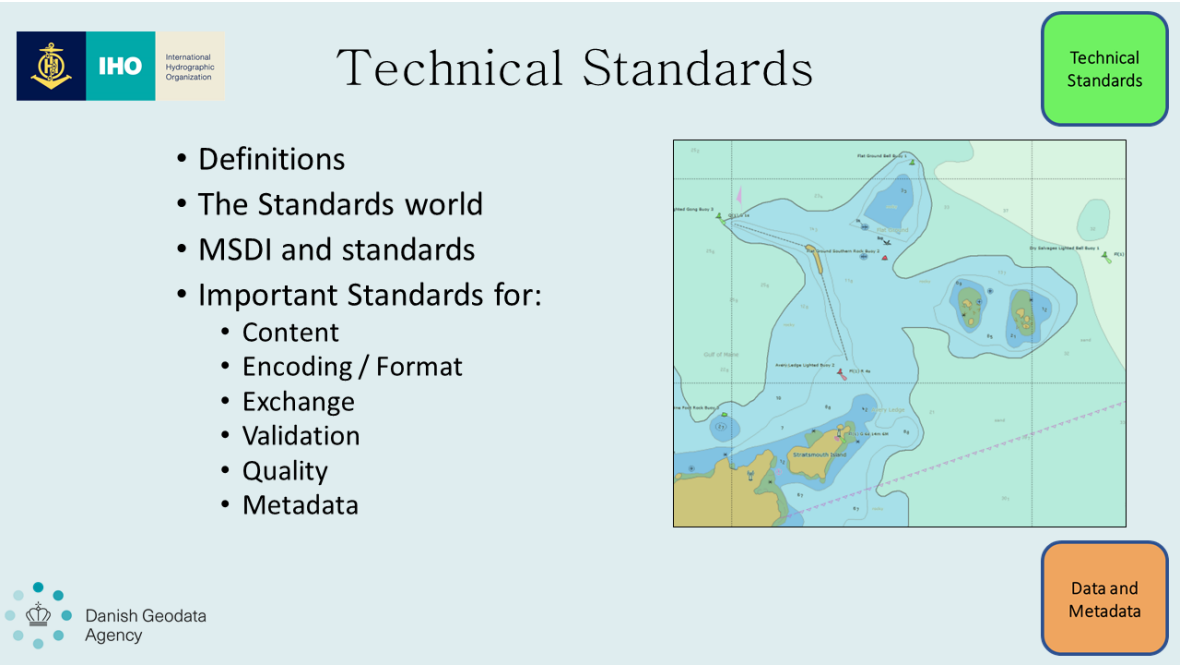
3.3 Technical Standards



In the technical Standards section we cover a description of technical standards and the bodies that author and maintain them and how technical standards are important for the distribution of marine spatial data within an MSDI. Standards exist in a number of areas in marine geospatial data, not just for content but formats, data validation, quality and metadata. Depending on the domain many different parts of the data can be subject to standardisation.

Key Messages:

- There are many different aspects of technical standards
- Standards, like MSDI are developed and maintained within a global community
- Many different things can be standardised in the geospatial world, e.g. content, format, quality, metadata etc.
- This section defines and explains the most relevant elements of MSDI technical standards

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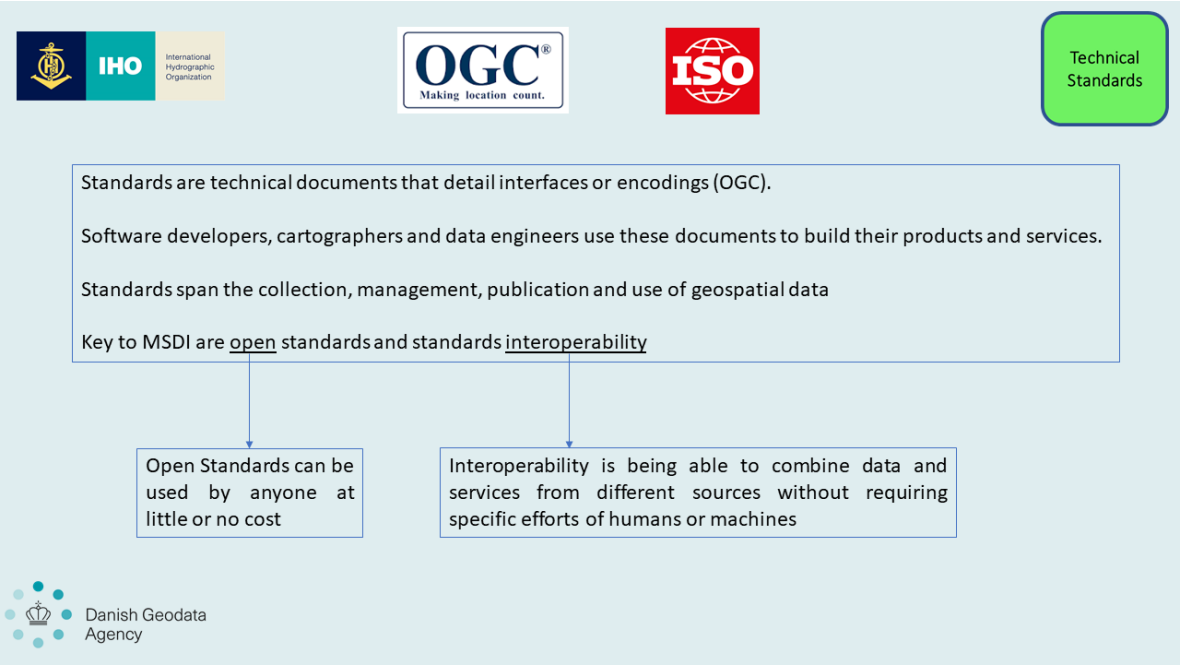

Technical Standards standardise many things, geospatial content, format, structure, terms and definitions and there are many global, regional and national standards bodies which exist to set out these common structures so that participants can build MSDI structures which are interoperable with each other.

Key Messages:

- Standards enable MSDI by giving all participants a common language to describe content, structure and encoding of marine geospatial content.
- Common standards are crucial for success in MSDI implementations
- Standards are most often defined by global standards bodies which encourage adoption by as wide a number of implementers as possible.
- Key to MSDI is the concept of open standards and the definition of interoperability. These two ideas underpin standards development for MSDI and allow data to be distributed widely for little or no cost

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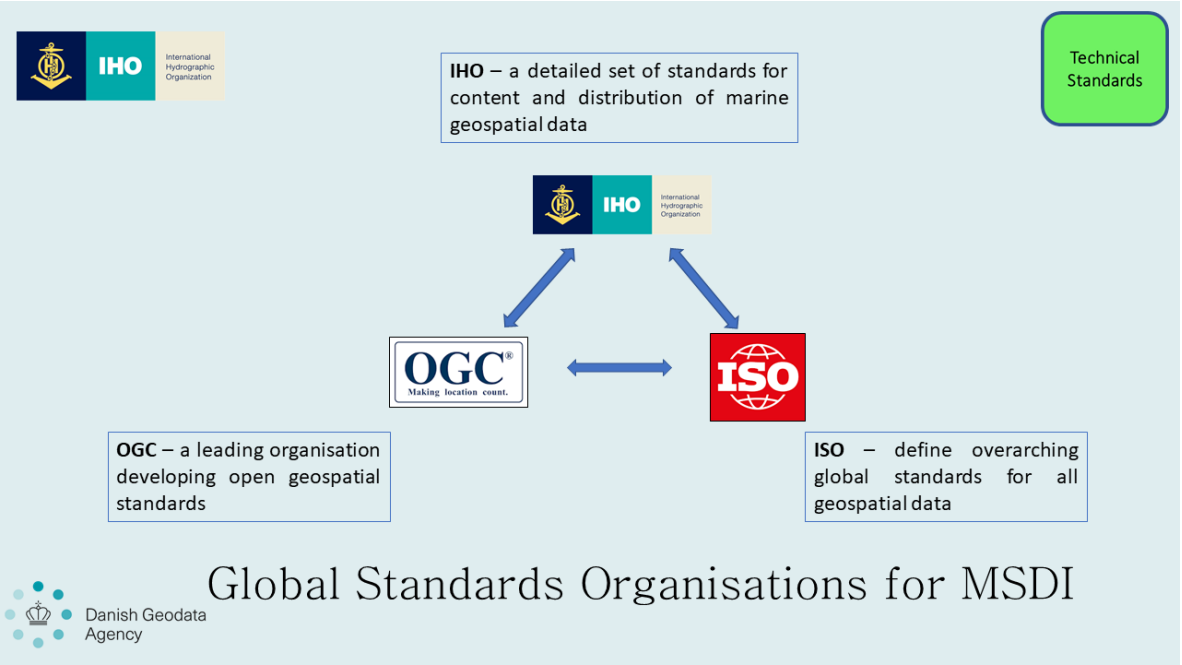


The three main standards bodies important for MSDI are:

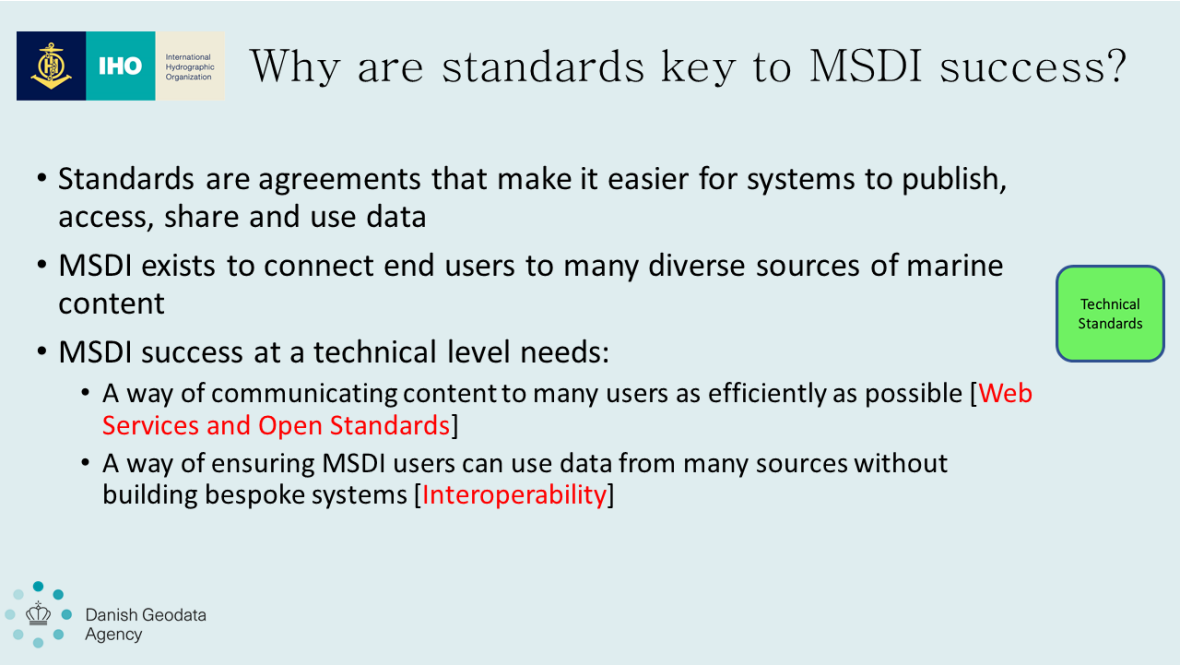
1. The IHO who define and implement standards for marine domain content, metadata and key encodings for primary and secondary uses of marine geospatial data.
2. ISO who provide a set of standards with a global reach covering all aspects of geospatial data definitions under the ISO19100 set of standards

OGC who assist MSDI development by developing and defining a set of standards for interaction via web services across many different domains

Key Messages:

- The three main standards development bodies relevant to MSDI are ISO, IHO and OGC
- They define standards for geospatial data, marine data content and web based communication of geospatial data

Notes:

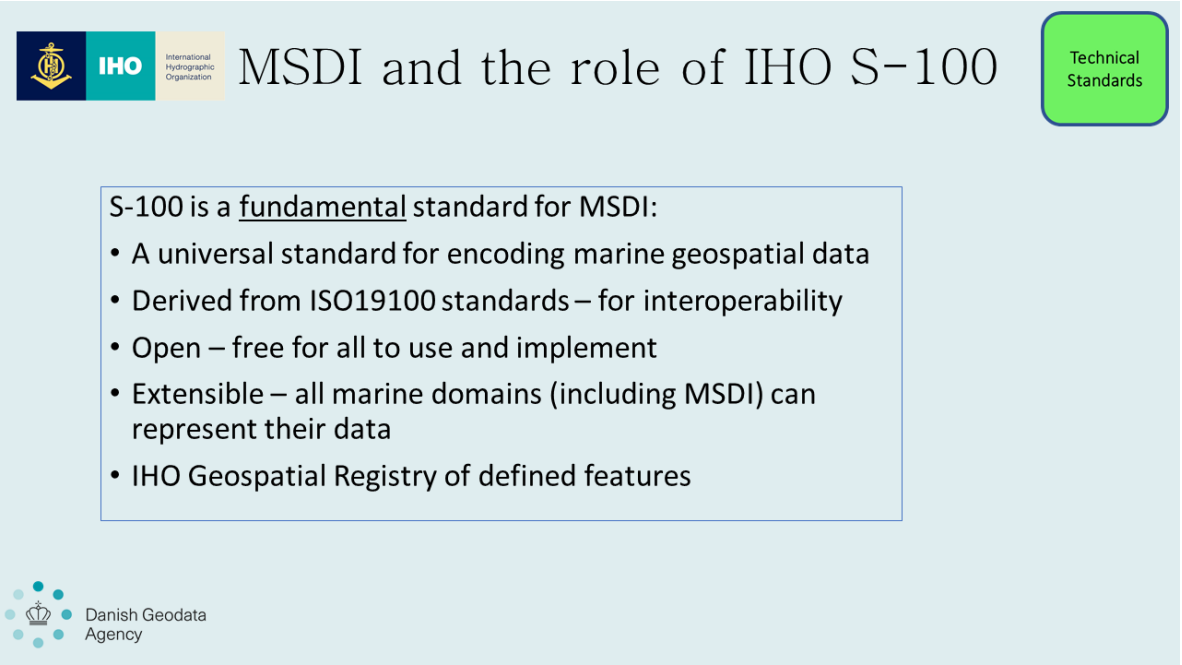


This slide reinforces why MSDI and technical standards are so closely linked. MSDI is about distribution and reuse of marine geospatial data and standards provide a common language for a diverse population of end users. To work efficiently however, standards should strive to be as open as possible.

Key Messages:

- MSDI fundamentally is about connecting a broad spectrum of end users with marine geospatial data.
- These users need to be able to search and consume data without building bespoke systems for every data source.
- Technical standards provide a common language to describe content among many participants.
- In order to make technical standards widely applicable, standards should be open so that all participants can implement them without excessive cost, and built to enable maximum interoperability between those participants.

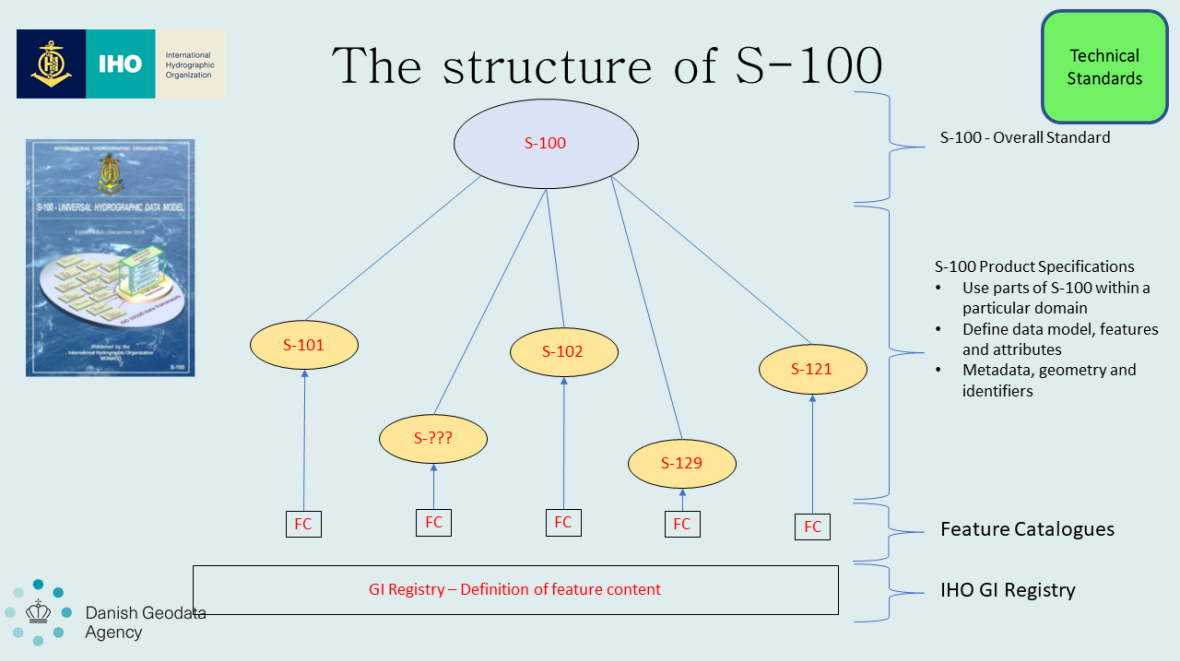
Notes:



Key Messages:

- IHO S-100 is a central standard for MSDI because
  - It provides an overall framework specifically for marine geospatial data
  - It is derived from the global ISO19100 series of standards which ensures interoperability with geospatial data from many other domains, e.g. terrestrial and 3D
- IHO S-100 is also open, free to use and extensible – any marine content can be expressed using its framework.
- S-100 provides comprehensive structures for cataloguing of content and metadata descriptions of datasets.
- The IHO registry contains a repository of all concepts, terms and definitions for entities within the marine domain, providing a reference for MSDI users from other domains to assist with interoperability.

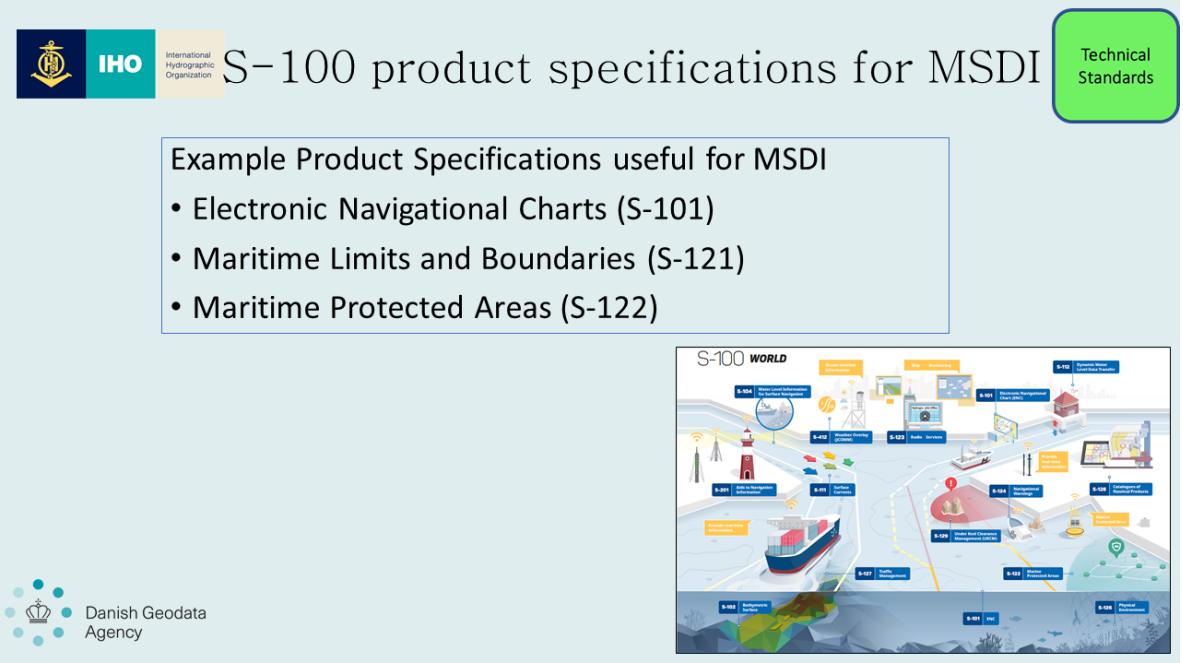
Notes:



Key Messages:

- IHO S-100 provides a number of different components to the marine geospatial community.
  - An overall framework focused on representation of marine geospatial data
  - A set of individual product specifications and a mechanism for specifying them in order to model individual domains within the marine ecosystem
  - An open and accessible geospatial registry containing specific definitions of features and their attributes which comprise marine geospatial data.
  - A community of working groups developing specifications and standards which support ongoing marine use cases.
- These form a single standards ecosystem, the S-100 World.

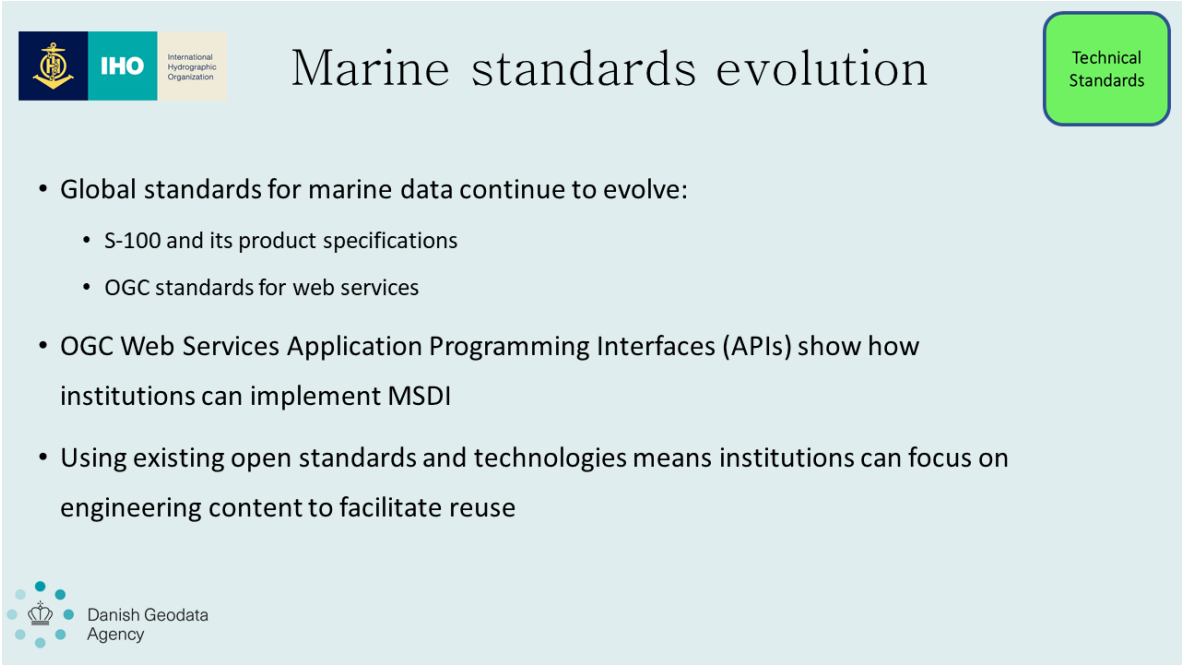
Notes:



Key Messages:

- Individual product specifications under S-100 model specific domains within the marine world.
- Examples of relevant product specifications currently are:
  - S-101 – the standard for navigational charts which contain many features with a high potential for reuse, such as depth areas, land areas and regulatory mechanisms
  - S-121 – a standard for expressing the maritime limits of a state, such as its territorial sea and exclusive economic zone. Much marine spatial planning is defined within limits and boundaries areas.
  - S-121 marine protected areas which may be an output of a marine planning process and an input into marine plans.

Notes:



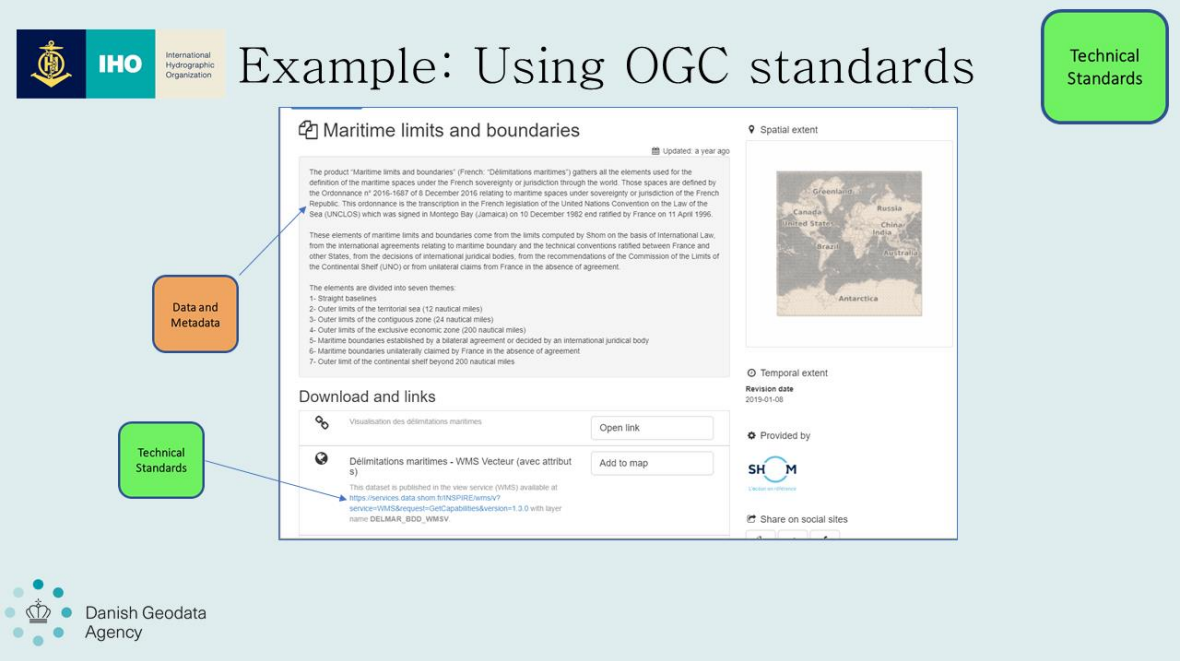
S-100 continues to be developed. Different domains (some of which may have great relevance for MSDI) can propose models and use the S-100 framework to produce data and specify the definitions of their individual features and attributes. Additionally the OGC is increasing both its scope (in terms of the data domains and standards it publishes) and the technical sophistication e.g WFS3.0.

The success of standards in the extent of their adoption. If data creators and MSDI end users adopt common standards then far fewer bespoke systems are needed and the whole MSDI behaves more efficiently.

Key Messages:

- S-100 (and its product specifications) are an ongoing development within the IHO and related standards development organisations.
- Some product specifications under S-100 will have more relevance than others to MSDI.
- The success of standards is in the extent of their adoption. This applies, nationally, regionally and globally.

Notes:



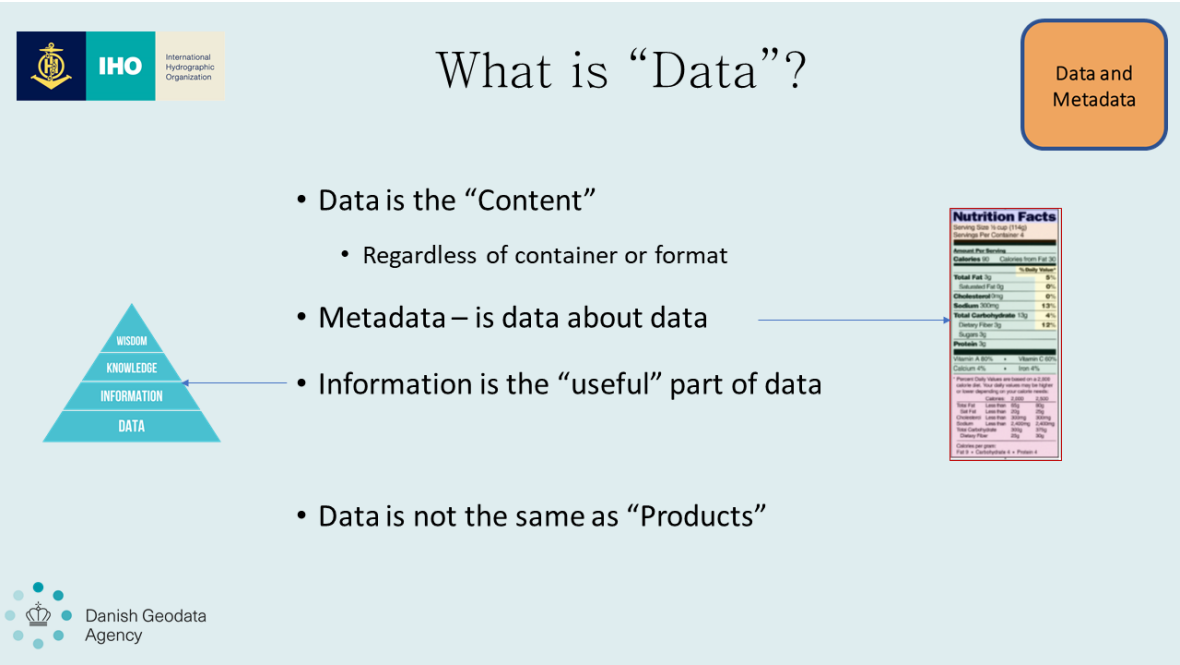
Although not mandatory, many MSDI implementations distribute data through OGC standards such as WMS and WFS. The form of the MSDI access point differs but common elements exist, such as the documentation of the data content and the web service access point (referred to as the "endpoint")

Key Messages:

- An example of publication of a dataset using OGC WMS standards.
- The documentation forms part of the metadata. The URL in the page is a link to the data itself formatted according to the OGC WMS standard.

Notes:

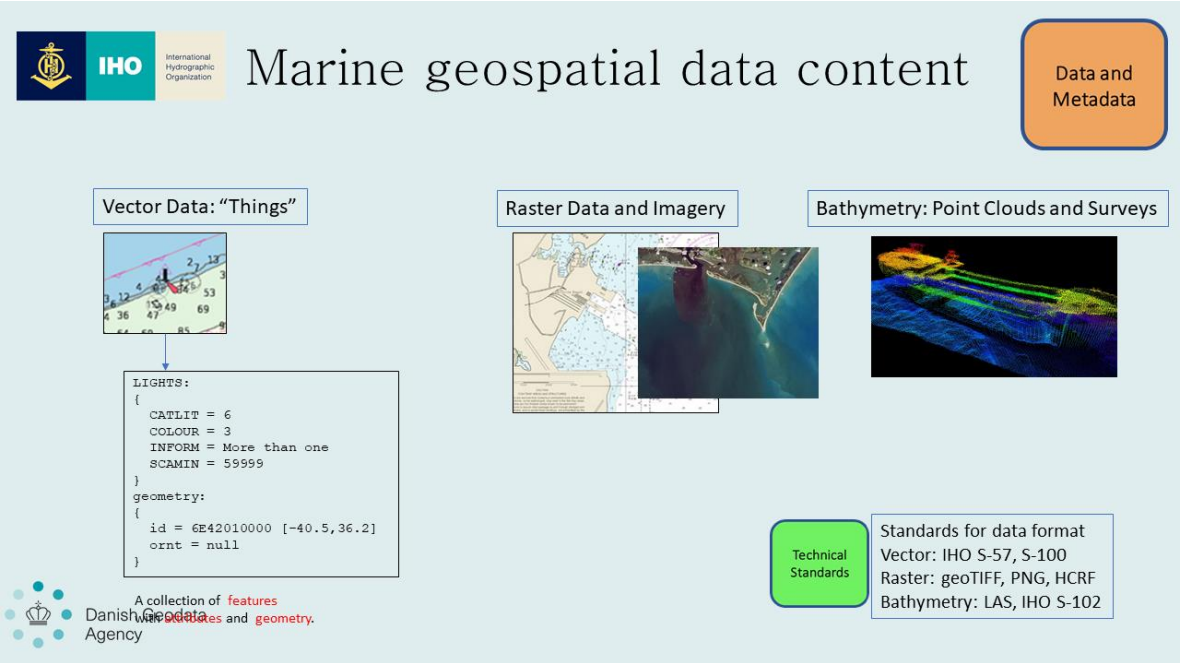
3.4 Content – Data and Metadata



Key Messages:

- Data and metadata is the last of the four MSDI elements
- Data is the content contained within the packaging of a "product".
- Data itself is independent of the format in which it is held.
- The parts of data most useful to an MSDI end user is the "information" – this will differ depending on the MSDI end user and emphasises the need for good and complete metadata.
- Metadata is "data about data" – data which describes the content

Notes:



Key Messages:

- Marine geospatial content data comes in different fundamental types. Important types for marine geospatial data are vector, raster and point cloud types. Each data type has its own family of standards defining the content and encoding
- Point Clouds are very important for holding bathymetric data, one of the fundamental data marine data types.
- Many other geospatial datasets are "vector" in nature where each geospatial feature is defined individually.
- Electronic Navigational Chart (ENC) is the most frequently seen marine vector geospatial data type. Its content is composed of individual features which have attributes and associated geometry.

Notes:

Example content: IHO S-57

Data and Metadata

- Very common MSDI dataset
- IHO S-57 product specification for Electronic Navigational Charts primarily designed for SOLAS navigation
- Features are collected into logical groups
- Also specifies important metadata

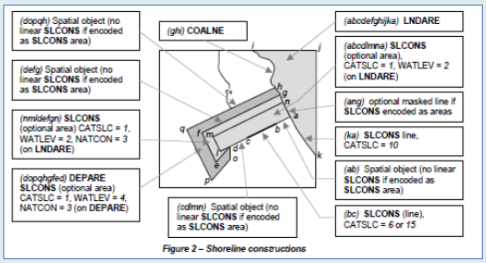


Figure 2 – Shoreline constructions

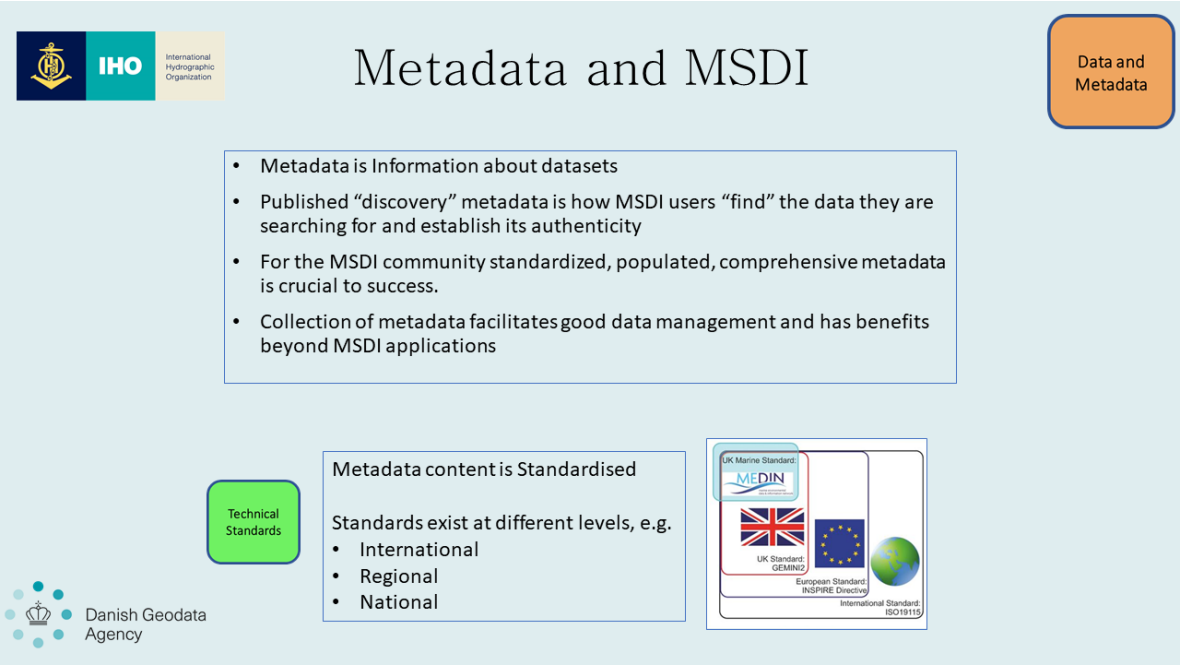
Standards provide detailed guidance on defining content

Technical Standards

Key Messages:

- IHO S-57 is probably the most common dataset produced by the international hydrographic community
- It is designed primarily for SOLAS navigation but often its features are reused in a wide variety of scenarios
- IHO standards define a range of groupings of S-57's features into themes
- Metadata and quality information are also specified within the S-57 feature and attribute catalogues and populated by data producers.

Notes:



Metadata is key to successful MSDI operation because, with a much broader user base, the ability to search and retrieve data is critical for success of the MSDI infrastructure. There are many methods of storing, managing and processing metadata and many technology solutions which can be used to make search and retrieval more effective and connect MSDI users with the right data. Often, metadata management can pose huge challenges for geospatial agencies in terms of correctness, completeness and standardisation. An additional factor is attributing datasets with appropriate provenance so that end users know where it has come from and that it is complete and consistent.

Key Messages:

- Metadata describes the information within a dataset and is published to allow MSDI users to "find" the data they are searching for. It can encompass information about coverage, scale, content, source, age, provenance and many other factors
- Metadata can also contain data authenticity information to establish the originator of a dataset. For many datasets the concept of an authoritative body for the content is incredibly important.

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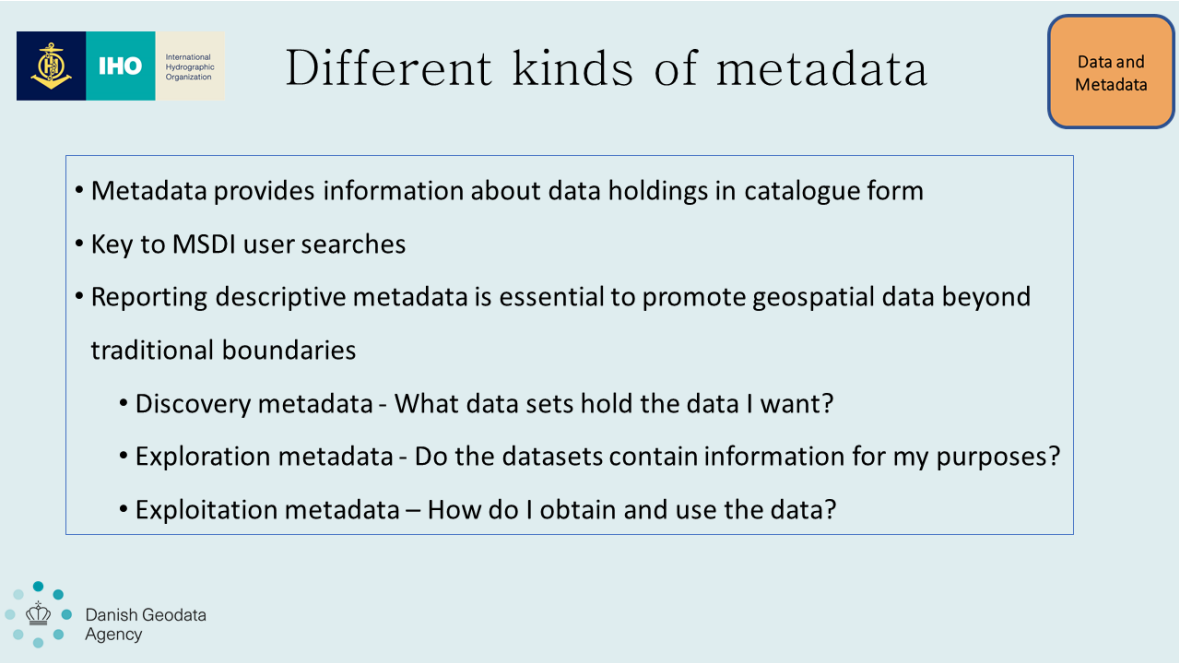
Notes:

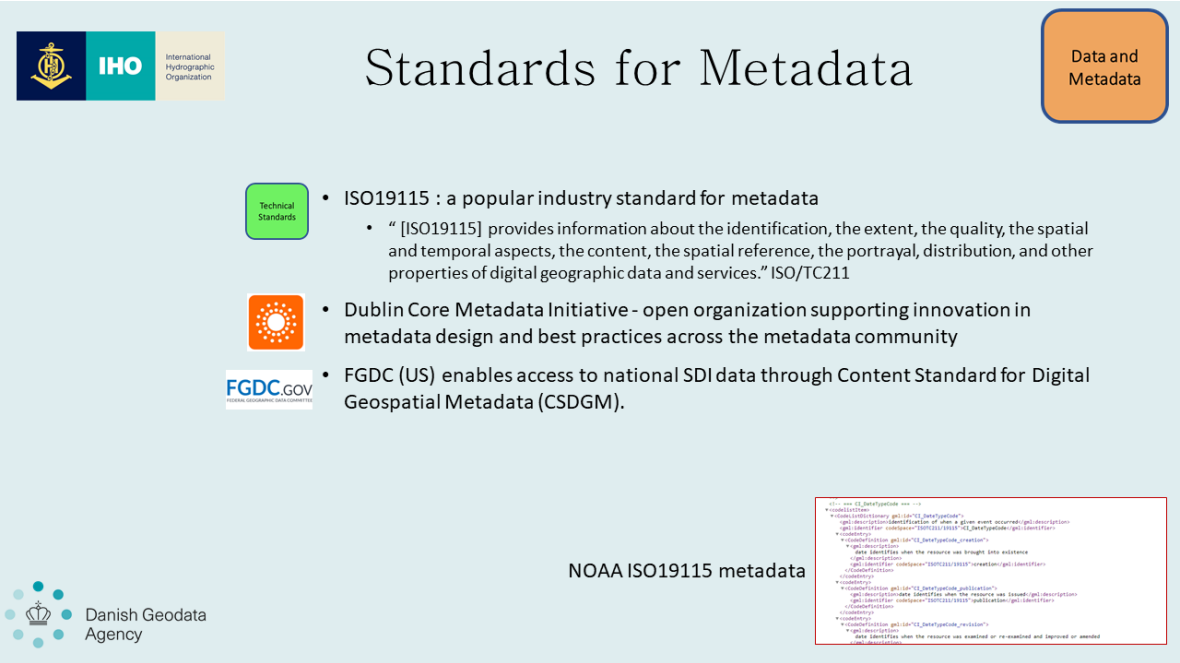


Metadata is a key resource for MSDI because it enables users to search and retrieve the data they want from the infrastructure. Metadata has a "catalogue" structure of key-value pairs and can comprise dates, keywords, links to definitions, extents, content types and all manner of other items. There are different types of metadata intended for different purposes. As data holdings grow and more participants join an MSDI, metadata becomes more important. The creation and management of consistent metadata is a common theme in many MSDI activities.

Key Messages:

- Metadata categorises information about individual datasets
- Different types of metadata are defined depending on end user purpose.
- MSDI depends on consistent metadata because it enables intelligent searching of large data stores by many participants.

Notes:



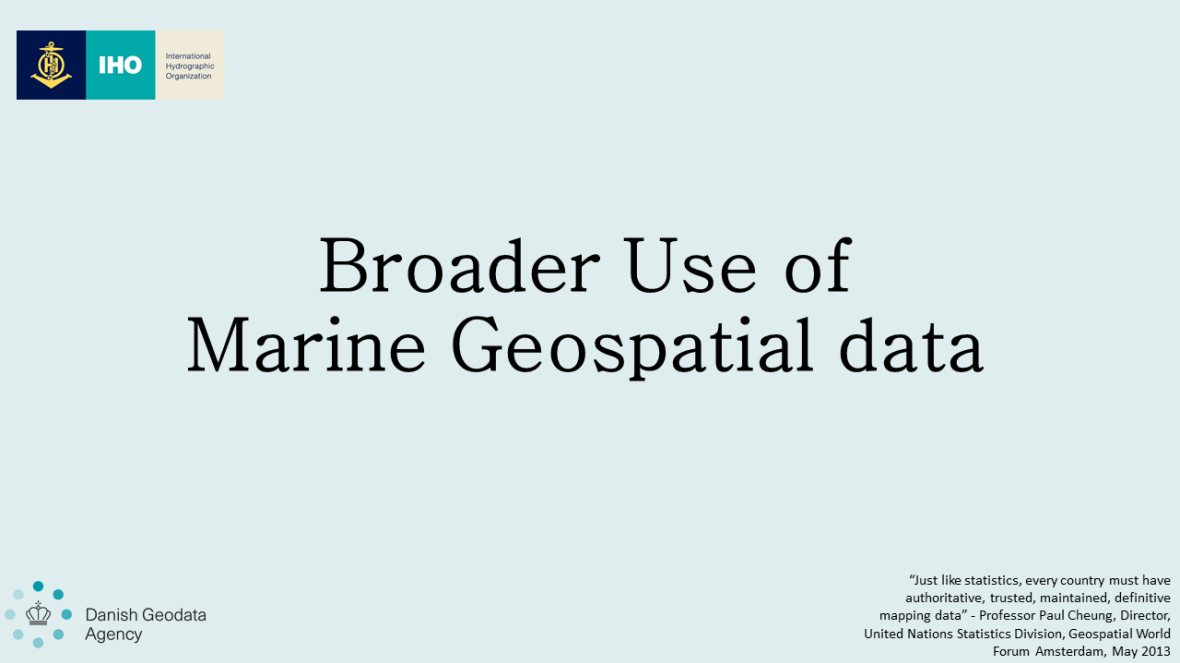
Note: CSDGM is now being superceded in the US by ISO19115 both by consensus and directive.

Key Messages:

- Consistency of metadata is so important to ensure users can search across multiple different sources that specific standards exist defining the structure and metadata fields.
- ISO19115 is the most common global standard for metadata content for geospatial data.

Notes:

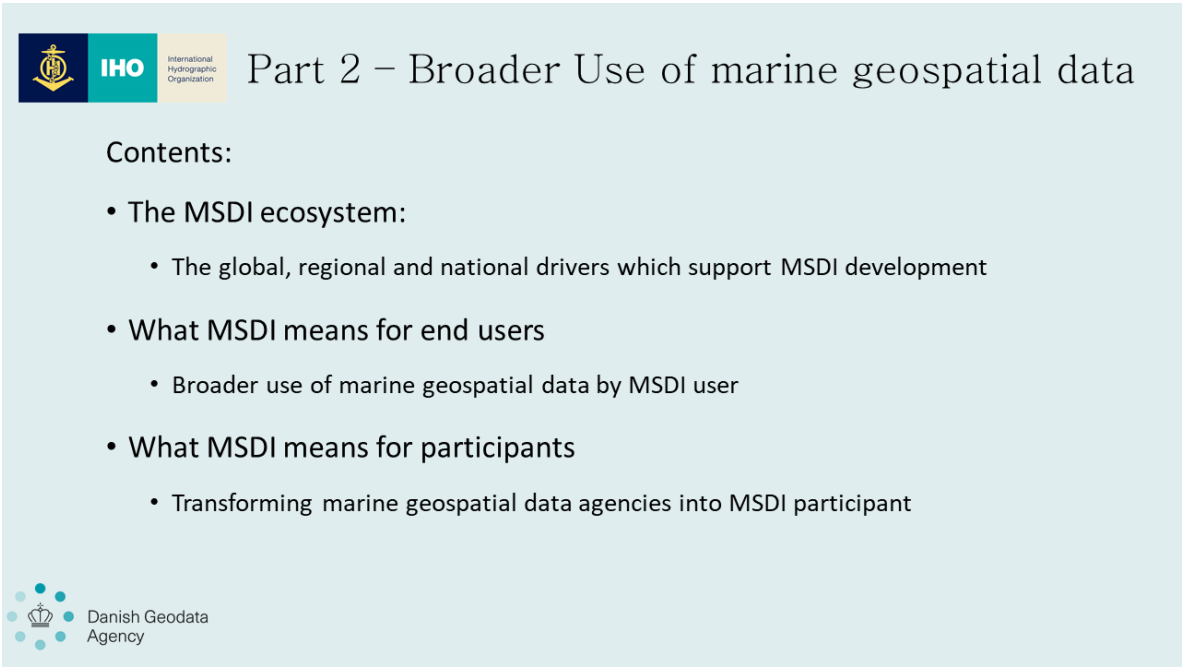
4 Uses and Application of Marine Geospatial Data



Key Messages:

- The next major section of the material presents different aspects of the central MSDI theme "Broader Use of Marine Geospatial Data".

Notes:

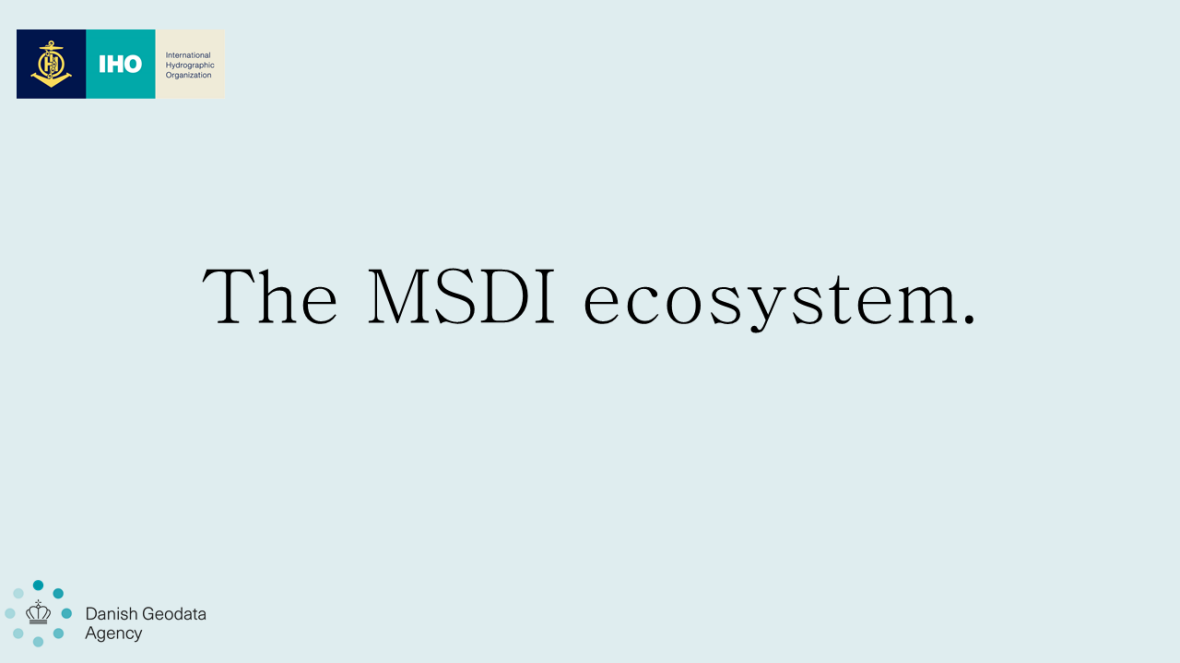


Key Messages:

- In this section we look at MSDI from different perspectives:
  - Some of the important drivers influencing MSDI activities
  - The uses and benefits for MSDI end users
  - The impacts of moving towards and MSDI implementation for participants.

Notes:

4.1 The MSDI ecosystem



Key Messages:

- The MSDI ecosystem is the collection of international movements, groups and bodies associated with the broader us of marine geospatial data. It is called an ecosystem because few of these bodies act in isolation.
- This section profiles some of the significant elements of this ecosystem.

Notes:

This slide shows how global movements influence regional initiatives and regional MSDI. Individual MSDI are built from national policies and frameworks and composed of individual institutional MSDI structures. The logos are examples of each kind of grouping from around the world. Shown are global initiatives UN-GGIM (dealt with in later slides), the global SDI movement, regional frameworks INSPIRE and the Arctic SDI implementation and below them a collection of national bodies, SDIs and other supporting entities.

Key Messages:

- Global and regional initiatives influence the engagement and creation of MSDI at institutional, national and regional level
- Equally, implementations of MSDI may influence the creation and content of such global initiatives.
- Global and regional movements can provide substantial guidance, standards and support to MSDI implementations.

Notes:

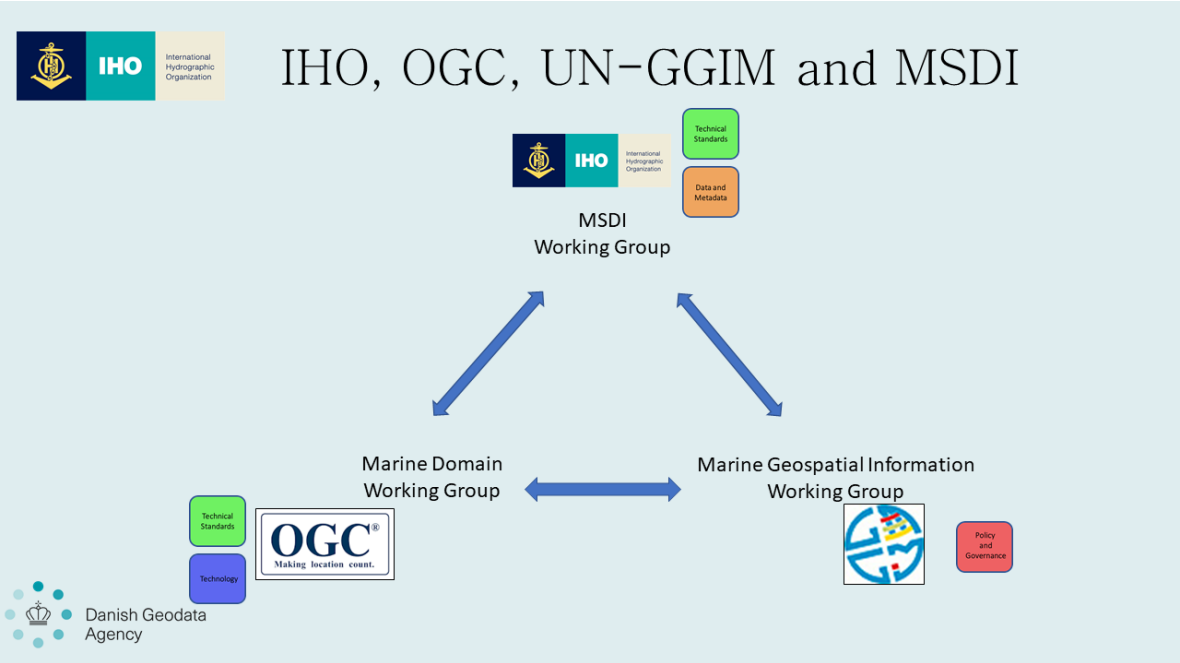
The United Nations initiative on Global Geospatial Information Management, UN-GGIM, was created in 2011 to assist in development of strategies for building capacity and exchanging best practices for geospatial information across many domains, including the oceans and "Life Below Water". UN-GGIM has a number of Sustainable Development Goals which define its objectives in various domains. Of most interest to MSDI participants are the "Life Below Water" goals.

UN-GGIM and the SDGs share the same purpose and mission as the global SDI movement, the global SDI movement (http://gsdi.org) has passed its responsibilities on to UN-GGIM and therefore marine elements of the SDGs have great significance for MSDI participants.

Key Messages:

- An major influence on both SDI and the marine elements, MSDI is the United Nations initiative on Global Geospatial Information Management
- UN-GGIM is the successor to the Global SDI movement http://gsdi.org

Notes:

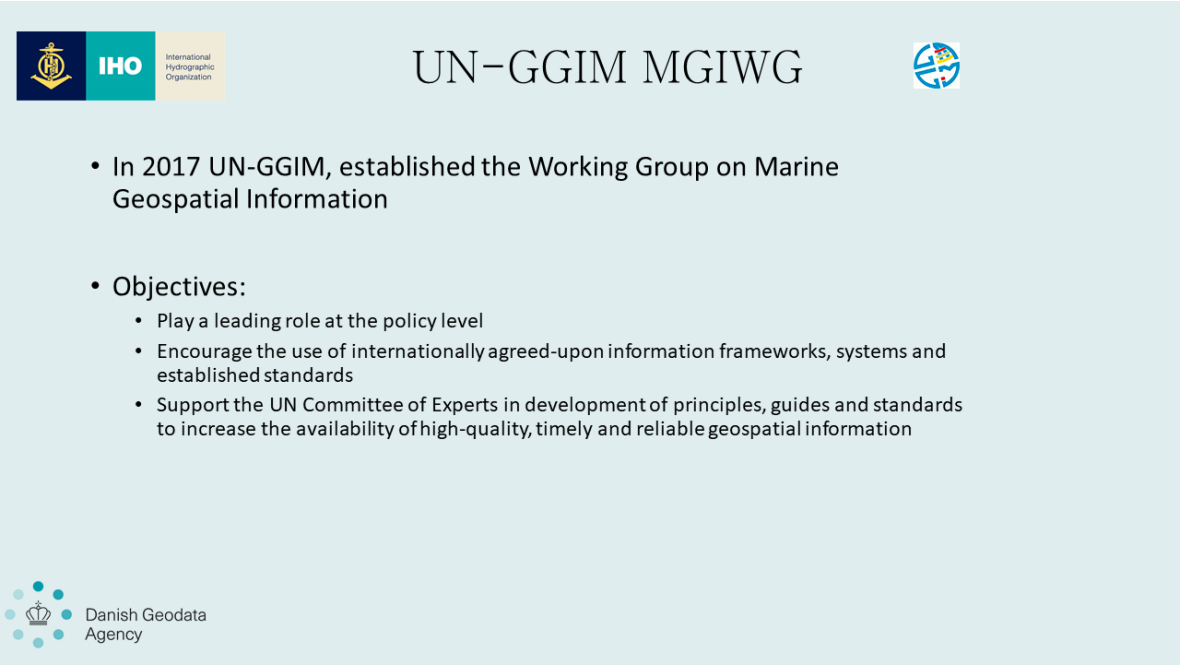


The three major global organisations influencing and supporting MSDI engagement are the IHO, the OGC and the UN-GGIM. Each has specific groups devoted to the marine domain and the development of MSDI. There are links between all these groups, reciprocal attendance at meetings and a recognition of relevant developments. The most recent is the formation of the Marine geospatial information working group under UN-GGIM.

Key Messages:

- IHO, OGC and UN-GGIM have specific marine domain groups which cover MSDI activities as part of their terms of reference.
- The groups have links defined between them to enable exchange of best practice and allocation of resources for particular challenges.

Notes:



Key Messages:

- The UN-GGIM's MGIWG is a recent group defined to form a marine focus within the larger UN-GGIM's activities.
- This group should raise the profile of the marine domain in UN-GGIM and provide a focal point for marine activities.

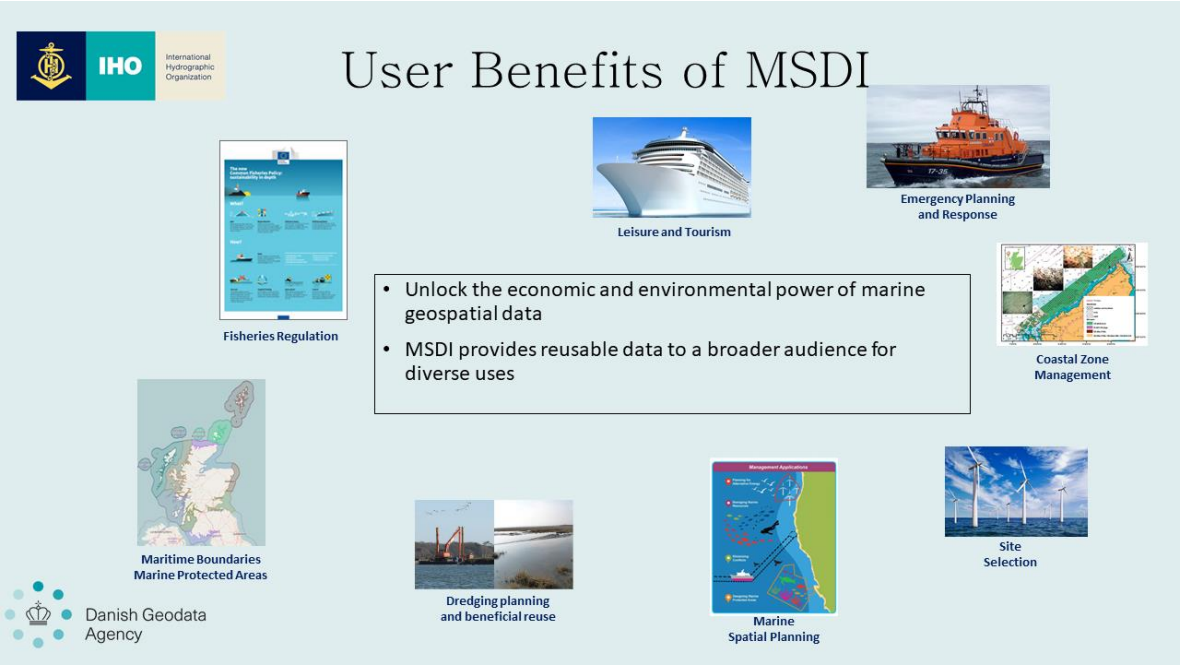
Notes:

4.2 What does MSDI mean for end users

Key Messages:

- This section of the material focuses on the scope and benefits of MSDI for its end users to provide a context for the production of reusable marine geospatial data for producers.

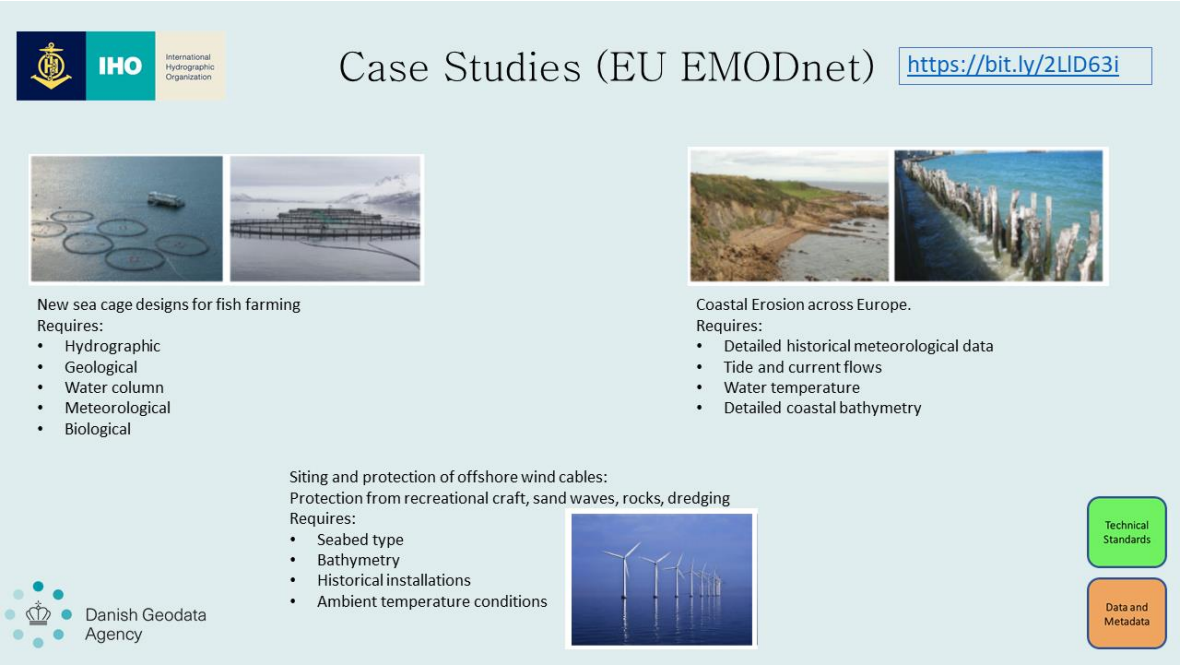
Notes:



Key Messages:

- The uses of marine geospatial data are many and varied but can be broadly grouped according to those relating to economic benefits and those of an environmental nature.
- The core goals of MSDI are to connect end users with marine geospatial data. The exact nature of those users and their use of data can vary greatly depending on the region and will depend on the data content, quality and metadata for search retrieval.
- Some typical uses are shown in the slide.
- Any MSDI business case should try to quantify the value of marine geospatial data to all MSDI participants including primary users.

Notes:



This slide shows some more detailed examples of marine geospatial data usage – the URL links to the source report from which they are taken. There is a broad array of different data types used in these typical examples.

Key Messages:

- More detailed examples of broader use of marine data for innovation, planning and environmental protection are presented together with the data requirements.

Notes:

The final use case presented for MSDI data is marine spatial planning (MSP). MSP is formalised as an activity in many regions of the world and is the term given to the process of analysing and planning activities in any marine space. Marine Spatial Planning has many elements and interpretations , especially across national boundaries and has many challenges and data requirements.

Key Messages:

- Marine Spatial Planning (MSP) is a global activity often performed under regional initiatives such as EU INSPIRE.
- MSP participants create "marine plans" which use existing data, often from MSDI, to set out long term sustainable plans for the marine space.
- Due to the long term nature of marine plans and the need to address the needs of many stakeholders MSP is a major focal point for the outputs of MSDI implementation and should be viewed as a key use case.

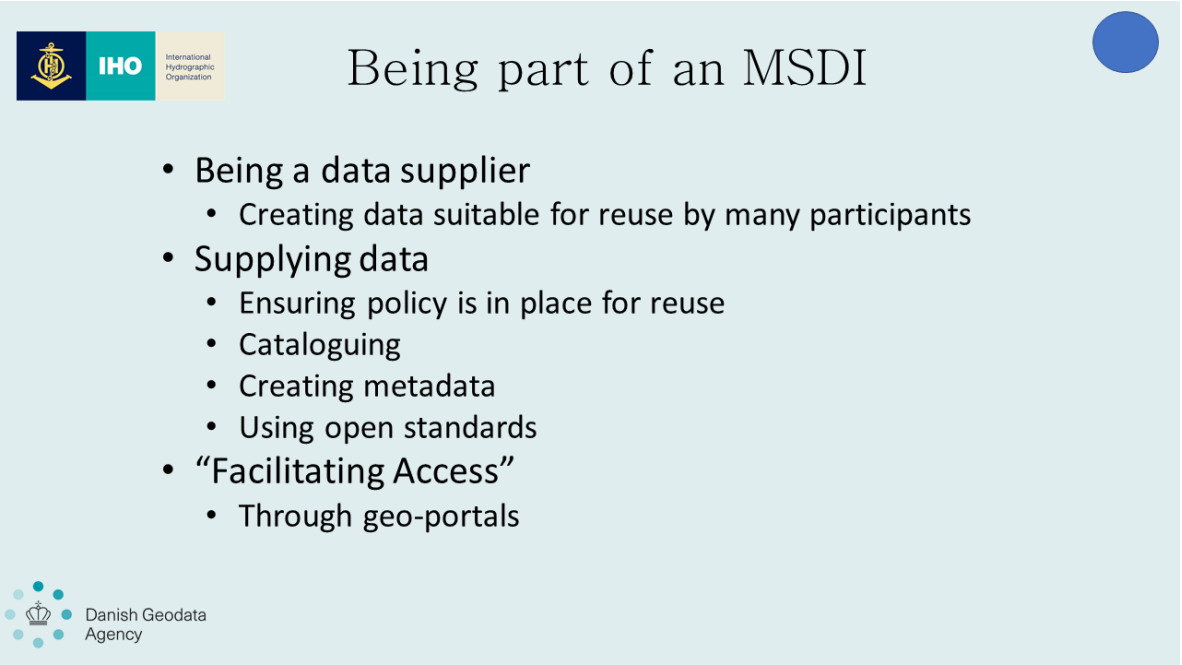
Notes:

What does MSDI mean for participants

Key Messages:

- The final part of the focus on drivers and impacts of MSDI looks at the impacts on the organisations forming the MSDI, the participants.

Notes:

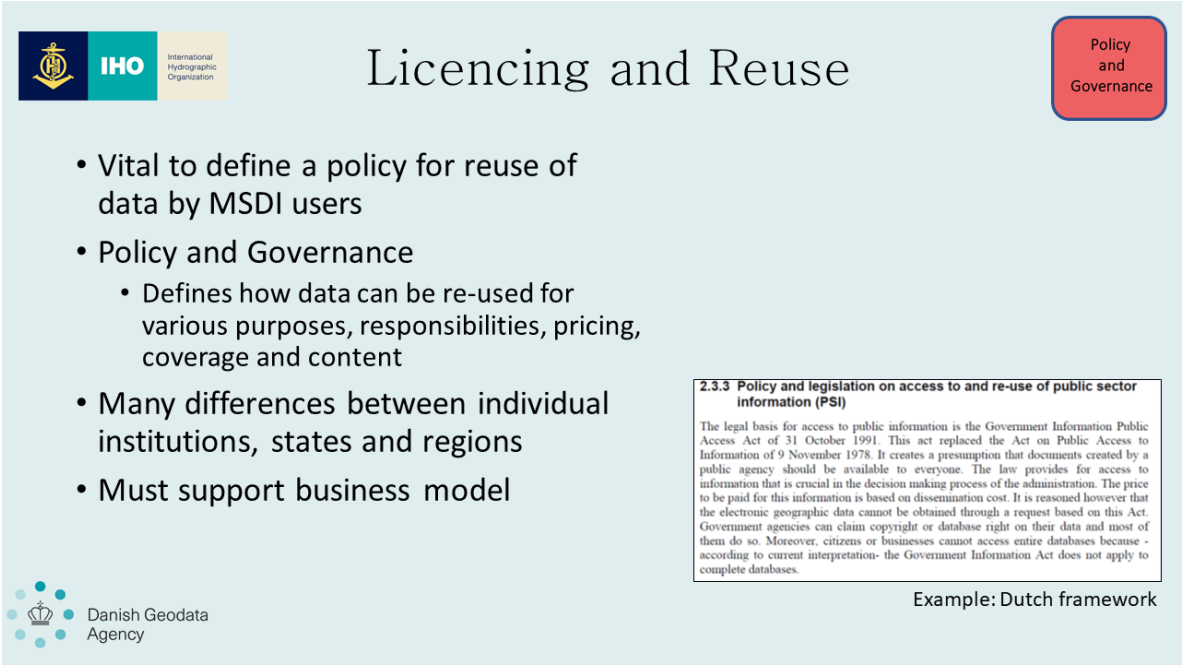


The slide shows a list of various elements of MSDI participation considered in this section. Above all is the responsibility to create and publish data which is ready for reuse into the MSDI framework. This responsibility is a complex one and has many facets including the creation of catalogues (which define the entities within data) and consistent metadata for the data holdings. Finally, the use of suitable standards all within a single policy and governance framework needs to be considered as part of an MSDI engagement plan.

Key Messages:

- This section looks at some of the activities of a marine geospatial agency working as part of an MSDI and the transformation of data and organisation required to maximise benefit to the MSDI end users.

Notes:



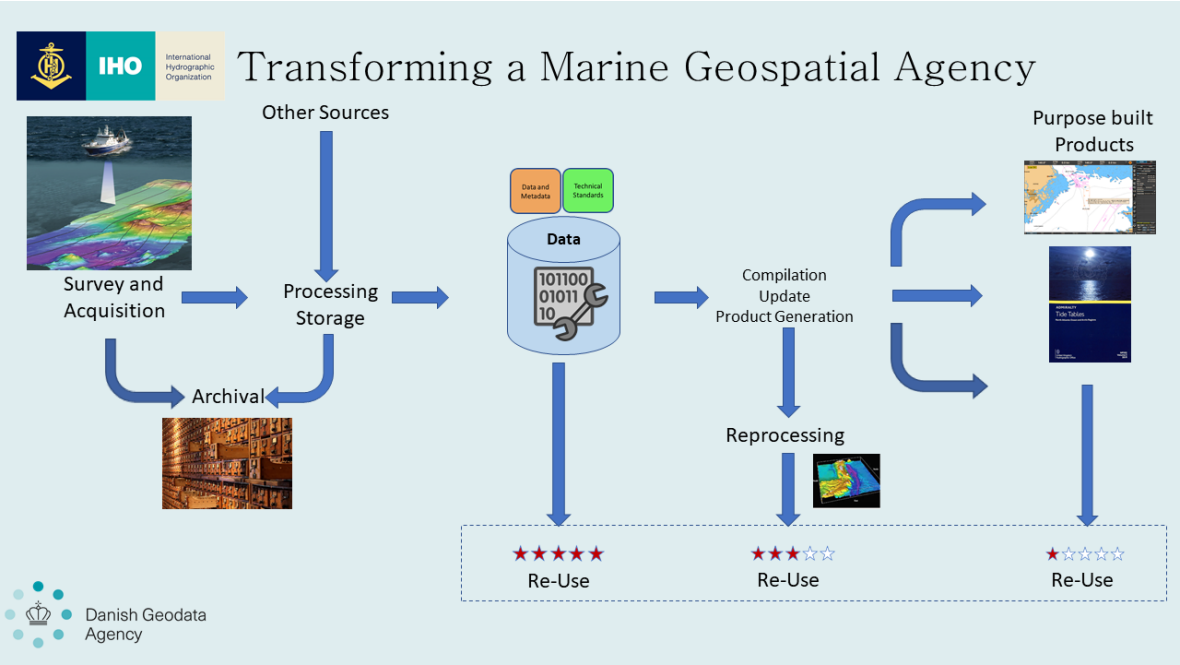
Example: Dutch framework

When we look at the impact of MSDI implementation on its core participants, the data suppliers, it is vital to see how important the policy and governance framework is. MSDI enables access to data and the terms and conditions under which data is released to its MSDI end users must be defined rigorously in order to protect the data suppliers and users. These models of data reuse licencing differ markedly in different MSDI.

Key Messages:

- A pre-requisite for MSDI implementation is a sound structure governing the resue and licencing of data from the MSDI participants.
- These rulesets are wide-ranging and differ between institutions and states.
- Often the licencing and reuse structure is designed to support a sustainable long term business model for the participating institution.

Notes:



This slide shows an example from the Hydrographic community of a hydrographic office ingesting data, managing and producing products.

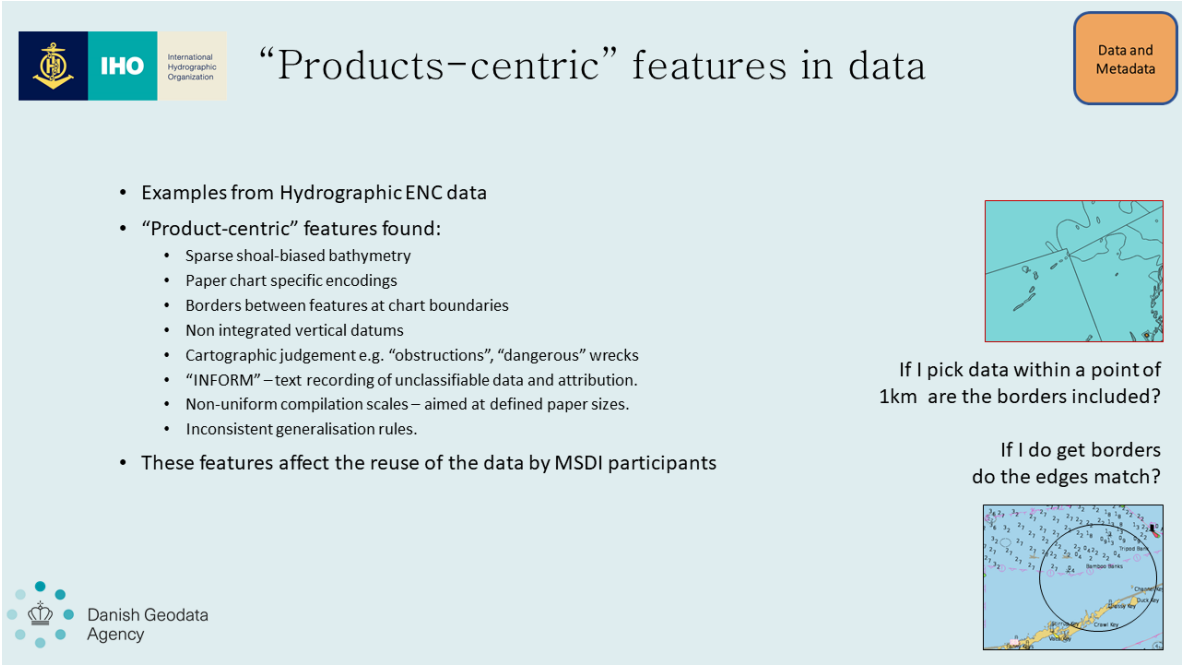
In tailoring data for specific products though, its broader use may be constrained – examples such as shoal bias, chart borders, navigation-specific encodings and a lack of seamlessness or data continuity may have an adverse effect on data use outside its primary customer base.

Re-using the core assessed and processed data prior to the addition of the product elements increases its potential for re-use because the data is not specific to any single group of end users. This is illustrated by the star ratings at each stage of the process.

Placing data at the centre of the agency and creating data specifically designed for re-use by a broader community of stakeholders is a long-term and significant challenge for many organisations. This transformation is referred to as “data-centric working”

Key Messages:

- Traditional Hydrographic Offices produce “products” for use by a single customer base where the use of data is fairly well defined. MSDI changes this fundamentally by exposing data to many different users for a much broader range of purposes.
- Issuing “product” data to MSDI users diminishes its usefulness because the process of compilation may suppress useful information and introduce much product-specific content which has less value to non-SOLAS users.
- Distributing product-neutral information for MSDI purposes from the central data store of an organisation places the data at the heart of the enterprise and is key to the concept of “data centric” working.
- Working in a data-centric way is not just good practice for MSDI working but can have many positive improvements for primary customers of data too.



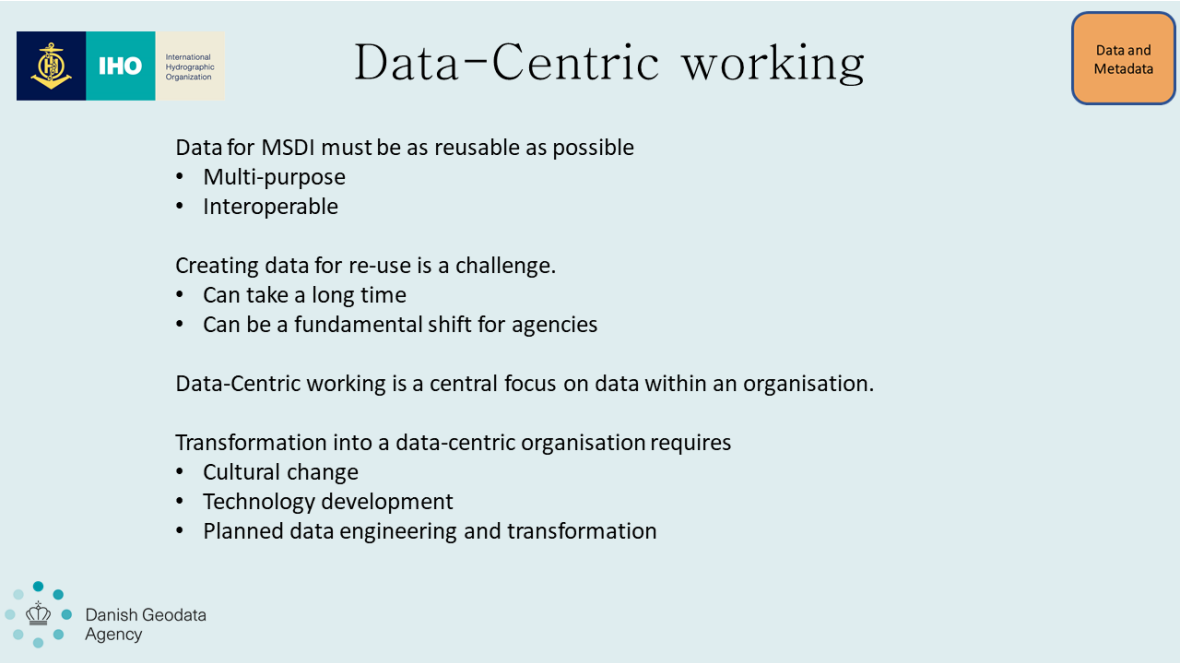
In the slide various hydrographic (and IHO S-57) features are listed which form part of the product-centric features within typical datasets.

These features sometimes have less appeal for broader MSDI use because they are highly specific to the primary user group only. The slide shows some of questions that may be asked when standard navigational chart data is downloaded for other purposes. These aspects of data reuse are critical to the success of an implemented MSDI and should form part of a long term plan by the institution to switch to production of "data which is ready for reuse" rather than data which is solely for a single user group or purpose.

Key Messages:

- The product centric features of hydrographic data are those which exist because of the primary use of the resulting data service.
- Product-centric features may be useful to a small population of end users and not to the broader MSDI community.
- Creating data optimised for reuse is a long term process and goal of the institution.

Notes:

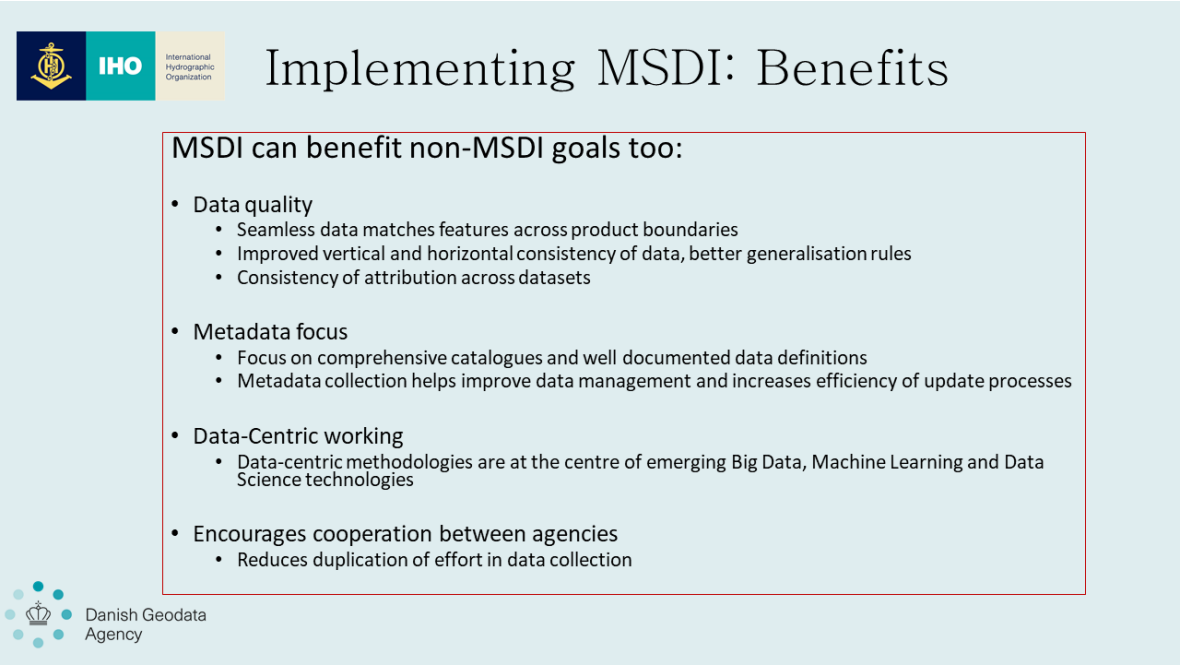


To summarise data-centric working from the perspective of the data producer – the fundamental goal of any MSDI is enabling reuse of data within a network of participants. Adopting data-centric working is an acknowledgment that data content needs to be the primary focus of an organisation to enable the MSDI effort to be successful.

Key Messages:

- Data Centric working is a central focus on data within an organisation.
- Adopting data-centric working practices focuses on creation of useful information for a broad group of end users.
- Data engineering, to create data for maximum reuse can be a significant challenge for many organisations.

Notes:



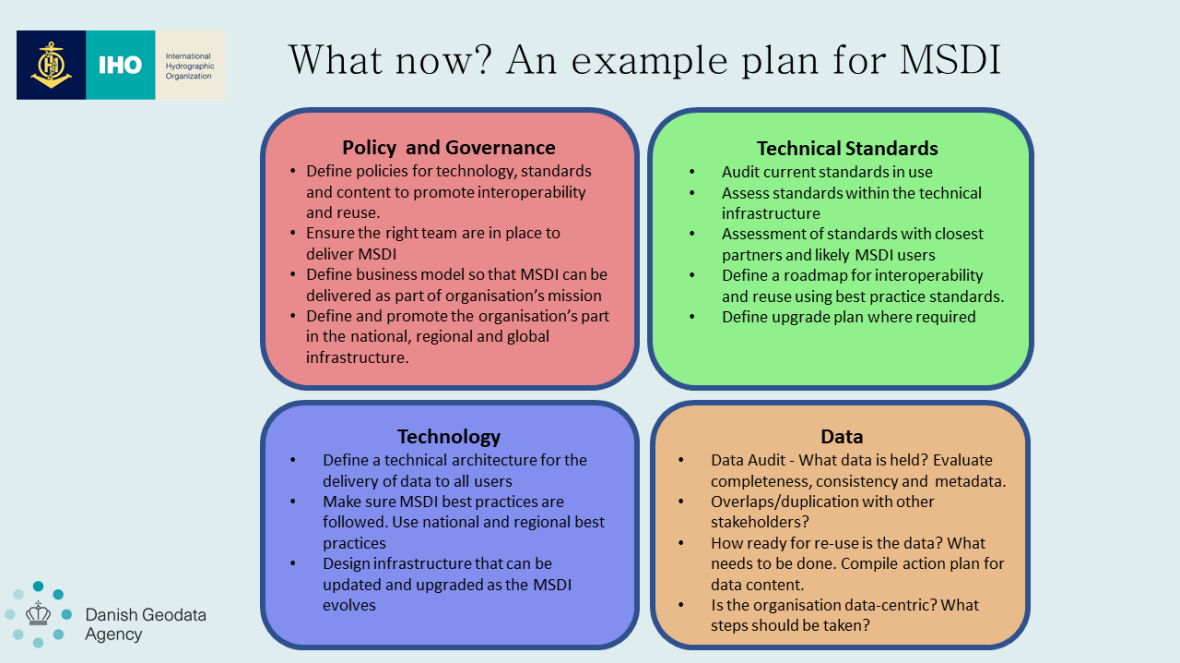
In drawing together this section on the meaning of MSDI for its participants it is worth observing that the implementation of an MSDI can have benefits for all participants and can benefit the primary goals of the institution as well. The basis of this observation is that data which is re-usable needs to be of higher quality, consistent, seamless, well-attributed with consistent and comprehensive metadata and these goals are of great benefit to primary users as well. From a hydrographic perspective the move to seamless, consistent, databased methodologies is a step change in improving working practices and focusing on the wider national picture can significantly help by eliminating duplication and unnecessary work between different agencies. MSDI has the capability to enable a national infrastructure for marine geospatial data and its benefits are rarely seen by only one organisation in the wider infrastructure.

Key Messages:

- There are many benefits to an organisation by engaging and implementing MSDI. The focus on data (through data-centric working) increases data quality and consistency
- Cooperation between different agencies can eliminate wasteful duplication of resources and skills.

Notes:

5 What Now?

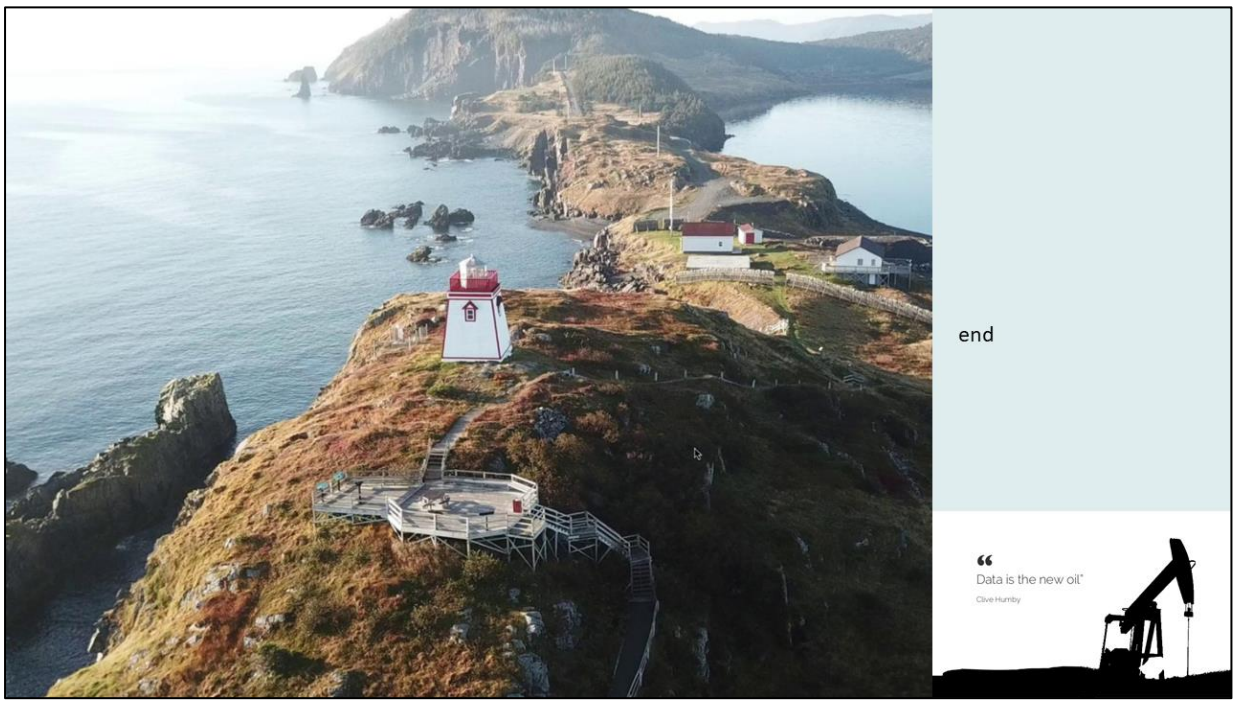


This slide shows a number of activities which can assist in the planning of MSDI engagement for organisations. They are categorised by the four MSDI elements we have seen throughout the training. These suggestions should generate ideas for engagement in participants and it is hoped that they can become the foundation for development of a national MSDI community and the engagement with the global MSDI movement.

Key Messages:

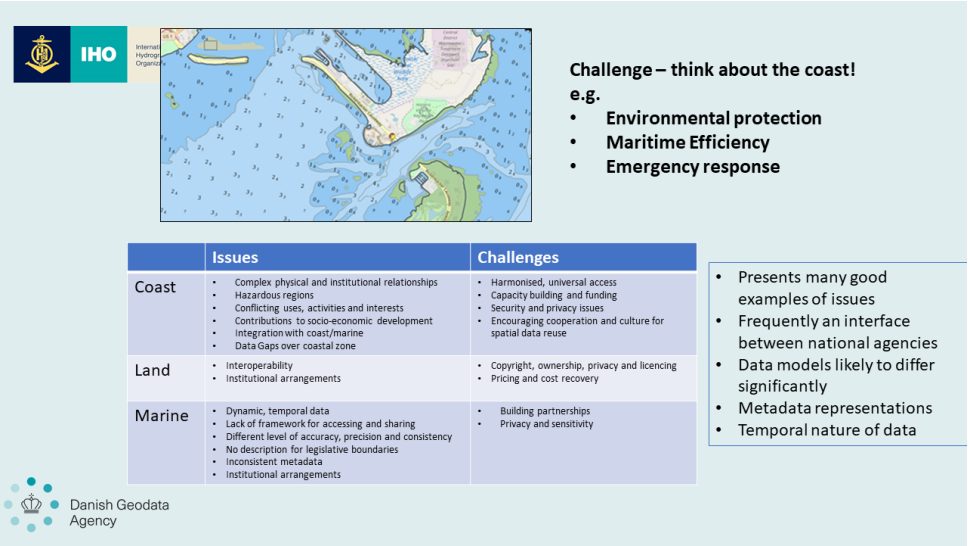
- Examples of ways to plan engagement with MSDI are presented
- Partitioning an action plan into initiatives mapped against the four MSDI elements ensures important tasks are not forgotten or ignored.
- More support can be gained through the IHO MSDIWG, regional partners and support documentation from the MSDI community.

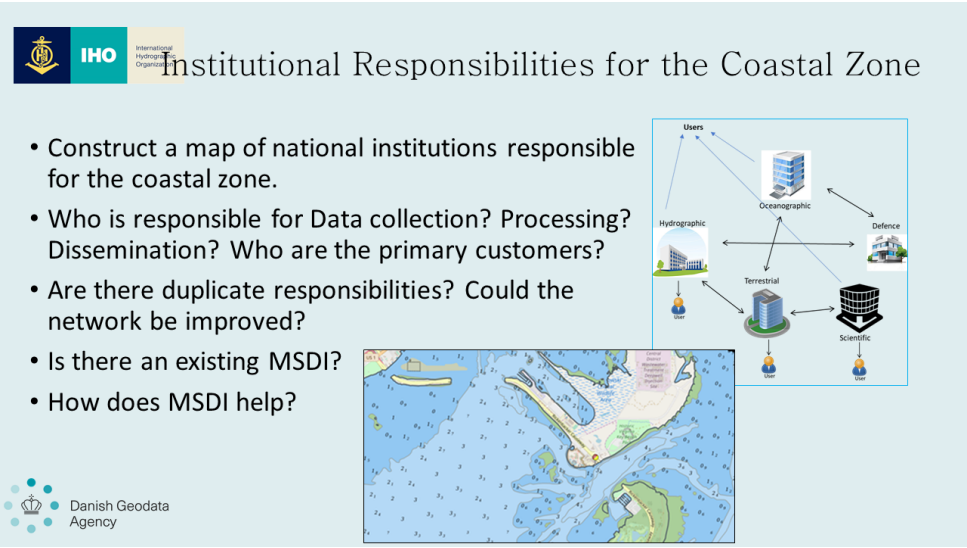
Notes:


end
“
Data is the new oil”
Clive Humby

6 Selected Exercises

These exercises can be considered in a group context or individually. Material in the course guide and links followed to explore the answers. Like many aspects of MSDI there are rarely single "correct" answers – MSDI is more about an understanding of the structures which define it, the benefits it leads to and a knowledge of current implementations and developments. These exercises are meant as exploratory tasks for the interested participant.

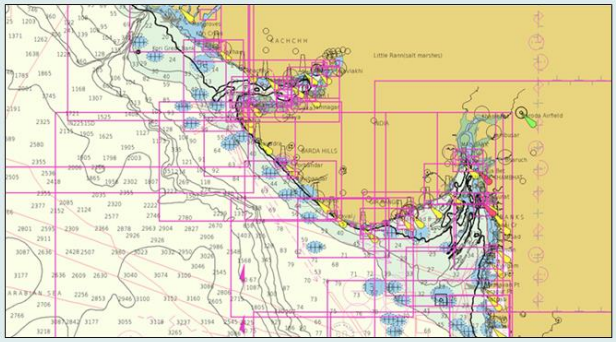




Notes:

Exercise: Data design for reuse

What aspects of content (data and metadata) might affect reuse but don't affect primary use?



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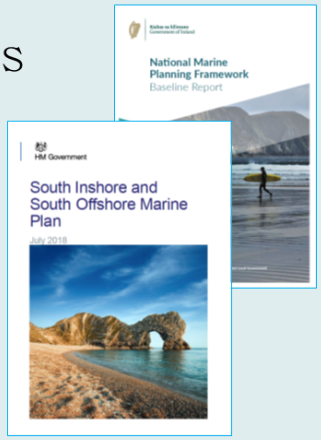
Notes:

Marine Plan Analysis

- Take a published Marine plan (or similar)
- Locate and analyse the geospatial data it uses
- Make a list detailing
  - What data is used?
  - Where it came from?
  - Was it compiled for the purpose of the plan?
  - Is it suitable?



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Notes: