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Common Implementation Strategy

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WG DIKE is invited to:

- a. Take note of the report;
- b. Send any comments in writing to JRC by 27/11/2015.



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Marine Pilot

D4.2 EMODnet and INSPIRE: benefits of closer collaboration and a framework for action

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Abstract

The European Marine Observation and Data Network (EMODnet) and the Infrastructure for Spatial Information in Europe (INSPIRE) are two initiatives of the European Union (EU) where closer collaboration would realise considerable benefits to all communities who use or make decisions based on marine data. Both initiatives have long development timelines and are being implemented over several years

Both EMODnet and INSPIRE have the aim to improve access to marine data to support improved decision making, policy development and economic growth. Although both are following a common trajectory, there are however differences between them in terms of scope, policy frameworks and technologies. It is therefore timely to consider these different approaches and identify efficiencies that could come about with closer alignment between EMODnet and INSPIRE.

This paper describes the two initiatives in terms of scope, themes, and interoperability and use of standards. The European Interoperability Framework is applied to give structure to the actions, which are being proposed as a mechanism to identify fully the benefits of a closer collaboration in particular at organizational, semantic and technical levels.

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1. Introduction

The European Marine Observation and Data Network (EMODnet) and the Infrastructure for Spatial Information in Europe (INSPIRE) are two initiatives of the European Union (EU) where closer collaboration would realise considerable benefits to all communities who use or make decisions based on marine data. This paper considers how this could be done.

Both EMODnet and INSPIRE aim to improve access to marine data. EMODnet is part of the European Commission's "Marine Knowledge 2020" initiative of DG Mare [1], endorsed by Council [2] and Parliament [3], which aims to unlock sources of public data and make them available for reuse for policy and industrial by private, public, research and civil society users. INSPIRE 2007/2/EC [4] is an EU law that obliges public authorities in EU Member States to share spatial data in support of environmental policies, or for policies and activities that affect the environment. It mandates rules and promotes standards for data and data services such that data can be effectively reused and exchanged.

EMODnet (<http://emodnet.eu>) aims to use INSPIRE (<http://inspire.ec.europa.eu>) standards. This has been done to a significant extent, but not to an extent that would meet compliance with the present INSPIRE legal acts. This is partly because EMODnet and INSPIRE had different implementation timescales that meant INSPIRE was not mature enough for adoption when required by EMODnet and EMODnet requirements may require solutions that diverge from INSPIRE.

We are now at the stage where INSPIRE is more mature so the two initiatives can be compared with a view to complete alignment. This may mean adjustment to INSPIRE or to EMODnet standards.

As such we can now explore a range of issues and questions:

- Legal - how do the INSPIRE requirements relate to the function and services that EMODnet intends to offer to organizations in the Member States? How can Member States' organizations align their INSPIRE obligations and EMODnet requests?
- Organisational - which partnerships and agreements need EMODnet data custodians need to establish to streamline data flows to serve both EMODnet and INSPIRE?
- Semantic - how can EMODnet improve data interoperability using the INSPIRE infrastructure, framework documents, and tools?
- Technical - what would EMODnet need to change to reach INSPIRE compliance at a technical level? How is INSPIRE compliance measured?

The purpose of this paper is to present a position on these issues to elicit what can be done now by both INSPIRE and EMODnet under a 'business as usual' scenario and what needs to be done as part of any future work plan. What is clear is that the two initiatives would benefit from closer cooperation. In this context, it should be noted that although Inspire is a Directive, there are elements that are not set in stone; there is an update mechanism in place so the findings from exercises in adoption such as this will support improved and wider uptake of INSPIRE.

The paper touches on topics such as background to EMODnet, key aims and operational status; background of INSPIRE and key tenants for data exchange; possible roles and responsibilities of EMODnet in the INSPIRE context; mapping and matching of INSPIRE and EMODnet themes, challenges to be addressed, and next steps.

The paper follows a workshop held between representatives of the INSPIRE and EMODnet communities on 31 July 2015 and subsequent discussions. The participants confirmed the considerable synergy between the two initiatives and identified areas that need to be addressed, i.e. to address a notional 20% gap between where EMODnet and INSPIRE are now and what it would take to make them fully aligned.

Lastly, although the focus of this paper is EMODnet, it is anticipated that any pan-European initiative delivering data services on behalf of Member States will benefit from this analysis and discussion.

2. European Marine Observation and Data Network - EMODnet

2.1. Scope

The European Marine Observation and Data Network (EMODnet) is a partnership of over 100 organisations that aim to unlock public marine data to support the sustainable growth of the blue economy. It now delivers a single access point to marine data across the EU such that an organisation in a particular Member State can equally access data from another. EMODnet also provides a political drive to overcome reluctance to grant open access to public data, resource and expertise to undertake the core harmonisation and delivery of the data and lastly a governance framework and mandate that sanctions the activity on behalf of Member States.

2.2. Themes

EMODnet is implemented as a series of partnerships with each partnership responsible for a data theme. In general a distinction is drawn between "data" which are the measurements or observations and "data products" which are derived from the data. For instance an acoustic survey of the seabed would be classed as data but a digital terrain model derived from the survey would be classed as a product. For the purposes of this discussion, however, the word "data" will be used interchangeably to apply to both. A summary of the themes is given in the table below.

Table 1. Overview of the EMODnet themes

Theme	Description
Physics	Physical conditions of the oceans such as waves, currents and temperature. Data is typically represented as single point time-series and profiles.
Chemistry	Chemical conditions of the oceans such as waves, currents and temperature. Data is typically represented as single point timeseries, profiles and single point ex--situ observations.
Bathymetry	Elevation of the sea floor. Data is typically represented as point clouds or processed to give a regular grid

Theme	Description
Geology	The geology data available includes sea-bed substrate, sediment accumulation rate, sea-floor geology, bedrock lithology, bedrock stratigraphy, coastline migration, mineral resources (oil and gas, aggregates, metallic minerals), and geological events (earthquakes, submarine landslides, volcanic centres).
Seabed Habitats	Flora and fauna of the seabeds
Biology	Access to metadata descriptions of almost 1000 thematic biological databases through the catalogue, including national marine biological monitoring datasets, scientific field surveys and experiments and data collection studies. Datasets cover marine species of phytoplankton, zooplankton, angiosperms, macro-algae, invertebrate bottom fauna, birds, mammals and fish.
Human Activities	Covers geographical information on aggregate extraction, dredging, fish catches, hydrocarbon extraction, major ports, mariculture, ocean energy facilities, telecommunication cables, protected areas, waste disposal (solids, including dredge material, dumped munitions, marine constructions), wind farms, and other forms of area management/designation. Additional information that is anticipated to be added soon includes the status of bathing waters, offshore installations, and hydrocarbon licences and bidding blocks.

2.3 Interoperability and use of standards

The EMODnet partnerships use a consistent suite of technologies to realise data discovery and access. These are largely based on ISO 19100 suite of geospatial data standards and corresponding implementation in open source software such as GeoNetWork.

A summary of approaches is given in the table below. There is a wide consistency of the interoperability techniques used between EMODnet themes, but there are differences in the data structures used. Most EMODnet themes have focussed on the harmonisation of source data at the theme level, but not at an inter--theme level. Inter--theme interoperability is limited to discovery and view services.

This is partly because at the onset of EMODnet, the Inspire standards for metadata and view services were established, whereas the data standards were not. Accordingly EMODnet adopted community practices at the theme level with the intent that these could be adapted at a later stage. These community practices did inform the development of the Inspire data specifications.

This limited interoperability between themes was recognized when the EMODnet team building a central portal started work on creating a common access to all themes using web services. It is intended that the themes become interoperable by late 2016.

Furthermore, given the interest of the EU in waters other than those under the jurisdiction of EU Member States, EMODnet needs to be aware of standards of international partners such as the United States, Japan and Australia and, if possible, be compatible with them. The United States National Oceanic and Atmospheric Administration (NOAA) Unified Access Framework already makes nearly all physical data straightforward to find and use.

Table 2. Standards in use for EMODnet metadata, data, and services

Data	Standards in use	Comment
Metadata	ISO19139	XML encoding of ISO19115/139. Developed from SeaDataNET CDI. Almost universally used by all topics
Data	ISO19136 ASCII	Some topics use GML, however most use a structured ascii format such as ODV. However this is not consistent across all topics. NetCDF is used for large gridded data sets.
Network Services	Standards in use	Comment
Discovery	OGC	CSW
View	ISO19128	WMS is used by all topics.
Download	ISO19142 FTP	WFS is used from some topics but most use a file download service.

3. Infrastructure for Spatial Information in the European Community - INSPIRE

3.1. Scope

INSPIRE, being a framework Directive, is a set of European Union and national legal acts and their coordinated implementation. Through INSPIRE the EU has created a common standard to make environmental information quickly and easily accessible for integrated policy decision-making at all levels of government while supporting the exchange of information and data between the local, regional, national and European or international levels.

By implementing INSPIRE, Member States, the Commission, and the European Environment Agency are adopting innovative data management practices that greatly improve the consistency, availability and re-use of spatial information. The infrastructure will improve decision making in support of environmental policies, and of policies and actions that have an impact on the environment.

INSPIRE requires EU countries to share spatial environmental data and information according to a number of agreements, laid down in the Directive, in the Implementing Rules Legal Acts (IRs), and in technical guidance (TG). The obligations laid down in the INSPIRE legal acts are independent of any particular reference that thematic environmental legislation may make to INSPIRE. Note that INSPIRE itself does not require Member States to produce new data.

The obligation for a public authority to share spatial information with other public authorities – that need this information for the execution of their public tasks – is in place since 2007 when the Directive

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entered into force. The obligations related to the other components of the INSPIRE Directive – the metadata, network services, data harmonization, harmonized license conditions, and the monitoring and reporting of the infrastructure – have been following a precise calendar, described in the INSPIRE implementation roadmap¹. In 2020 all INSPIRE obligations will need to be implemented by the Member States.

3.2. Themes

As INSPIRE focusses on decision making in support of environmental policies, and of policies and actions that have an impact on the environment, the thematic scope is broad. The Directive includes three annexes that list 34 data themes that define the scope of INSPIRE. Examples of data themes of relevance to the marine community include - but are not limited to - Coordinate reference systems, geographical grid system, Hydrography, Protected sites, Area Management/Restriction/Regulation Zones and Reporting Units, Bio-geographical Regions, Elevation (which includes bathymetry and shorelines), Environmental monitoring facilities, Habitats and Biotopes, Sea regions, and Oceanographic geographical features.

INSPIRE is a distributed infrastructure. Each Member State is responsible for the implementation and operation of their national INSPIRE infrastructure, also referred to as Spatial Data Infrastructure (SDI). By following the common rules and a coordinated implementation of the INSPIRE components, the national infrastructures become interoperable: information can be accessed, exchanged and understood without further interventions across borders, thus creating a European infrastructure.

2.3 Interoperability and use of standards

From a technical point of view, INSPIRE has identified a number of components that support the so-called Publish – Find – Bind” (PFB) pattern. The owner of a data set publishes the data (using the metadata, discovery, view and download service components of INSPIRE), and a user should be able to find a data set or service (using the INSPIRE geoportal and registry components of INSPIRE), and “bind” the data set or service to his or her application, which can be anything from a web application to a desktop GIS.

The Publish-Find-Bind pattern is based on de-jure and de-facto standards in geographic information, notably from ISO/TC 211 (the so-called ISO 19100 series of standards) and from the Open Geospatial Consortium (OGC). However, the INSPIRE Implementing Rules Legal Acts mandate some additional elements to these standards in order to fulfil the requirements of the Directive. INSPIRE compliance for network services, for instance, may mean compliance with the relevant OGC standards, but being compliant with an OGC standard does not necessarily mean that one is compliant to INSPIRE.

One area in which INSPIRE has a fundamental contribution to environmental data management is the harmonization and interoperability of data - the so-called semantic interoperability. Using where possible existing community standards, INSPIRE has defined for the 34 data themes approximately 1000 spatial objects with their specific definition, fundamental properties, and relationships.

¹ <http://inspire.ec.europa.eu/index.cfm/pageid/44>

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This model-based approach, grounded on the ISO 19100 series of standards, allows for a spatial object (for instance a polygon for a restriction zone, or the point location of a measurement station) to become a “hook” to which thematic data (such as detailed information on the legal instruments, or a measurement and the description of how the measurement was performed) can be attached. The spatial objects can be re-used by using the INSPIRE unique identifier, for instance for reporting the state of a sea region to the Marine Strategy Framework Directive, or to the Water Framework Directive.

4. Legal, organizational, semantic and technical aspects of interoperability

4.1 EMODnet and INSPIRE in the context of the EIF

The topic of interoperability is increasing in importance - and not only for geospatial information. For many years, the Commission has been working on the European Interoperability Strategy (EIS) and the European Interoperability Framework (EIF). In COM(2015) 192 final “A Digital Single Market Strategy for Europe” and the related DSM roadmap [5], the EIF will increase in importance, and the Commission wants a revised version of the EIF to become mandatory.

The European Interoperability Framework (EIF) [6] defines interoperability in the context of European public service delivery as *“the ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations, through the business processes they support, by means of the exchange of data between their respective ICT systems.”*

This section uses the four levels of interoperability defined in the EIF to help understanding how EMODnet and INSPIRE could be best aligned: the legal, organizational, semantic and technical levels. All four levels are important when addressing the alignment of EMODnet to INSPIRE. Focusing only on the semantic or technical interoperability could lead to important omissions.

The following subsections outline in more detail what these levels entail for both EMODnet and INSPIRE, and uses that as a framework for actions that that support the alignment of EMODnet and INSPIRE.

4.2 Legal interoperability

Each public administration contributing to the provision of a European public service works within its own national legal framework. Sometimes there are incompatibilities between legislation in different Member States that make working together more complex or even impossible, even where such legislation is the result of transposing European directives into national law. Legal initiatives may be needed to remedy such situations.

The EIF recommends therefore that public administrations carefully consider all relevant legislation relating to data exchange, including data protection legislation, when seeking to establish a European public service.

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At EU level, this function is provided through the “digital check”, and the ICT implications of EU policies of the Commission-driven programme “Interoperability Solutions for European Public Administrations” (ISA).

EMODnet already includes representatives of all the communities that define data standards – National Oceanographic Centres, national hydrographic offices, geological survey and the European Environment Agency (for instance for the EIUNIS habitat classification) and is compatible with global efforts such as the World Registry of Marine Species (WORMS). It is aiming to set up a process that moves reporting on the marine environment from a push to a pull process but this is complex technically and legally.

EMODnet also complies with and reinforces the Directive 2013/37/EU of 26 June 2013 amending Directive 2003/98/EC on the re-use of public sector information. This aims to prevent public bodies being monopoly providers of services based on the data they collect. In principle they should make data available for re-use under the same conditions as it is provided for their own services.

The INSPIRE Directive focuses in particular on information needed for environmental policies and for policies and actions that are related to the environment; INSPIRE compliance for data that are underlying the reporting for thematic legislation such as the Marine Strategy Framework Directive has therefore a priority.

Suggested actions:

- *EMODnet and INSPIRE to establish a formal liaison to ensure a consistent approach to achieving and reporting on legal interoperability in the marine domain. This should make use of established mechanisms such as the EMODnet steering committee*
- *EMODnet projects to actively participate in the INSPIRE Conference (24-29 September 2016, Barcelona)*
- *INSPIRE, through the INSPIRE marine pilot, to consider the use of EMODnet products and services*

4.3 Organizational interoperability

This aspect of interoperability is concerned with how organisations, such as public administrations in different Member States, cooperate to achieve their mutually agreed goals. In practice, organisational interoperability implies integrating business processes and related data exchange. Organisational interoperability also aims to meet the requirements of the user community by making services available, easily identifiable, accessible and user-focused. It is a tool to make explicit the dependencies between organizations - dependencies that need to be understood and formalized.

In the case of EMODnet and INSPIRE there are different levels that can be distinguished: European, national, and sub-national.

Table 3. Policy owners and paymasters of EMODnet and INSPIRE

Characteristics	EMODnet	INSPIRE
Policy owner	European Commission (DG Mare)	European Commission (DG Environment), assisted by the EC-EEA INSPIRE team
Paymaster	European Maritime and Fisheries Fund, , National public and private entities (data collection efforts)	EU Member States Framework Programmes for Research (DG Research and Innovation), Competitiveness and Innovation framework Programme (DG Connect), Interoperability Solutions for European Public Administrations (DG Informatics)
Stakeholder potential to influence initiative	Services are procured through binding contracts with terms of reference determined by Commission Services and European Agency for Small and medium Enterprises.. User Group is being set up to accelerate feedback from users	Direct participation in pool of experts and through the national INSPIRE coordination structures

4.3.1 National and EU governance of INSPIRE

National coordination is crucial to the successful implementation of INSPIRE, and the Directive dedicates two articles to this aspect. Article 18 requires that Member States shall ensure that appropriate structures and mechanisms are designated for coordinating, across the different levels of government, the contributions of all those with an interest in their infrastructures for spatial information. These structures shall coordinate the contributions of, *inter alia*, users, producers, added-value service providers and coordinating bodies, concerning the identification of relevant data sets, user needs, the provision of information on existing practices and the provision of feedback on the implementation of this Directive.

INSPIRE Art. 19 requires each Member State to designate a contact point, usually a public authority, to be responsible for contacts with the Commission in relation to the Directive. This contact point will be supported by a coordination structure, taking account of the distribution of powers and responsibilities within the Member State.

At EU level the implementation, maintenance and evolution of INSPIRE is governed by the INSPIRE Maintenance and Implementation Framework (MIF). Actors in this framework include the formal representation of the Member States in the Maintenance and Implementation Group (MIG) and the European Commission-European Environment Agency INSPIRE Team, which coordinates INSPIRE. The activities of the MIG are driven by the INSPIRE Maintenance and Implementation Work Programme.

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The INSPIRE Implementing Rules and the Technical Guidance documents have dependencies with European and international standards (both formal standards developing organizations – SDOs - such as ISO, CEN, and de-facto SDOs such as OGC). These dependencies were introduced with the intention that the implementation of INSPIRE would be facilitated because industry would support these standards.

The core standards of INSPIRE rely on ISO and OGC standards, which are complemented with community standards whenever required. The dependencies with ISO, OGC, and community standards will be managed the context of the INSPIRE Maintenance and Implementation Framework.

In fact, the link with the thematic communities relies heavily on the INSPIRE Thematic Clusters, which support INSPIRE implementation in the Member States. The experience gained during the development of the Technical Guidelines as well as lessons learned by implementing the infrastructure, especially in thematic domains, need to be shared to optimise performance of the infrastructure to meet policy objectives and to increase its usability within thematic domains.

4.3.2 Opportunities for EMODnet

EMODnet can play a powerful role in advancing INSPIRE compliance for member states. Similarly wider use of INSPIRE standards can be useful to the bigger EMODnet picture of promoting access to marine data.

Three potential roles emerged that EMODnet could play in relation to INSPIRE and these are described in the following sub-sections. However, these roles should be considered generic as EMODnet interfaces with INSPIRE should be a good template for future pan-European projects.

Role 1: User of the INSPIRE infrastructure

In this context EMODnet builds its capacity and capability through the use of data from multiple Inspire-compliant services across Member States. EMODnet then has the primary role to ‘focus’ these to the marine community and the policy and blue-economy objectives of EMODnet. In effect, EMODnet provides a key value-add service to the generic Inspire services of members states

Role 2: Producer of INSPIRE harmonized data products

This context is almost the inverse of the above option. Here EMODnet supports the INSPIRE compliance of MS through collection and transformation of data in the marine domain for MS to distribute through their national Inspire infrastructure. In this context, Emodnet is providing a key community engagement to realise Inspire compliance

Role 3: Provider of “INSPIRE as a service” to Member States’ authorities

In this context, EMODnet delivers INSPIRE compliance on behalf of member states. MS delegate aspect of Inspire compliance to EMODnet where it is relevant to do so. This may be a particular Inspire Annex, or a subset of data, or data from a particular provider. This is a continuation of current practice and collaboration within the EU Marine Community, however it also takes on a legislative dimension.

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It is highly likely that EMODnet may actually adopt a hybrid approach of each of these three options. Option 3 will need particular consideration, particularly is different MS may 'pick and choose' to what extent EMODnet delivers Inspire compliance on their behalf.

Suggested actions:

- *EMODnet data custodians to have a dialog with the national INSPIRE contact points to determine which data sets and services need to be included in the national INSPIRE catalogue - and thus in the INSPIRE geoportal. This is linked to the EIF recommendation that Public administrations should document their business processes and agree on how these processes will interact to deliver a European public service.*
- *EMODnet consider and agree its longer term role(s) in the context of INSPIRE and set targets to achieve this within the current programme, i.e. up to 2020*

4.4 Semantic interoperability

Exchange of and access to (spatial) data is the principal objective of a Spatial Data Infrastructure (SDI), and therefore also of a marine SDI. The data are at the heart of the infrastructure [2]: the biggest investment is the actual data collection, and a careful documentation of the data is not only important for semantic interoperability - understanding the meaning of the data across communities - but also for making sure that the data can be understood and used decades from now.

The (spatial) data are a representation of the real world. This representation is called a *data model* in the ISO 19100 series of standards and INSPIRE speak, and is developed according to well defined methodologies described in standards and framework documents. It is made explicit through a concise description of what are called data specifications (in INSPIRE) or metadata (in EMODnet speak).

4.4.1 Resources to support semantic interoperability

Any approach to achieving semantic interoperability entails bridging the viewpoints of the domain community on the same reality.

These naturally present different perspectives of the world and a dialogue between the two is needed to optimise interoperability. The viewpoints typically embrace two areas; how the data is represented and the thematic scope of the data. For example observed data may fall under one INSPIRE theme, but the processed and aggregated version of the same data may fall under another.

In INSPIRE, a number of resources are available to help thematic communities with the implementation of INSPIRE. These include:

- The INSPIRE website
- INSPIRE framework documents
- UML models and application schemas
- Feature concept dictionary and the interactive data specifications (the "find your scope" tool)

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- INSPIRE Thematic Clusters

In addition to these tools across INSPIRE, resources specific to the marine community has been developed as part of the INSPIRE marine pilot [9]. Specifically the marine pilot takes the generic resources and applies them to the context of the MSFD. The results are a suite of training materials, reports and demonstrations.

4.4.2 Aims of Mapping and Matching

Parameters v Spatial Object Types

The marine data in EMODnet falls into two categories. Data that is closely related to how it was observed and data that is closely related to how it was processed. Taking as an example ocean temperature the structure of the dataset will vary depending on the data collection technique; ocean buoy, ship, CTD or satellite. The same data may also be processed to generate climates or exceedances.

We are fortunate that inspire 'built in' extensive support for coverage data types so there is no data type that EMODnet would require that INSPIRE does not support. The key challenge is that a given community may view their data as a coherent set, whilst the other may not.

The INSPIRE Generic Conceptual Model has a common approach for handling coverages that typically arise from an observation process. This means that no matter what parameter, it can be described by a spatial object that is consistent across all INSPIRE themes

Matching inspire theme to EMODnet topic

The table below provides an overview of how the Emodnet topics match to the Inspire themes. As can be seen, for some topics there is a clear 1:1 mapping between the two however for topics such as 'human activities' several Inspire themes are relevant. This is because 'human activities' can encompass a vast range of parameters and spatial objects. Whilst this may be convenient from a 'marine data' perspective, it hides all many of complexities from an interoperability perspective. This could be made simpler if 'human activities' were to be considered under a single 'sea use' model - i.e. the existing inspire Land Use model, but applied to the marine domain. Ultimately it comes down to what is relevant to be modelled as 'human activities'.

Table 4. Draft mapping of INSPIRE themes to EMODnet themes

EMODNET Topic	Inspire Cluster	Inspire Theme in relation to the portal products	Notes
Physics	Metocean	[OF] Ocean geographical Features, [EF] Environmental Monitoring Facilities, [AC&MF] Atmospheric Conditions and Meteorological Geographical Features	https://themes.jrc.ec.europa.eu/discussion/view/35152/ef-om-and-results-data-in-other-themes
Chemistry	Metocean	[OF] Ocean Geographical Features [EF] Environmental Monitoring	https://themes.jrc.ec.europa.eu/discussion/view/35152/

EMODNET Topic	Inspire Cluster	Inspire Theme in relation to the portal products	Notes
		Facilities, [AC&MF] Atmospheric Conditions and Meteorological Geographical Features	ef-om-and-results-data-in-other-themes
Bathymetry	Elevation, Orthoimagery and grids	[EL] Elevation, [SR] Sea Regions,	
Geology	Earth Science	[GE] Geology	
Seabed Habitats	Biodiversity and Area Management	[HB] Habitats and biotopes, [PS] Protected sites, [BR] Bio-geographical regions [SR] Sea regions	
Biology	Biodiversity and Area Management	[SD] Species distribution	
Human Activities	Topographic and Cadastral Reference Facilities, utilities and public services	Utility and Governmental Services Production and Industrial Facilities Agricultural and Aquaculture Facilities Administrative Units [HY] Hydrography [TN] Transport networks	

Suggested Actions

- *Taking the above draft conceptual mapping and the work of the Inspire Marine pilot as a starting, EMODnet and the INSPIRE communities should establish a work programme to undertake detailed mapping of their current data models to INSPIRE-compliant data models.*

4.5 Technical interoperability

Concerning technical interoperability, INSPIRE has identified a number of components that support the so-called “Publish – Find – Bind” (PFB) pattern. The owner of a data set publishes the data (using the metadata, discovery, view and download service components of INSPIRE), and a user should be able to find a data set or service (using the INSPIRE geoportal and registry components of INSPIRE),

and “bind” the data set or service in his or her application, which can be anything from a web application to a desktop GIS.

These functions of discovery, view, transformation and download The INSPIRE network services builds on the Open Geospatial Consortium (OGC) and ISO/TC 211 standards for this purpose.

The table below illustrates the relation between the different INSPIRE components and the different levels of interoperability defined in the EIF.

Table 5. INSPIRE technical components vs. IES levels of interoperability

INSPIRE component	EIF levels of interoperability covered
Metadata	Semantic, technical
Network services for discovery, view, download, transformation, and invoke	Technical
Spatial Data Services	Technical
Harmonization and interoperability of spatial data	Semantic
INSPIRE geoportal	Semantic, technical
Registries	Semantic, technical

Suggested Actions:

- *EMODnet and INSPIRE to collaborate on establishing best-practice INSPIRE-compliant download services for marine data. This could build on the work of the INSPIRE Marine Pilot and consider at a minimum both the WFS profile of the INSPIRE download service, and WCS (for which an INSPIRE download service profile is being developed).*

5. Conclusions and next steps

The European Interoperability Framework (EIF) has broad aims to improve the efficiency and effectiveness of European institutions in the digital age through improved access and use of data. Geospatial data is one key component of this that will be an integral part of the information mix. Through INSPIRE the EC has implemented a legal framework for the standardised supply of geospatial that applies to public bodies; this includes the data services of the EC itself. Through EMODnet the EC has implemented a process for the collation and harmonisation of marine data

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collated by EU public bodies. To ensure consistency with the the EIF both EMODnet and Inspire need to be aligned.

- Legal – Some data are provided by public authorities who need to meet the requirements of the INSPIRE Directive.
- Organisational - EMODnet has a key opportunity in supporting the EIF through the provision of marine data services. How these services operate in conjunction with the requirements of Member States to deliver services is an important decision point that will to some extent set the scene for the next steps in Inspire : EMODnet collaboration. INSPIRE has established an infrastructure for community engagement such as the Thematic Clusters that could play a key role in supporting whatever direction is taken.
- Semantic - There is already a large degree of semantic interoperability between EMODnet and INSPIRE. The object types used by EMODnet are consistent with those used in INSPIRE. The data description in EMODnet was developed to meet the specific standards developed over the years by recognized holders of marine data together with the users.. More work needs to be done to determine whether adoption of INSPIRE standards as they are at present would result in a user-friendly system or whether it would add costs or unnecessary complexity to the present system or whether the INSPIRE Standards need to be modified. This would not create any burden to existing users since if they are not being used by the EMODnet community they are not being used by anyone in the marine world.
- Mapping and transformation of these to INSPIRE objects is a significant piece of work, but not a difficult piece of work. It could not be done wholly as EMODnet 'business as usual' but could be done if 'business as usual' was augmented with dedicated project effort to support the transformation. The organisational and technical framework to deliver this has been established by INSPIRE and hence the focus of this task is implementation rather than invention. A similar exercise was undertaken in the context of realising the Inspire Marine Pilot that could be used as template for this work. In this context the INSPIRE JRC played an important advisory and support role to the data providers.
- Technical - There is already a large degree of technical interoperability between EMODnet and INSPIRE. Both mandate and implement the same 'technology stack'. The key issue with technology lies in the adoption of INSPIRE-compliant data download services by EMODnet, however this is also an issue with INSPIRE compliance in member states outside of EMODnet. The opportunity is therefore of EMODnet to take a lead delivering best practice in this respect. This again can be delivered as a specific project to augment EMODnet business as usual

In the context of EIF, both EMODnet and INSPIRE play a key role. Ultimately however the success of their roles will be measured in how invisible they become in the larger information landscape of EIF. The future is for marine data to be used seamlessly by all communities who need it and not exclusively marine users. This can include Smart Cities, Financial Trading and Investment, Insurance, Leisure and Public Awareness. All of these should consume data without inherent knowledge of either EMODnet or INSPIRE.

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What can be achieved by EMODnet and INSPIRE collaboration in this way is an exemplar as to how EC initiatives can and should work together towards a common and bigger policy aim.

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