Ocean Data Interoperability Platform

Deliverable D3.1: Definition of Prototypes 1

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Contents

1   Executive Summary

The 1st ODIP Workshop took place on 25th to 28th February 2013 at the IODE Programme Office in Ostend, Belgium. More than 40 people from the three regions (Europe, USA and Australia) and representatives from IODE participated in both the plenary and break-out sessions. The workshop focused on the on the six topics that were prioritized by partners following the ODIP kick-off meeting which was held on 20 November 2012 in London, UK.

The minutes of the first workshop (Deliverable D2.2) includes an extended list of proposed actions that resulted from the discussions during the workshop. Many of these actions will now be addressed through the development of a number of ODIP prototype interoperability solutions.

This deliverable outlines a first set of proposed ODIP prototype development projects:

- ODIP 1: Establishing interoperability between SeaDataNet CDI, US NODC, and IMOS MCP data discovery and access services including making use of brokerage services for interacting with the IODE-ODP and GEOSS portals

- ODIP 2: Establishing interoperability between cruise summary reporting systems in Europe, the USA and Australia including making use of GeoNetWork for interacting with the POGO portal

- ODIP 3: Establishing a Sensor Observation Service (SOS) prototype for selected sensors (SWE) installed on vessels and in real-time monitoring systems

To underpin the proposed prototype development the following approach has been adopted. It has been assumed that each ODIP prototype development project will incorporate a number of the actions identified and documented as part of the outcomes from the 1st ODIP workshop. Some of these actions may also be addressed in more than one of ODIP prototypes where appropriate.

The development of these ODIP prototypes will be a joint activity between the consortium partners in cooperation with and leveraging on the activities underway in the related regional projects and initiatives such as SeaDataNet (EU), IMOS (Australia), and R2R (USA). By developing this collaborative approach to the development activities, ODIP will provide a communication and exchange platform where partners can interact and align their development activities. This will ensure that results of these activities lead to the development of components that are fit for supporting and building the ODIP prototypes.

This deliverable outlines each of the three proposed prototype projects, indicates which actions identified during the 1st ODIP workshop will be addressed within each prototype project and the regional projects and initiatives that will contribute to the individual development activities. This document also provides an outline plan for the development and implementation of the three ODIP prototype projects.

Each prototype project will include ODIP partners from the three regions involved in the project and make use of their participation in relevant ongoing regional projects and initiatives. The major challenge for the prototype development projects will be balancing the requirements of the existing individual regional infrastructures with those of the ODIP project.

Leadership of each of the three ODIP prototype development projects is proposed to be as follows:

- ODIP 1 - to be led by EUROPE via SeaDataNet (MARIS)

- ODIP 2 - to be led by the USA via R2R (LDEO)

- ODIP 3 - to be led by Australia via AODN

2 Introduction

The Ocean Data Interoperability Platform (ODIP) project aims to create an EU-USA-Australia coordination platform with the objective of establishing a common framework for marine data management through the development of interoperability between existing regional marine data management infrastructures. This co-ordination will be demonstrated through the creation of a number of joint EU-USA-Australia prototype solutions which ensure persistent availability and effective sharing of data across scientific domains, organisations and national boundaries. These development activities will also be supported by and include input from the International Oceanographic Data and Information Exchange (IODE).

A total of four joint ODIP Workshops will be held in which project and associate partners will review and compare existing marine data standards in order to identify both commonalities and major differences between them, and propose how to overcome these through the development of interoperability solutions and/or common standards. Following each workshop the results, conclusions and actions will provide direct input into work package 3 (WP3) for the purposes of this prototype development.

The 1st ODIP Workshop took place in Ostend, Belgium, on 25-28 February 2013 with more than 40 attendees from the three regions involved in the ODIP project (Europe, USA and Australia) and also representatives from IODE. This workshop focused on the first six topics that were identified and prioritized after the ODIP kick-off meeting. These topics were:

- Common Vocabularies

- Metadata formats for discovery

- Metadata and data exchange mechanisms

- Data formats

- Observation and Measurements (O&M) metadata formats

- Added value viewing services

The minutes from the first ODIP workshop (Deliverable D2.2) includes an extensive list of potential actions that were compiled during the plenary and break-out sessions at the meeting. This list of actions is also included in this deliverable (see Chapter 2) as they will form the basis for the development and implementation of the ODIP prototype solutions.

Each prototype project will combine a number of the actions with some being included in more than one prototype where appropriate. Each of the selected actions will form components of the prototypes under development.

This deliverable outlines the proposed ODIP prototype solutions that will be developed as individual sub-projects by the project partners and which will also leverage on the activities and expertise of the existing regional infrastructures. This document will also indicate which actions from the list compiled during the 1st ODIP workshop will be included in each of the prototype projects and which regional projects and initiatives will contribute according to the specific interests and activities of each initiative. A plan for the organisation and implementation of the ODIP prototype solution development projects is included in Chapter 5.

3 Workshop outcomes: comprehensive list of actions compiled during the plenary and break-out sessions during the meeting

The minutes of the first workshop (Deliverable D2.2) contain a summary of the observations made for each of the six topics addressed during the meeting. It also includes a full and comprehensive list of potential actions that resulted from the discussions during the plenary and break-out sessions. The summary and extended list of actions is also included in this deliverable because they form a major part of the input for the formulation of the ODIP prototype projects.

3.1 Workshop discussion topics and outcomes

3.2 Summaries

During the plenary and break-out sessions at the workshops a number of general observations were made by the participants for each topic. These were summarised to provide a list of key points that were relevant to the development of the ODIP prototypes projects.

Topic 1: Common vocabularies

- SDN P01 parameter vocabulary consists of concatenated terms, following a conceptual model. The number of concepts could increase considerably, e.g. for water quality and contaminants in biota. There is a need to increase the visibility of the underlying model and make it more accessible. This will make it easier to map to these vocabularies and also submit new entries, including the possibility of using external vocabulary components (e.g. WORMS for marine taxonomy)

- SPARQL endpoints allow simultaneous submission of queries to different vocabularies.

- SDN P25 vocabulary or similar can be formulated to mark-up data products in relation to groups of P01 terms

- NVS 2.0 is important for multiple use operations worldwide

- R2R and EUROFLEETS are developing vessel event logging systems

- There is experience of using the SDN vocabularies (NVS 2.0) in GeoNetWork available in the MyOcean project which might be of interest for others

- Controlled vocabularies are also used in sensor web enablement (SWE) e.g. Observations & Measurements and SensorML profiles

Topic 2: Marine metadata formats for discovery

- Metadata profiles: Europe has SeaDataNet CDI; Australia has the Marine Community Profile (MCP); US NODC develops the US NODC metadata profile. All of these profiles are based on the ISO19115 / ISO19139 standards.

- Cruise summary reporting: Europe has SeaDataNet Cruise Summary Reports (CSR); US R2R project has Cruise Summary (CS) and both have significant similarities.

- Europe has the Sextant metadata profile for describing data products which is also based upon the ISO19115 / ISO19139 standards and the NVS 2.0 vocabularies used by the SeaDataNet, MyOcean and EMODNET projects.

Topic 3: Metadata and data exchange mechanisms

- Europe operates SDN CDI data discovery and access service; Australia operates the IMOS service with MCP; US NODC also operates a data discovery service

- Europe has SDN CSR (Cruise Summary Report); US R2R has CS (Cruise Summary); BODC and MARIS together operate the POGO portal which includes Cruise Programmes and CSR

- Linked data services are becoming important

- Authentication services are used for controlling access to data and also for tracking and monitoring data access and use. SeaDataNet uses CAS, but other systems which are also becoming widely used are OpenID and Shibboleth. This is an area of common interest among partners.

Topic 4: Data formats

- There are various NetCDF (CF) formats in use.

- SeaDataNet also makes extensive use of ASCII via the SeaDataNet ODV format.

- A number of partners deliver large aggregated data sets as data products.

- Biology data tend to make use of spreadsheets (note: biology is beyond the scope of ODIP but there is a need to have an awareness of common practices in the wider community).

- Data brokerage services provide possible solutions for achieving interoperability between existing data systems.

Topic 5: Observations & Measurements / SensorML

- Sensor Web Enablement (SWE) offers potential opportunities for streamlining and better documentation of the flow of data between the point of acquisition and the data centres. Applications are in an early stage of development and there is a lot to gain from global cooperation in this area.

- SensorML also allows data quality and calibration information to be encoded.

- Observations & Measurements (O&M) allows additional metadata to be included.

- Sensor Observation Service (SOS) is an OGC component of SWE. It provides possible solutions for streamlining the flow of data between the point of acquisition and the data centres. There are only a few applications currently available and there is a lot of scope for setting practical standards and establishing best practice in this area.

Topic 6: Existing implementations of standards and protocols

- There are various software tools available for visualisation and analysis of data sets, for example Ocean Data Viewer (ODV) used in SeaDataNet and the Integrated Data Viewer (IDV) used by UNIDATA. There are also Eclipse RCP, service chains and MATLAB which are used by some partners.

- Data brokering services are also showing potential but might have scalability problems.

- Volumes of data are increasing creating big data issues which need to be considered.

- Mobile platforms such as smart phones are increasingly used to access data and information services.

3.3   Extended list of actions

The discussions during the plenary and break-out sessions resulted in an extensive list of actions which are to be considered for inclusion in the development of the ODIP prototypes. The actions are also categorized by topic:

Topic 1: Common vocabularies

Action 1.1: Implementation of SPARQL technology and mapping between vocabularies using SKOS

- Establish further SPARQL end-points for the exposure of controlled vocabularies.

- Organise these end-points into a federated network.

- Build user-friendly tools to query this federated network.

- Set up a pilot portal with mappings to demonstrate the use of SPARQL

Action 1.2: Establishing thesaurus-based semantic aggregation of data marked up using the BODC/SeaDataNet parameter usage vocabulary (P01)

- Develop a well-governed controlled vocabulary of terms for aggregated data products, with particular reference to EMODnet mapped to P01. (Similar idea to P25 developed for NETMAR)

- Look for other applications of this approach across the ODIP community

Action 1.3: Formally document the NERC vocabulary server governance structure

- Prepare documentation for content management and governance, including tracking history

- Refer to the ISO19135 model for governance

Action 1.4: Harmonization of the conceptual models and controlled vocabularies used for event logging on research vessels with particular reference to Eurofleets and R2R

- Compare and harmonize conceptual models

- Harmonize controlled vocabularies used for events

- Establish a governance structure for these controlled vocabularies

Action 1.5: Develop a unified approach to the utilisation of controlled vocabularies under NERC Vocabulary Server governance in GeoNetWork

Action 1.6: Develop a unified approach to the utilisation of controlled vocabularies under NERC Vocabulary Server governance in other metadata standards such as O&M and SensorML

Topic 2: Marine metadata formats for discovery

Action 2.1: Analyze interoperability between the SDN Common Data Index (CDI), Australia Marine Community Profile (MCP) and the US NODC metadata profiles

- Compare formats

- Compare use of vocabularies

- Analyse possible mappings of formats and vocabularies

- Analyze potential interoperability options

Action 2.2: Analyze interoperability between SDN Cruise Summary Report (CSR) and the US R2R Cruise Summary (CS):

- Compare formats

- Compare use of vocabularies

- Include analysis of the relationship with the EuroFleets SSR (Ship Summary Reports)

- Analyse possible mappings of formats and vocabularies

- Analyze potential interoperability options

Action 2.3: Formally document Sextant catalogue service and metadata profile

- Prepare documentation for the Sextant catalogue, including metadata profile, use of controlled vocabularies and governance

- Identify potential interest in USA and Australia for joint activities

- Analyze potential interoperability options

Topic 3: Metadata and data exchange mechanisms

Action 3.1: Facilitating semantic interoperability by enabling wider adoption of the BODC/SeaDataNet Parameter Usage Vocabulary (P01) by:

- Exposure and utilisation of the underlying semantic model

- Design and deployment of subsets through concept scheme thesauri

- Development of code selection tools incorporating transparent, automated vocabulary extensions

- User empowerment through education

Action 3.2: Establishing interoperability between SDN, IMOS and US NODC data discovery and access services (initially at metadata level only)

- Analysing interoperability at metadata level taking into consideration formats and controlled vocabularies

- Take into account the actions from Topics 1 and 2

- Assess the options for adopting common approaches

- Include potential interoperability with the Ocean Data Portal (ODP)

- Evaluate possible alternative solution using the EuroGEOSS brokerage service which allows for harmonising three different inputs into a single common output

Action 3.3: Establishing interoperability between cruise summary reporting systems in Europe, the USA and Australia (supporting the POGO initiative)

- Analyse interoperability at the metadata level, considering formats and controlled vocabularies

- Taking into account actions from Topics 1 and 2

- Possible setting up of GeoNetWork instances in Europe, the USA and Australia for harvesting and exchanging cruise summary reports between regions, supporting global coverage of POGO portal

- Include URLs from CSR to data

Action 3.4: Authentication services: exploring use of OpenID and Shibboleth, their mutual interoperability and also with CAS

- Bring together best practice documentation on CAS, OpenID and Shibboleth

- Use experience from the EU GENESI-DEC project

- Analyze possible bridges between the various systems

- Analyse support of authentication systems in GeoNetWork

Action 3.5: Linked data: sharing lessons learnt from R2R (using DERI approach) by documenting best practices and experiences, and development of a joint pilot for linked data services.

Action 3.6: Share experience with the SCOR/MBL-WHOI/BODC/IODE joint project on data publication and its published cookbook

Topic 4: Data formats

Action 4.1: Compare different versions of NetCDF (CF) and establish a common format (point, profile, trajectory, grids (bathymetry), etc.)

> Note: SDN ODV ASCII format might also be interesting for US and Australia

Action 4.2: Establish NetCDF (CF) format for glider data sets (note that comparison between existing glider formats is available

Action 4.3: Defining an optimum format for delivery of large aggregated data sets both as collections and grids

Topic 5: Observations & Measurements / SensorML

Action 5.1: Defining SensorML profiles for selected instruments including controlled vocabularies, and in cooperation with equipment manufacturers

- Prepare a shortlist of instruments

- Make use of experience and contacts with industry available within the project consortium

- Define a number of SensorML profiles

- Use these profiles in a prototype interoperability solution

Action 5.2: Defining SensorML profiles for data quality and calibration

- Make use of experience of OGC Spatial Data Quality working group

- Extend instrument SensorML profiles from Action 5.1

- Use these extended profiles in a prototype interoperability solution

Action 5.3: Definition of O&M profiles for selected data types supported by controlled vocabularies including considerations related to ease of population

- Prepare shortlist of data types

- Make use of EU experience with using O&M and SensorML from the Geo-Seas project for seismic data and EuroFleets for instruments on board research vessels

- Define a number of O&M profiles

- Use these profiles in a prototype interoperability solution

Action 5.4: Analysis and further development of SOS services for vessels and real-time monitoring systems (SWE)

- Include actions 5.1, 5.2, 5.3 and 5.4 in the development of a single prototype solution

- Document learning experiences to inform future development activities in this area

- Promote industry engagement

- Possible prototypes:

    - Glider management

    - Bathymetry and/or seismic data

Topic 6: Existing implementations of standards and protocols

Action 6.1: Prepare overview of visualisation and analysis software in use and compare features, learning from each other and sharing

- Make an inventory of existing visualisation tools and services

- Compare the functionality of the available software

Action 6.2: Exploring operation and scalability of data brokerage services (e.g. ESSI-Lab GI-axe)

- Evaluate reporting on data brokerage service and its scalability as tested in GEOSS (CNR)

- Exploration of WPS service chains

Action 6.3: Share experiences on different data servers (such as THREDDS) and provide community feedback for future developments

- Gather an inventory of community data models

- Compare features

Action 6.4:   Share experiences to identify and formulate future joint developments in the area of big data

- Prepare a list / matrix of data types that might fall under the heading of 'big data'

- Share outcomes of the forthcoming conference 'Big Data From Space' being held at ESA in Frascati, Italy on 5 – 7 June 2013

- Assess current best practice in the area of big data

4 Regional projects and initiatives: potential areas of interest in the actions identified during the 1st ODIP workshop

The activities which will address the actions identified during the ODIP workshops will be carried out in partnership with existing regional infrastructure projects and initiatives, for example SeaDataNet (EU), IMOS (Australia), and R2R (USA). These initiatives are stakeholders in ODIP and many of the project partners are also involved with the development and management of these existing regional marine data management infrastructures. ODIP will provide a communication and exchange platform where partners can meet, discuss and align their development activities. It will also ensure that the results of these activities provide suitable input for building the ODIP prototype interoperability solutions.

In order to identify the potential synergies between ODIP and the regional infrastructure initiatives, the extended list of actions from the first ODIP workshop has been circulated to all project partners in the form of a Microsoft PowerPoint presentation. The document included a matrix containing the actions for each topic against which each ongoing project in EU, USA and Australia could indicate an interest. This matrix has been completed by all ODIP partners and is summarized in Table 1 below.

The following ongoing regional projects and initiatives have been included in the compilation of the matrix:

EUROPE:

- **SeaDataNet 2**: EU supported project providing a pan-European infrastructure for ocean and marine data management

- **Eurofleets 2**: EU supported project for the innovation and coordination of the European research fleet

- **JERICO**: EU supported project providing the Joint European Research Infrastructure network for Coastal Observatories

- **EMODnet**: EU initiative established within the remit of the EU Marine Strategy Framework Directive (MSFD) for a European Marine Observation and Data Network

- **MyOcean**: EU COPERNICUS Marine Core Service aiming to deploy a pan-European resource for ocean monitoring and forecasting.

USA

- **R2R**: NSF funded Rolling Deck to Repository program responsible for comprehensive fleet-wide management of underway data for the U.S. academic research fleet. The R2R partners are Lamont-Doherty Earth Observatory at the University of Columbia, Scripps Institution of Oceanography, Woods Hole Oceanographic Institute and Florida State University

- **US NODC**: the US National Oceanographic Data Centre is one of the national environmental data centres operated by NOAA.

- **IOOS**: NOAA led development and implementation of the US Integrated Ocean Observing System

- **UNIDATA**: provides an extensive set of services and tools for earth science such as the UNIDATA THREDDS Data Server (TDS) and the NetCDF (CF) data format.

AUSTRALIA

- **IMOS**: Australian Government funded Integrated Marine Observing System project, led by the University of Tasmania

- **AODN:** Australian Ocean Data Network funded by the Australian Government with participation by University of Tasmania, CSIRO, AIMS, Geoscience Australia, AADC, RAN and BoM

These initiatives, projects and organisations are all represented in ODIP by one or more partners. Table 1 below summarizes the responses from the various organisations, initiatives and projects represented in the ODIP consortium.

Table 1 Partner interests in the individual actions identified during the 1st ODIP workshop
(U1 = LDEO; U2 = SIO; U3 = WHOI; U4 = FSU; A1 = UTAS; A2 = CSIRO; A3 = AIMS; A4 = GA)

ACTION	EUROPE					USA				AUSTRALIA	
	SeaDataNet	Eurofleets	JERICO	EMODNet	MyOcean	US NODC	UNIDATA	R2R	IOOS	IMOS	AODN
Topic 1: Vocabularies											
1.1: Implementation of SPARQL technology and mappings between vocabularies (SKOS)	E	E				U		U1,2,3,4	U	A1	A2
1.2: Establishing thesaurus-based semantic aggregation of data marked up using the SeaDataNet Parameter Usage Vocabulary (P01).	E			E						A1	
1.3: Formally document vocabulary governance for the NERC vocabulary server	E										A2
1.4: Harmonization of conceptual models and controlled vocabularies used for RV event logging with particular reference to Eurofleets and R2R		E						U3			A2
1.5: Develop unified approach to	E							U1		A1	A2,3

use of controlled vocabularies under NERC vocabulary server governance in GeoNetWork											
1.6: Develop unified approach to use of controlled vocabularies under NERC vocabulary server governance in other metadata standards such as O&M and SensorML	E	E	E			U			U		A2,3
Topic 2: Marine metadata formats for discovery											
2.1: Analyze potential interoperability between SDN Common Data Index (CDI), Australian Marine Community Profile (MCP) and US NODC metadata profile	E					U			U	A1	A3,4
2.2: Analyze potential interoperability between SDN Cruise Summary Report (CSR) and US R2R Cruise Summary (CS)	E	E						U1,2			A2
2.3: Formally document Sextant catalogue service and metadata profile	E			E	E					A1?	

Topic 3: Metadata and data exchange mechanisms											
3.1: Facilitating semantic interoperability by enabling wider adoption of the SeaDataNet Parameter Usage Vocabulary (P01)	E			E	E					A1	A2
3.2: Establishing interoperability between SDN, IMOS and US NODC data discovery and access services (metadata level)	E					U				A1	
3.3: Establishing interoperability between Cruise Summary reporting systems in Europe, US and Australia (also on behalf of POGO)	E	E						U1,2			A2
3.4: Exploring use of OpenID and Shibboleth, their mutual interoperability and also interoperability with CAS	E			E						A1	
3.5: Learning from R2R (using DERI) by documenting best practices and experiences, and		E						U1,4		A1	A2

by developing a joint pilot for linked data services											
3.6: Share experience with the SCOR/MBL WHOI/BODC/IODE Joint Project on data publication and its published cookbook	E					U				A1	
Topic 4: Data formats											
4.1: Comparing different versions of NetCDF (CF) and establishing a common format (point, profile, trajectory, grids (bathymetry), etc.)	E	E	E	E	E	U	U	U4	U	A1	
4.2: Establishing NetCDF (CF) format for glider data sets	E		E		E	U	U		U	A1	A2
4.3: Defining an optimum format for delivery of large aggregated data sets as collections and grids	E				E	U				A1	A2

U1 = LDEO; U2 = SIO; U3 = WHOI; U4 = FSU; A1 = UTAS; A2 = CSIRO; A3 = AIMS; A4 = GA

Topic 5: Observations & Measurements / SensorML											
5.1: Defining SensorML profiles for selected instruments, supported by controlled vocabularies, also in cooperation with manufacturers	E	E	E			U		U1	U	A1	A3
5.2: Defining SensorML profiles for quality and calibration,	E	E	E			U			U	A1	A2,3
5.3: Defining O&M profiles for selected data types, supported by controlled vocabularies, also taking into consideration ease of population	E	E	E						U		A2
5.4: Analysis and further development of SOS services for vessels and real-time monitoring systems (SWE)	E	E	E			U?			U	A1	A2,3
Topic 6: Existing implementations of standards and protocols											
6.1: Prepare overview of visualisation and analysis software in use and compare functionality	E				E		U	U2		A1	A3
6.2: Explore operation and scalability of data brokerage services (e.g. ESSI-Lab GI-axe)	E			E			U				

6.3: Share experiences on different data servers (such as THREDDS) and provide community feedback for further developments	E				E		U		U	A1	A2
6.4: Share experiences to identify and formulate future joint developments for big data					E	U				A1	A3

U1 = LDEO; U2 = SIO; U3 = WHOI; U4 = FSU; A1 = UTAS; A2 = CSIRO; A3 = AIMS; A4 = GA

5 Proposed ODIP Prototype projects and associated actions

Using the outcomes of the 1st ODIP workshop and taking into consideration current developments and activities in the ocean and marine data management community it has been possible to devise a proposal for the development of three ODIP prototype interoperability solutions. These prototype development projects will each address a significant proportion of the actions identified during the first ODIP workshop.

Each of these projects will also act as a framework for testing the components that will result from the selected actions and associated activities. In addition the proposed prototype projects have been devised in such a way that, rather than leading to the development of an ODIP 'portal' which might compete with other ongoing portal initiatives, they will instead contribute to ongoing global initiatives such as IODE-ODP, GEOSS and POGO. This will also promote the alignment of the regional projects and initiatives with these global initiatives.

The three proposed ODIP prototype projects are:

- **ODIP 1**: Establishing interoperability between SeaDataNet CDI, US NODC, and IMOS MCP data discovery and access services including making use of a brokerage service to facilitate interaction with the IODE-ODP and GEOSS portals

- **ODIP 2**: Establishing interoperability between the cruise summary reporting systems in Europe, the USA and Australia, including making use of GeoNetWork to establish connectivity with the POGO portal

- **ODIP 3**: Establishing a prototype for a Sensor Observation Service (SOS) for selected sensors (SWE) installed on vessels and in real-time monitoring systems

5.1   ODIP 1

Europe, USA and Australia each operate and manage their own regional data discovery and access service which include their own metadata formats, vocabularies, access control, data formats and data policies. Each of these services has been developed to address their

specific regional requirements and independently of other similar projects. However, there is willingness among these regional initiatives to contribute to the global IODE Ocean Data Portal (ODP) and the GEOSS portal initiatives. One potential mechanism to achieve this interoperability is through the use of a brokerage services that can harmonize the regional services to a common level that will then interact with both the IODE - ODP and GEOSS portals. The SeaDataNet project has already had some success in developing interoperability with the ODP and GEOSS portals using the EuroGEOSS brokerage service but to date this has only been implemented at the metadata level.

The ODIP 1 sub-project aims to extend this approach to all three regional data discovery and access services, starting at the metadata level, but also to go beyond metadata to data access, including providing solutions for possible authentication, authorization and administration systems.

This will be achieved by implementing a common brokerage service between the three regional services and the global portals. This approach is preferable to attempting to harmonize the three regional services and the formats, vocabularies and access control systems which are used by each one because there is then little or no need for modification of the existing regional infrastructures.

Further development of the brokerage service concept is planned as part of the collaborative effort between GEOSS and the European partners. These activities will also contribute to the ODIP 1 prototype development activities and as a result the solutions developed will become part of a fully operational system which will be sustainable in the long-term.

5.2   ODIP 2

Activities are currently on-going in Europe, USA and Australia to support the administration of cruises and the associated data acquisition being undertaken by their research vessels, as well as for innovation of the related information systems. In addition all three regions are participating in the Partnership for Observation of the Global Oceans (POGO). As part of POGO a portal (http://www.pogo-oceancruises.org) is maintained which aims to share information on planned, current and past cruises in order to enhance awareness of opportunities and to improve the cost-effectiveness of cruises. This portal has been developed and is managed by NERC-BODC and MARIS in a contract with POGO. European input to the portal is delivered via the SeaDataNet and Eurofleets activities and in partnership with national agencies and organisations. Additional input from the USA and

Australia is collected by NERC-BODC but this requires significant effort due to a lack of a coherent system and as a result there is no steady flow of information into the POGO portal from these regions.

The objective of ODIP 2 is to strengthen the cruise data and information management in each of the three regions by sharing common formats and vocabularies where possible, and to streamline and improve the contributions of the three regions to the POGO portal. A potential solution is to make use of the GeoNetWork CSW service and harvesting mechanism to provide regular input into the common POGO portal from each of the three regional cruise summary reporting systems.

Initially ODIP 2 will only cover the delivery of cruise summary report data for completed cruises but it will also address information about cruise programmes and current cruises at a later stage.

5.3   ODIP 3

OGC provides a family of standards specifications called 'Sensor Web Enablement' (SWE) which includes detailed information about the sensors making measurements and the platforms that carry the sensors. SWE makes use of the Sensor Model Language (SensorML), general models and XML encodings for sensor Observations and Measurements (O&M). It also includes the Sensor Observation Service (SOS) protocol for providing access to observations from sensors and sensor systems in a standard way.

ODIP partners from all three regions have expressed an interest in taking steps towards to adopting SWE and developing the standards that can be applied in operational observation systems to describe their observations in more detail, and to provide standardised access to these observations using the SOS service protocol. Implementation of SWE in the ocean observation networks can potentially provide direct access to data streams from operational sensor systems, such as real-time ocean monitoring networks and underway data from systems onboard research vessels.

ODIP 3 will include defining SensorML profiles for selected instruments and sensors used in monitoring networks, including fixed platforms and gliders, and onboard vessels. The development of these definitions will be conducted in consultation with the sensor manufacturers because their engagement is essential in order to establish industry-wide standards. There are currently only a few applications of SOS available and significant

opportunities therefore exist for ODIP to set practical standards which extend beyond the present applications.

ODIP 3 will also seek to engage with the OGC Interoperability Program (IP) to test, validate and fine-tune the solutions being developed by the project that are based on the OGC standards. This collaboration and alignment with the OGC expert community will also promote the acceptance and adoption of the ODIP standards by the wider community. To facilitate this collaboration ODIP will seek to sponsor an ODIP - OGC Interoperability Project, where ODIP will specify the requirements and definition of a use case and provide draft specifications. OGC will then make requests inside the OpenGIS Consortium for participation. The key outcome of this activity would be an Interoperability Program Report with a set of validated OGC specifications for application within the ODIP environment.

5.4   Actions relevant to each of the ODIP prototype projects

An analysis has been carried out to identify which ODIP actions are relevant to each of the three proposed ODIP prototype projects. Table 2 below gives an overview of this analysis and clearly shows that the majority of actions identified by partners during the 1st ODIP workshop will be addressed by one or more of the prototype development activities. This also demonstrates that the individual prototype projects provide a framework for developing, deploying and testing all of the components which will be developed by the ODIP project activities.

Table 2 Overview of actions relevant to the individual prototype development projects

ACTION	Prototype project 1	Prototype project 2	Prototype project 3
	Interoperability of regional data discovery and access services aligned with ODP and GEOSS	Interoperability of regional cruise summary reporting services aligned to POGO	Prototype Sensor Observation Service (SOS) for vessels and real-time monitoring systems (SWE)
Topic 1: Vocabularies			
1.1: Implementation of SPARQL technology and mappings between vocabularies (SKOS)	X		
1.2: Establishing thesaurus-based semantic aggregation of data marked up using the SeaDataNet Parameter Usage Vocabulary (P01).	X?		
1.3: Formally document vocabulary governance for the NERC vocabulary server	X	X	
1.4: Harmonization of conceptual models and controlled vocabularies used for RV event logging with particular reference to Eurofleets and R2R		X	
1.5: Develop unified approach to use of controlled vocabularies under NERC vocabulary server governance in GeoNetWork		X	

1.6: Develop unified approach to use of controlled vocabularies under NERC vocabulary server governance in other metadata standards such as O&M and SensorML	X		X
Topic 2: Marine metadata formats for discovery			
2.1: Analyze potential interoperability between SDN Common Data Index (CDI) , Australia Marine Community Profile (MCP)and US NODC metadata profile	X		
2.2: Analyze potential interoperability between SDN Cruise Summary Report (CSR) and US R2R Cruise Summary (CS):		X	
2.3: Formally document Sextant catalogue service and metadata profile			
Topic 3: Metadata and data exchange mechanisms			
3.1: Facilitating semantic interoperability by enabling wider adoption of the SeaDataNet Parameter Usage Vocabulary (P01)	X	X	X
3.2: Establishing interoperability between SDN, IMOS and US NODC data discovery and access services, initially metadata level	X		
3.3: Establishing interoperability between Cruise Summary reporting systems in Europe, US and Australia, also on behalf of POGO		X	
3.4: Exploring use of OpenID and Shibboleth, their mutual interoperability and interoperability with CAS	X		

3.5: Learning from R2R (using DERI) by documenting best practices and experiences, and developing a joint pilot for linked data services		X	
3.6: Share experience with the SCOR/MBL WHOI/BODC/IODE Joint Project on data publication and its published cookbook	X?		
Topic 4: Data formats			
4.1: Comparing different versions of NetCDF (CF) and establishing common format (point, profile, trajectory, grids (bathymetry), etc.)	X		
4.2: Establishing NetCDF (CF) format for glider data sets			X
4.3: Defining an optimum format for delivery of large aggregated data sets as collections and grids	X		
Topic 5: Observations & Measurements / SensorML			
5.1: Defining SensorML profiles for selected instruments, supported by controlled vocabularies, also in cooperation with manufacturers			X
5.2: Defining SensorML profiles for quality and calibration,			X
5.3: Defining O&M profiles for selected data types, supported by controlled vocabularies, taking into consideration ease of population			X
5.4: Analysis and further development of SOS services for vessels and real-time monitoring systems (SWE)			X

Topic 6: Existing implementations of standards and protocols			
6.1: Prepare overview of visualisation and analysis software in use and compare functionality			
6.2: Exploring operation and scalability of data brokerage services (e.g. ESSI-Lab GI-axe)	X		
6.3: Share experiences on different data servers (such as THREDDS) and provide community feedback for further developments			
6.4: Share experiences to identify and formulate future joint developments for big data			

6   Organisation and planning of ODIP prototype projects

By combining the results of the analysis described in chapters 3, 4 and 5 it has been possible to produce a matrix that shows which of the regional projects and initiatives will be involved in and contribute to each of the ODIP prototype development projects. Table 3 below provides an overview of the potential synergy and input from the ongoing regional projects and initiatives into each of the three ODIP prototype projects. The table also includes an indication of the organisations representing the individual regional initiatives in each of the prototype projects.

Table 4 below indicates which ODIP partners will participate in each of the three prototype development projects. The participation by each partner will require that they seek to align their contributions to the ODIP project with their activities in the respective regional infrastructure projects. This will ensure alignment of the ODIP prototype development activities with those of the existing regional infrastructures and also promote synergy between ODIP and the associated regional projects in Europe, USA and Australia as well as with the wider marine data management community.

Each of the three ODIP prototype development projects will be led by partners from one of the three regions participating in the project.

Leadership of each of the three projects will be:

- • ODIP 1 - led by EUROPE via SeaDataNet (MARIS)

- • ODIP 2 - led by USA via R2R (LDEO)

- • ODIP 3 - led by Australia via IMOS (AODN)

6.1   Prototype development project planning

Using the tables below a subgroup of project partners has been identified which will participate in each ODIP prototype project and be responsible for the development of a specific ODIP prototype solution.

Initially each of these subgroups will prepare a concise plan for the implementation of their respective ODIP prototype development projects taking into account the relevant actions from the 1st ODIP workshop and also the activities and expertise from the associated regional projects and initiatives as identified in the tables included in this deliverable.

Each plan will specify the project aims and approach in more detail, including its possible interaction with the global initiatives such as IODE-ODP, GEOSS and POGO where relevant. Each prototype development plan will also include an assessment of the feasibility of the proposed development activities.

These prototype development project plans will then be reviewed by the ODIP Steering Committee and any adjustments made as necessary. The individual development projects will then move into the implementation phase following approval by the Steering Committee.

The plans, progress reports and results from each ODIP prototype development project will form a major part of the agenda of subsequent ODIP workshops and will provide all ODIP partners with a chance to comment and contribute to the ongoing development activities.

The next ODIP workshop is planned for 3 - 6 December 2013 at Scripps Institution of Oceanography, USA and this will focus on presenting and discussing the progress of the three ODIP prototype development projects described in this document[1].

The ODIP workshops will also provide the sub-groups participating in each of the prototype development projects with an opportunity for face-to-face working as much of the development work will otherwise be conducted remotely due to the geographical spread of the ODIP project partners.

ODIP is also supporting communication between the project partners participating in the prototype development projects by:

- providing a collaboration platform on the ODIP website with threads for the selected ODIP prototypes using the COLLA collaborative tool developed by OGS.

- actively seeking additional opportunities for ODIP participants to meet where a number of the partners are already attending scheduled events such as conferences or other workshops e.g. EGU, AGU etc.

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[1] Also included in the agenda are additional discussion topics identified by the ODIP partners that will contribute the development of further prototype development projects that form part of deliverable D3.3 *Definition of prototypes 2*.

Table 3 Planned input to prototype projects by existing regional initiatives

INITIATIVE/PROJECT/ORGANISATION	Prototype project 1 Interoperability of regional data discovery and access services towards ODP and GEOSS	Prototype project 2 Interoperability of regional cruise summary reporting services towards POGO	Prototype project 3 prototype for a Sensor Observation Service (SOS) for vessels and real-time monitoring systems (SWE)
EUROPE			
SeaDataNet	E	E	E
Eurofleets	E	E	E
JERICO	E		E
EMODNet	E		(E)
MyOcean	E		E
(GROOM)			E
USA			
US NODC	U		U
R2R	U1,2,3,4	U1,2,3,4	U1

IOOS	U		U
UNIDATA	U	U	U
AUSTRALIA			
IMOS	A1		A1
AODN	A2,3,4	A1,2,3	A1,2,3

E = European ODIP partners; U1 = LDEO; U2 = SIO; U3 = WHOI; U4 = FSU; A1 = UTAS; A2 = CSIRO; A3 = AIMS; A4 = GA

Table 4 Prototype project contributions and alignment with global initiatives

GLOBAL			
IODE-ODP	X		
GEOSS	X		
POGO		X	

Table 5 gives a detailed overview of participation by the ODIP partners in the various regional projects and initiatives which provides the links and synergy between the three ODIP prototype development projects and these associated regional infrastructures.

Table 5 Partner involvement in regional initiatives

INITIATIVE/ PROJECT/ ORGANISATION	EUROPE											USA							AUSTRALIA					
	NERC	MARIS	OGS	IFREMER	HCMR	ENEA	Ulg	CNR	RBINS	TNO	CSIC	US-NODC	LDEO	SIO	WHOI	FSU	UNIDATA	IOOS	UTAS	CSIRO	AIMS	GA	AADC	RAN
EUROPE																								
SeaDataNet	Xa"Xb	X	X	X	X	X	X	X	X	X"	X													
Eurofleets	Xb	X	X	X	X			X	X		X													
JERICO	Xb	X	X	X	X			X	X		X													
EMODNet	Xa,b	X	X	X	X	X	X	X	X	X	X													
MyOcean	Xb		X	X	X	X		X	X		X													
(GROOM)	Xb		X	X	X						X								(X)					
USA																								

US NODC										X																	
R2R											X	X	X	X													
IOOS															X												
UNIDATA														X													
AUSTRALIA																											
IMOS															X												
AODN																	X	X	X	X	X	X					

Xa = NERC-BGS; Xb = NERC-BODC; X1 = LDEO; X2 = SIO; X3 = WHOI; X4 = FSU

Note 1: CSIC has been added to the European group of partners because CSIC plays a leading role in SWE developments for the SeaDataNet and Eurofleets projects.

Note 2: NERC-BGS and TNO are also contributing to SeaDataNet through the Geo-Seas project

Note 3: GROOM has been added as an EU project because it has a focus on developing a standard data management system for gliders. This is also potentially now being adopted as the global standard. SWE developments in the ODIP 3 Prototype project can contribute to this development

Annex A   Figures and Tables

Appendix B   Terminology

Term	Definition
CDI	Common Data Index metadata schema and catalogue developed by the SeaDataNet project
CAS	Central Authentication Service: a single sign-on protocol for the web
CSR	Cruise Summary Reports is a directory of research cruises
DERI	Digital Enterprise Research Institute: a research institute at the National University of Ireland, Galway focusing on research into the semantic web and linked data
Eclipse RCP	Eclipse Rich Client Platform for developing general purpose applications including visualisation tools and services
GeoNetwork	An open source catalogue application for managing spatially referenced resources. It provides a metadata editing tool and search functions as well as providing embedded interactive web map viewer
IDV	Java-based software framework for analyzing and visualizing geoscience data.

IMOS	Integrated Marine Observing System: Australian monitoring system; providing open access to marine research data
ODP	Ocean Data Portal: data discovery and access service, part of the IODE network
IOC	Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO).
IODE	International Oceanographic Data and Information Exchange (part of IOC)
ODV	Ocean Data View (ODV) data-analysis and visualisation software tool.
O&M	Observations and Measurements: OGC standard defining XML schemas for observations, and for features involved in sampling when making observations
OGC	Open Geospatial Consortium: an international industry consortium to develop community adopted standards to "geo-enable" the web
OpenID	An open standard that allows users to be authenticated by certain co-operating sites (known as Relying Parties or RP) using a third party service
POGO	Partnership for Observation of the Global Oceans: forum for leaders of major oceanographic institutions around the world to promote global oceanography, particularly the implementation of international and integrated global ocean observing systems
SensorML	OGC standard providing models and an XML encoding for describing sensors and process lineage
Sextant	catalogue of geo-referenced data which is based on the standards of the Open Geospatial Consortium (OGC) and ISO TC211 standards

SDN	SeaDataNet: EU-funded pan-European e-infrastructure for the management and delivery of marine and oceanographic data
Shibboleth	A 'single-sign in' or logging-in system for computer networks and the Internet. It allows people to sign in, using just one 'identity', to various systems run by 'federations' of different organizations or institutions
SKOS	Simple Knowledge Organization System: a common data model for sharing and linking knowledge organization systems via the Web
SOS	Sensor Observation Service: a web service to query real-time sensor data and sensor data time series. Part of the Sensor Web
SPARQL	a query language for databases, able to retrieve and manipulate data stored in a Resource Description Framework (RDF) format
SWE	Sensor Web Enablement: OGC standards enabling developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and useable via the web
R2R	Rolling Deck to Repository: a US project responsible for the cataloguing and delivery of data acquired by the US research fleet.
WPS	Web processing service