

Marine ALSF GIS

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Data resource interoperability evaluation

**Marine Environment Protection Research
MEPF 04/07
Marine ALSF Offshore Geographical
Information System (Marine ALSF GIS)**



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Data resource interoperability evaluation

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1 Introduction

1.1 Background

In September 2004 Defra awarded the MEPEF 04/07 Offshore GIS project¹ to a team comprising of ABP Marine Environmental Research Ltd and GeoData Institute. The purpose of the project is to ensure that marine aggregate research provides maximum benefit and addresses policy needs through an improvement in 'knowledge management'. The project will provide a web-based facility to hold a live register of research studies structured as a spatial metadatabase and, where available, supply direct links to research outputs. A fuller description of the proposed developments of the Marine ALSF GIS programme is set out in the User Requirement Specification and the Technical Specification.

The initial proposal for the development of the Marine ALSF GIS required the evaluation of the potential to link to other marine data resource sites. The word 'link' may imply a range of levels of interaction and integration; from merely adding a simple website link to similar databases through to fuller integration (real-time data feed).

We are aware of the other marine information systems (e.g. MarLIN, JNCC, UKOOA), although no formal review of their scope and technological solutions has been undertaken. Nevertheless, the proposed development of the Marine ALSF GIS includes, within its specification, the appreciation of these other marine info systems. A greater understanding of the range of facilities, resources and their value to the marine aggregate research community is required to reduce duplication of effort and to ensure compatibility and improved knowledge base and knowledge finding.

1.2 Justification for interoperability enhancement

The principle of the Marine ALSF GIS project is to enable users to find data on relevant research and surveys within the marine sector through text and spatial searches. In order to be most effective this implies that these searches should allow users to find information wherever it is physically located.

If the Marine ALSF GIS is developed in isolation then the interoperability and search will be limited to the project metadata server. The principle of extending this through 'links' is to ensure that the Marine ALSF GIS user gains access to a wider range of resources through access to a wider community of metadata and data. There are clearly limitations to be established - in defining both the technical and semantic interoperability within the marine aggregate sector.

Linking to these other relevant data and metadata resource systems have differing cost implications, from nil to a considerable additional expenditure and time commitment. There clearly needs to be a firm justification for adding a data and information portal to the Marine ALSF GIS programme. Evaluation of the scope of and business case for development is needed; to generate a specification and costing for the delivery and to establish the implications on the Marine ALSF GIS use if the development is not recommended or supported.

¹ Marine ALSF GIS (<http://www.marinealsf.org>)

These options reflect on the overall objective of the Marine ALSF GIS programme ultimately to the delivery of a useful product, as well as in future-proofing the development and integrating it as part of the wider community of marine information systems.

The implementation of the Marine ALSF GIS will conform to relevant ISO/TC211² and Open Geographic Consortium (OGC)³ specifications. Interoperability is a founding principle upon which these specifications are built. It is therefore logical to conceive of the Marine ALSF GIS as contributing to an overarching framework of information resources for the marine sector. Closer links with the UK Marine Data Gateway and similar projects would be valuable in properly positioning the Marine ALSF GIS, such that it becomes an important contribution to, and integrates effectively with, other systems. This would position the Marine ALSF GIS within the larger spatial data infrastructure arena to be compatible with the INSPIRE⁴ directive and Global Spatial Data Infrastructure (GSDI)⁵ initiatives.

1.3 Document structure

This document focuses on scope for the linkages with other marine sector data and metadata management services.

- Examines the projects and data repositories that are relevant to the evaluation, examining their offerings and approaches
- Studies the technical issues in implementing interoperability
- Results of discussions with data / metadata providers
- Recommendations for the development of links with other marine sector resources

2 Linking

2.1 What data are we linking with?

The scope of the Marine ALSF GIS is to assist in locating resources on research projects that may be of relevance to the marine aggregate sector. Within the development of the Marine ALSF GIS there is a limit to the coverage and scope of those resources that can be added to the system. Although it is intended that the system be populated by the sector itself, after initial population of the database within the scope for the project there are still a wide range of sources that are relevant that 1) may fall outside the scope of the project yet still be relevant to the sector, 2) where metadata records have already been entered by other organisations, 3) where associated sites hold raw or processed data.

The GIS element of the Marine ALSF GIS is underpinned by the ability to use geographic information through a web interface to search for research surveys and as a basis for displaying the geographic

² ISO/TC211 (<http://www.isotc211.org>)

ISO/TC 211 Geographic information/Geomatics is responsible for the ISO geographic information series of standards.

³ OGC (<http://www.opengeospatial.org>)

The Open Geospatial Consortium, Inc. (OGC) is a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services.

⁴ INSPIRE (<http://www.ec-gis.org/inspire/home.html>)

The Infrastructure for SPatial InfoRmation in Europe initiative (INSPIRE) aims at making available relevant, harmonised and quality geographic information for the purpose of formulation, implementation, monitoring and evaluation of Community policy-making.

⁵ GSDI (<http://www.gsdi.org>)

The purpose of the Global Spatial Data Infrastructure association (GSDI) is to promote international cooperation and collaboration in support of local, national and international spatial data infrastructure developments that will allow nations to better address social, economic, and environmental issues of pressing importance.

coverage of textual searches. The choices made within the user requirements specification will determine the metadata and datasets with which it would be relevant to link and would allow priorities to be set for interoperability. The scope of the survey information is envisaged as covering the physical, geophysical, biological, chemical and socio-economic sectors (Figure 1).

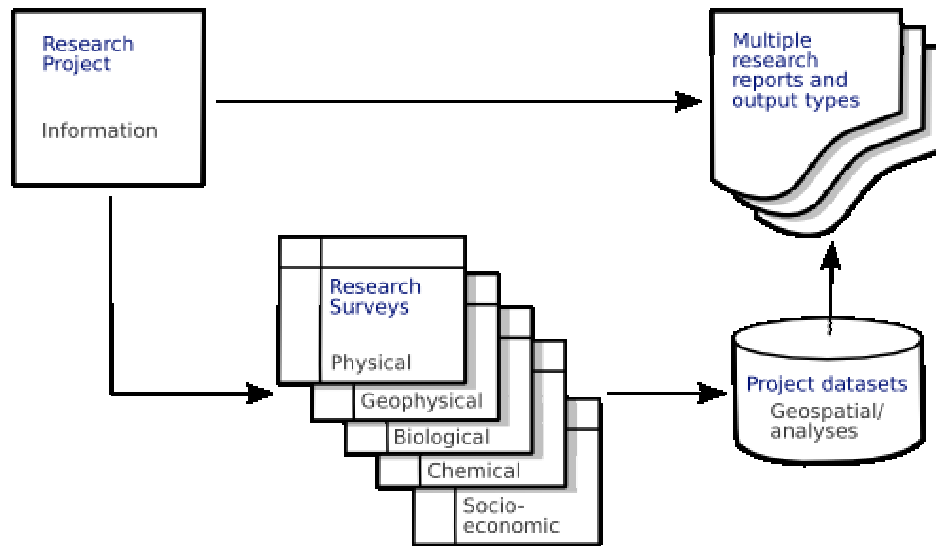


Figure 1. *Data resource content within the Marine ALSF GIS*

2.2 Tasks

2.2 Evaluation methodology

As part of the interoperability evaluation the following tasks have been completed.

1. An investigation of which other metadata and data management systems are most relevant to 'link' to: (e.g. MARLIN, UKOOA, JNCC, BODC, UKMED, NBN, OceanNet etc). Given the scale of the tasks involved it is necessary to prioritise the sites selected. This stage has involved a rapid review of the relevant systems and their scope of coverage (spatial and thematic), and the issues that need to be considered in interoperating. The output takes the form of a brief review report, included below, recommending the most relevant databases to investigate further. Many of the systems may be relevant as HTML links but without interoperability, others will be important links in establishing the role of the Marine ALSF GIS (e.g. ocean information portals) whilst others will form the targets for interoperation.
2. Metadatabase interoperability is not something that can be delivered without the discussion and agreements with the data holders and data management organisations. In order to establish the scale of the interoperability development, a pilot will be developed with the Channel Coastal Observatory (CCO)⁶. Given that the Marine ALSF GIS is a new initiative, it does not form part of the wider body of organisations that are contributing to the management of marine and coastal information. Whilst there are some important initiatives in this area (IACMST, DIMM etc) there is no agreed route to centralising or creating a fully interoperable marine portal.

Discussions have been held with the key organisations to understand the structure and interoperability issues surrounding these other online databases, the standards adopted and

⁶ CCO (<http://www.channelcoast.org>)

The programme provides a consistent regional approach to coastal process monitoring, providing information for development of strategic shoreline management plans, coastal defence strategies and operational management of coastal protection and flood defence.

the data distribution policy. The outcome of these meetings forms an examination of data structures, interoperability mechanisms and standards compliance used within these other systems to evaluate technical issues for linking.

3. Development of a proposal and costing for the Marine ALSF GIS development options for greater interoperability with other key metadatabase providers relevant to the marine aggregate sector.

Search functionality and returning results from interoperable metadatabases assumes that the source of the records is identified and that subsequent exploration and downloads of resources are driven from the host server by linking to the resource. Having agreed interoperability with other sites there is the option to refine the search across specific metadata resources by allowing selection of the data resources within the search criteria.

The development of the linkage is seen as being more than just adding hyperlinks, but offering additional functionality to the users to interoperate with other web sites through searches directed to a number of other marine data gateways. Obviously there is an element of Catch 22 in that the development of the Marine ALSF GIS is an interim specification, subject to user specification and technical review. Nevertheless, the principles of interoperability design are largely technical questions of implementation that are less likely to change. The steps needed to evaluate the scope of interoperability come from both the requestor and provider systems and the following tasks have identified the route to recommendations for interoperability.

In summary:

1. Investigation of Marine ALSF GIS to determine:
 - the current proposed functionality of the Marine ALSF GIS
 - the current information (data sets) held within the Marine ALSF GIS (proposed)
 - the current outputs / products of the Marine ALSF GIS (proposed)
 - which other metadata provider outputs / products are relevant / of interest to the Marine ALSF GIS audience
2. Review of other marine data gateways / portal systems to determine:
 - options of Marine ALSF GIS linkage to the other systems for review and appraisal - assessment of key target systems as basis for further stages of linkage evaluation.
 - assessment of how to implement the interoperability of the Marine ALSF GIS with other systems; evaluation of the communication protocols, metadata standards used etc
 - potential design and functionality for Marine ALSF GIS hyperlinks; scope for output within the Marine ALSF GIS, through direct link to the other portals or combinations of linkage mechanisms
 - Review of other successful linked websites and search routines with other marine data portals
3. Consultation with marine data gateway / portal partners to determine:
 - validity of preferred options for Marine ALSF GIS linkage to the other data systems
 - processes for the production of preferred Marine ALSF GIS linkage to the other gateways.
4. Present costed recommendations
 - for the future development of linkages with other metadata / data providers
 - develop links with ocean / GIS portals that will help to disseminate and publicise the Marine ALSF GIS.

2.3 Link and interoperability options

2.3.1 Introduction

The term 'link' covers a broad spectrum of potential methods of interaction with other information providers. These methods range in sophistication from simple hyperlinks through to distributed network

applications with a high degree of integration. The level of interoperability necessarily increases with the sophistication of the interactions.

Interoperability can be defined as the capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units. It is envisaged that the implementation of the Marine ALSF GIS will conform to the OGC Reference Model⁷ and will therefore have the potential to interoperate with information partners through a broad spectrum of possible methods of interaction.

It is intended that the Marine ALSF GIS website will maintain a comprehensive index of hyperlinks to relevant sites. The options for linkage that are investigated in Section 2.3.2, therefore, concentrate on linkage methods that are truly interoperable as per the definition in the previous paragraph. This interoperability will focus on the ability for metadata-based search criteria to be concurrently submitted to multiple online data resource catalogues thereby allowing searches over a range of remote metadata catalogues. Interpretation of the term 'links' here is thus taken to be: *the simultaneous searching of different metadata, relevant to the content themes of the Marine ALSF GIS where the resources are maintained by other organisations and are held on remote servers.*

This interpretation of linkage embodies the principle of a data portal or gateway, where the user is not required to run separate searches to cover separate but relevant information feeds. The principles of such approaches are seen as important in reducing duplication of records, allowing growth of specific domain record input and in enhancing access to more comprehensive records.

2.3.2 Interoperability Options

Providing links is important ultimately to the delivery of a useful product, as well as in future-proofing the development and integrating it within the wider community of marine information systems. This interoperability is implemented within other Marine information systems (MIS); for example, a search from MARLIN may link to NBN Gateway – providing a 'family' of information resources for the marine zone - including others such as MEDAG/UKMED, BODC, etc. It is logical to conceive of the Aggregate GIS as contributing to an overarching framework.

The opportunity to reduce overlap between the system and these existing databases should help both us, as developers, and the user community. Closer links with the proposed UK Marine Data Gateway and similar projects will be valuable in properly positioning the work, such that it becomes an important and non-duplicating contribution, and integrates effectively with other systems.

The proposal for linking to additional online databases requires a knowledge of the main marine metadata programmes - potentially both in the UK and overseas. The concentration at present has been within UK waters, although overseas links may be appropriate where there is information of generic value or best practice to evaluate. The initial list of potential links has been assessed in terms of the data products that are available and the data delivery mechanism. From this long list (Table 1) a short list of relevant and complementary partners to the Marine ALSF GIS project was selected for further evaluation through interoperability meetings. The following groups were selected for further assessment of the potential links: BODC, JNCC, and CEFAS. These groups have significant marine data holdings that are relevant to the marine aggregate industry and established data archive and dissemination mechanisms. Meetings have been held with each of these groups and the potential programme discussed with them to evaluate the scale and level of involvement required.

Potential links within the Marine ALSF GIS with existing marine information portals in the UK are proposed. Given the metadata standards employed there is potential to search using the same criteria across a number of separate databases. This has been employed in a number of existing coastal and marine metadata systems, such as the NERC Metadata Gateway. Currently all such examples use low-resolution textual searches to submit search criteria across the distributed servers. The ability to

⁷ OGC ORM (http://portal.opengeospatial.org/files/?artifact_id=3836)

The ORM describes a framework for the ongoing work of the OGC in terms of its specifications and the implementation of interoperable solutions and applications for geospatial services, data, and applications.

execute high resolution, spatially and temporally sensitive queries has traditionally been limited to single, monolithic applications due to the fact that custom interoperation at this level is a complex undertaking. However, providing this functionality over a network of peer resources is now a technically valid proposition thanks to the relevant standards specified by the OGC. These standards, such as the OpenGIS Catalogue Services Specification⁸, provide methodologies for efficient implementation of the desired functionality in an interoperable manner. As detailed in Section 2.3.4 it is proposed that the Marine ALSF GIS will implement these standards as a method for meeting its core remit.

The standards are only just emerging, however, with the implication that they are not yet widely deployed. One of the key issues, therefore, is how and to what extent legacy systems from information partners could be embraced by the Marine ALSF GIS.

2.3.3 Interoperability Issues

Potential areas of concern when discussing and implementing pan-organisation interoperability in the light of relevant standards can be highlighted as follows:

- **Technical infrastructure.** The majority of potential partner organisations have legacy systems that were developed without much thought having been given to interoperating with other systems. In the case that they do interoperate it is unlikely that they do so in a manner compliant to the emerging standards.
- **Semantic infrastructure.** Systems may be able to interoperate at the technical level but the meaning and categorisation of data may differ, resulting in a conceptual mismatch. This translates to irrelevant results appearing in a user's search.
- **Security.** Although there is an industry wide move to make data more freely available there is, and always will be, the need to maintain data confidentiality between parties. Copyrights and commercial sensitivity are drivers in maintaining security. The result is that certain resources implement access constraints which appropriate authorisation is required to satisfy.

Addressing these issues is a substantial challenge which must be undertaken at both the technical and policy levels. It is envisaged that the technical problems would be met with the development of appropriate web services. Web services provide for interoperability by being a collection of protocols and standards used for exchanging data between applications or systems. Thus, as a concept, they perfectly complement the Service Oriented Architecture of the Marine ALSF GIS described in Section 2.3.4.

Web services provide the basis for a solution in that they are autonomous entities with a public interface. As such they enable the sharing of schema and a contract, thereby allowing data to be passed across the explicit boundaries between client and provider services. A web service explicitly separates such structural issues from the semantics of the data being dealt with by advertising its capabilities in a machine-readable form. These capabilities can be catalogued as a subset of the service metadata. If presented as part of the search interface, a user would be able to assess these capabilities as to the suitability or otherwise of a service for use in a search. For example, an information partner could provide a catalogue service that is itself catalogued by the Marine ALSF GIS portal. The capabilities of this service would include the details of the service provider and the user could use this information to decide whether or not metadata from that source should be queried as part of a search.

The significance of this is that web service compatibility can be wholly determined by policy, resulting in a high level of flexibility and easy adaptation to change that does not entail a complete technical restructure. Web service based solutions to the aforementioned issues can be defined as follows:

⁸ OGC CAT (http://portal.opengeospatial.org/files/?artifact_id=5929&version=1)

This specification defines the interfaces, bindings and a framework for creating application profiles required to publish and access digital catalogues of metadata for geospatial data, services and related resource information.

- **Technical infrastructure.** Custom web services can be created on a per-partner basis. Depending on individual requirements they could provide facilities that do anything from acting as a gateway for harvesting metadata (which would be stored locally in the Marine ALSF GIS catalogue service) to implementing real-time querying of partner catalogues. In the former case this would enable the Marine ALSF GIS to act as a proxy to partner resources and, in effect, provide them with a standards-compliant interface. A partnership with MESH¹⁴ would likely implement this approach.
- **Semantic infrastructure.** Many data holders produce metadata that is compliant with the ISO 19115⁹ standard to be used by the Marine ALSF GIS. In these cases semantic interoperability is simplified. In other cases, however, search requests and data fields will have to be mapped based on policy decisions and implemented by the provider web service. Most metadata schemas, for example, contain fields which can be mapped to the Dublin Core¹⁰.
- **Security.** Provider web services can choose which data to make available. Data can also be made available to authorised client requests based upon desired criteria. These could be secure transactions at the network level (i.e. using the Secure Sockets Layer), HTTP authentication, Web Services Security¹¹ or other well-known forms of identity validation.

2.3.4 Support for interoperability by the Marine ALSF GIS

Applications which implement an interoperable architecture present the user with a seamless interface to resources, be they data or services. In the context of the Marine ALSF GIS these resources will be the research project information and associated analyses illustrated in Figure 1. The proposed architecture of the application means that it can be viewed as a geospatial portal; a gateway providing a single access point to multiple resources even though these resources are sited on a single server and are accessed by users as a stand-alone entity.

The proposed architecture of the Marine ALSF GIS represents an Application Integration Framework (AIF)¹². This AIF would provide an operational environment that would have the ability to dynamically integrate an ever expanding set of standards compliant geo-resources into the portal. These resources can be located on the local server (as per the current project specification) but they also have the potential to be located remotely if interoperability is employed. Either way resources will be catalogued and integrated using their metadata.

Assuming that a remote resource is also a conforming AIF, this design provides for the implementation of the clearinghouse concept (See Figure 2). The distributed but cross-referenced nature of clearinghouse networks allows users to obtain data from nodes 1 and 5, even though the portal through which they are accessing this data (node 3) has no direct knowledge of those data sources. Implementing this paradigm would enable the Marine ALSF GIS to integrate specifically with the UK marine spatial data infrastructure and more generally with the national and global spatial data infrastructure.

⁹ ISO 19115

(<http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=26020&ICS1=35&ICS2=240&ICS3=70>)

This International and British Standard defines the schema required for describing geographic information and services.

¹⁰ Dublin Core (<http://dublincore.org>)

The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models.

¹¹ OASIS WSS (http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wss)

This specification delivers a technical foundation for implementing security functions such as integrity and confidentiality in messages that are exchanged between higher-level Web Services applications.

¹² The AIF is described in the OGC Geospatial Portal Reference Architecture available at https://portal.opengeospatial.org/files/?artifact_id=6669

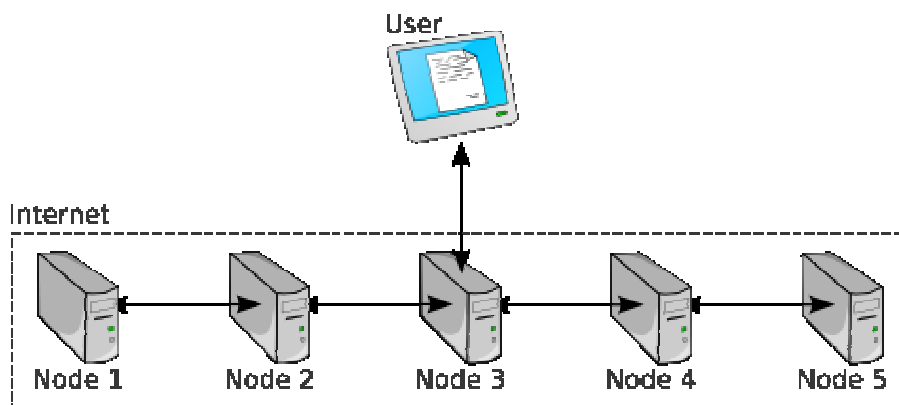


Figure 2. *The clearinghouse concept*

Effective communication is key to the success of interoperability within the AIF. The communication model underpinning the AIF is the Service Oriented Architecture (SOA). Service orientation is a way of viewing software assets within the AIF. It represents a service trading paradigm called the Publish-Find-Bind pattern (PFB). The fundamental roles and interactions of PFB actors are illustrated in Figure 3.

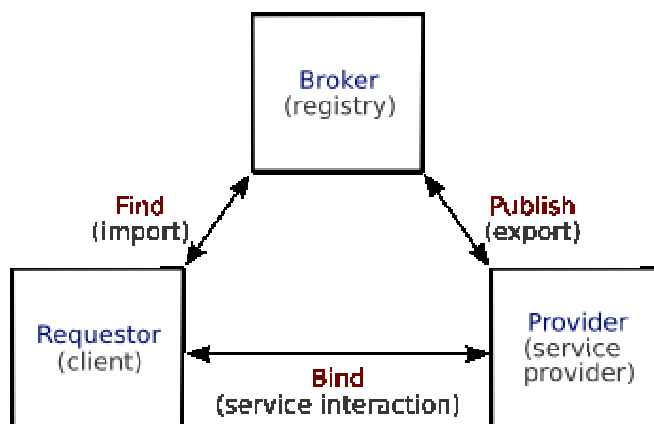


Figure 3. *The service trading communication structure*

The role of the broker in the PFB is pivotal as it effects resource referencing and allows clients to find services. The lynchpin service that underpins the broker is the Catalogue Service⁸. Catalogue services support the ability to publish and search collections of descriptive information (metadata) for data, services, and related information objects. Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software. Catalogue services are required to support the SOA through discovery and binding to registered information resources within an information community.

As the technical specification for the Marine ALSF GIS currently stands, a catalogue service will be the cornerstone of the project. It will be used to broker both the clients and providers in the stand-alone SOA but the standards it follows also mean that it has the potential to transparently broker clients and providers from the wider marine information community. The role that the portal could adopt within such a set of interactions is summarised in Figure 4.

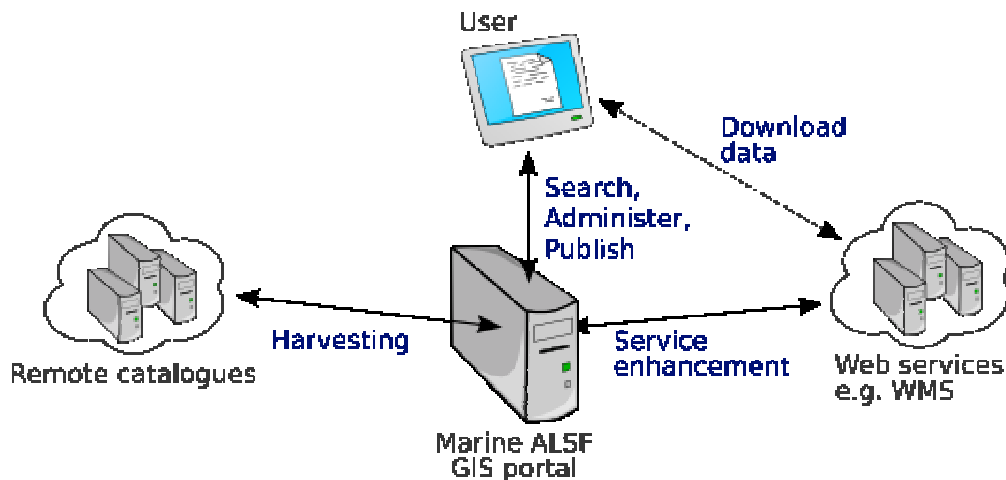


Figure 4. The core components of the Marine ALSF GIS portal could combine to provide access to remote resources by cataloguing, through metadata, both the data that is available and how to interact with it.

2.4 Linking - which systems?

The selection of the partner groups from the long list of marine data information holders is based on both the data holdings and the potential and desire to generate interoperability. The organisations selected are all members of the Marine Data and Information Partnership (MDIP)¹³. MDIP is a new group examining and promoting metadata standards, seeking to provide a framework for the management of marine data and information across the UK. Although this group was only formed in March 2005 it provides, at least conceptually, an important framework component to the marine information community.

Whilst the MDIP programme currently has issued no guidance, the principles of its operation are considered here and within the Marine ALSF programme. Linking with a number of its partner organisations allows Marine ALSF GIS, and particularly the interoperability component, to provide a demonstrator as to how components of MDIP might function. Essentially, this may be seen as a pilot of the role for MDIP applications and offer the opportunity to test a key component of the infrastructure needed to make the data archive objectives of MDIP a reality.

The tasks for the collaboration in Marine ALSF GIS interoperability pilot are:

- Evaluating which other data / metadata providers are most relevant at this stage to link with. Discussions with MESH¹⁴, CEFAS¹⁵, BODC and CCO⁶ have resulted in a consensus support for contributing in principle to an interoperable infrastructure. Enabling this needs an agreement that relevant datasets should be made available to partners on a no-fee basis.
- Evaluation of the appropriate communications protocols with partner organisations
- Evaluation of desirable search, navigation and output options for parallel searches
- Pilot implementation of the interoperability development.

¹³ OceanNET (currently hosting MDIP) <http://www.oceannet.org/>

¹⁴ MESH (<http://www.searchmesh.net>)

¹⁵ CEFAS (<http://www.cefas.co.uk>)

3 Proposal to develop interoperability

Following discussions with CEFAS, JNCC and BODC it has been established that developing interoperability links between the Marine ALSF GIS and these partners would provide significant benefits to the Marine ALSF community.

The principle objective here is to establish data partnerships that work together to ensure user accessibility and effective archiving of data.

The aims include:

- Integrating the Marine ALSF GIS into the wider marketplace of Marine Information Systems
- Reduce duplication of resources that have already been catalogued by other organisations and initiatives
- Provide links to information that is outside of the scope of the Marine ALSF GIS but still relevant to the marine aggregate sector
- Provide access to information about marine data resources
- Maintain the longevity of the Marine ALSF GIS
- Aligning the Marine ALSF with principles promoted by MDIP (essentially as a pilot of part of the infrastructure required of MDIP).

In order to achieve the benefits listed above and ensure the longevity of the interoperability links it is essential that hosting organisations are involved in the development of the links. The following section outlines a proposal for creating interoperability links between the Marine ALSF GIS and the CEFAS I-SEA database, JNCC MESH database and the BODC Marine Data Archive. This would facilitate simultaneous querying of these databases and display of results via the a Marine ALSF GIS website portal. The proposal is broken down into key tasks. The time, cost and organisation are also listed.

Task	Description
1	<p>Partnership building / management</p> <p>Establish meetings to refine the scope of the programme. The target is to develop partnerships with three agencies/NGOs, to test and prove the ability to develop a network of collaboration. Identify partnerships/MoU, draft formal agreements, working protocols, review and confirm agreements, identify future partners.</p>
2	<p>Consolidation of spatial metadata standards and mapping</p> <p>Map metadata schema to ALSF standards</p> <p>Separate and joint meetings with all contributors to agree mappings between each spatial metadata database/standard in use and the metadata standard adopted by the Marine ALSF GIS.</p> <p>Identify common elements and definitions.</p>
3	<p>Specification of interoperability model, standards and protocols</p> <p>Produce and agree a technical interoperability definition for the development.</p> <p>Establish a functional specification and development plan.</p>
4	<p>Development of Web Service orientated interoperability infrastructure</p> <p>Develop the interoperation infrastructure based on a Web Services architecture, described above. This will comprise 3 distinct elements:</p> <p>a) Web application extension to the marine ALSF GIS presenting the search interface to multiple metadata sources.</p> <p>b) Generic Web Service component for communicating with the ALSF</p>

	<p>Web application (a) from a remote metadata source, but implemented independently of any specific organisation or database.</p> <p>c) Component interfaces between Generic Web Service component (b) and specific remote metadata back-end databases.*</p> <p>* GeoData will implement a version of (c) as for the pilot implementation interoperating with the CCO metadata database. This implementation could therefore be used as a template for other organisations, if desired. (see Figure 5 which illustrates the separate functional components of the WebService orientated interoperability infrastructure).</p>
5	<p>Build dissemination materials and vision for the service</p> <p>Develop environment to support user testing. Co-ordinate technical and marine aggregate industry user testing. Testing would be based on the population of the marine ALSF project metadatabase and selected metadata systems from other organisations</p>
6	<p>Refinements to operation based on user testing</p>
7	<p>Management and reporting</p> <p>progress reports and meetings</p>
	<p>Total</p>

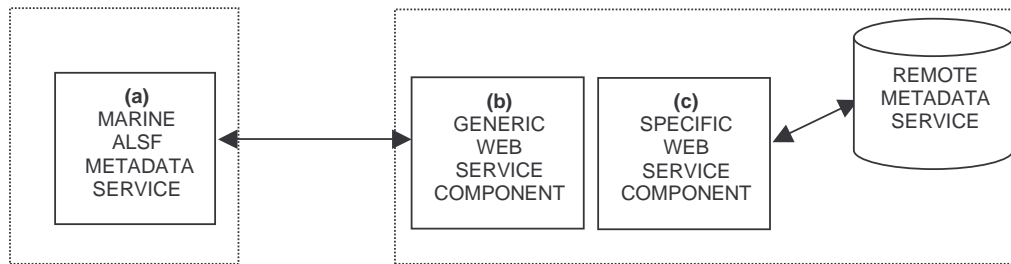


Figure 5 Separate functional components of the WebService orientated interoperability infrastructure

3.1 Deliverables

Deliverables for the proposed interoperability project would comprise:

- An online web-based system for interoperable access to metadata for marine aggregate related information
- Technical report on the implementation
- User testing report

4 Conclusion

The proposed standards-based design of the Marine ALSF GIS portal around a Service Oriented Architecture would inherently facilitate interoperation with partners in the information community. The fact that these facilities for interoperation are intended to already be in place in the base Marine ALSF GIS implementation means that the overhead for implementing interoperating services with partners could be linear in relation to the number of services added.

It is anticipated, however, that most potential partner organisations do not currently provide standards compliant data delivery mechanisms. In these cases custom gateways would have to be created between the partner datasources and the Marine ALSF GIS. Custom web services would implement the gateways, and thus the degree of interoperation would be based on individual policy agreements. The resulting structure would, in effect, provide a standardised interface (through the Marine ALSF GIS portal) to the data provided by partner organisations. Their resources would be made available to the marine aggregate community as well as the wider geospatial data infrastructure as envisaged by INSPIRE⁴ and the GSDI⁵. The Marine ALSF GIS portal, in turn, could contribute to that infrastructure by acting as a metadata provider.

The result would be a robust and future-proofed data portal providing a heterogenous but complementary and integrated set of geo-resources. The Marine ALSF GIS, therefore, has the potential to become an important information portal in the marine aggregate domain.

Table 1. Listing of organisations, information and scope of data and information delivery within the marine sector. 'Interoperability' is defined as those sites that return searches (map and metadata) from remote servers – rather than more simple links to other resources. The inclusions in this table of data, metadata and facilities are the result of our marine dredging focused investigation of sites. Sites and data services may include other programmes that do include other features that we have not assessed in this review.

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
MarLIN	Marine Life Information Network UK & Ireland www.marlin.ac.uk	368 Surveys providing descriptions of where particular habitats, communities and species occur, and descriptions of the features of those habitats, communities and species which indicate sensitivity in relation to natural events and human activities. Marine node of NBN contributing to the NBN Gateway.	NBN Metadata	Data Benthic species data	Adobe SVG - output	No	No	No
Mermaid (JNCC)	Marine Environmental Resource Mapping and Information Database. www.incc.gov.uk/mermaid/	Marine habitat and species information around Britain	NBN	Data Sites, habitats and species	Link to NBN	No	With NBN as pilot	No
NBN	National Biodiversity Network www.nbn.org.uk	Biodiversity, wildlife, species and habitats information	NBN Metadata	Data	Yes	Yes	With other biodiversity sites	No
UKOOA	UK Offshore Operators Association www.ukooa.co.uk	Representative organisation for the UK offshore oil and gas industry. Documents published online for registered users.	Metadata	No	via DEAL	Via DEAL	No	No
DEAL	DEAL Data Registry (owned by UKOOA) www.ukdeal.co.uk	Data and information about offshore Oil & Gas Exploration & Production for the U.K. Well, seismic and other baseline data. Developed by CDA a subsidiary of UKOOA	Metadata	Data	Web GIS	Data descriptions etc	Developing XML schemas BGS, CDA, DTi and POSC. Data submission by spreadsheet URL to vendors	No
UKMED Operated under IACMST	UK Marine Environmental Data (OceanNET) www.oceannet.org	Inventory of marine environmental data (the UK contribution to EDMED), sea level data, cruise information, marine monitoring, moored current meter data.	Metadata	Data	No	Reports	Yes – links to multiple metadatabases through OceanNET	No
BODC	British Oceanographic Data Centre	A wide data coverage, including Tide gauge network, wave data index, research vessel cruise information, GLOSS sea level stations, DODS sea level model data,	Metadata	Data	Web, map and paper	Yes	NERC Metadata	Yes

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
	www.bodc.ac.uk	CTD profile index, current metre inventories. Hosted by Proudman Oceanographic Laboratory, BODC is the NERC Designated Data Centre for Marine Science. Part of the NERC Metadata Gateway – allows searches across NERC sites (BODC, EIC, BGS etc)			formats		Gateway Extensive – but EDMED collates records	
NERC Metadata Gateway	Natural Environmental Research Council Metadata Gateway www.nmp.rl.ac.uk	Searches Metadata from British Atmospheric Data Centre (BADC) British Oceanographic Data Centre (BODC) Environmental Information Centre (EIC) British Geological Survey (BGS) NERC Earth Observation Data Centre (NEODC) Important example of interoperability of metadata searches.	Metadata	Yes	No	No – but may be available through to linked organisations	NERC Metadata Gateway – linked resources from 6 data centres (not all marine)	No
Sea-Search	BODC Sea-Search www.sea-search.net	An EU project, coordinated by MARIS, Netherlands, which has generated several metadata catalogues, including a European directory of marine environmental data. All national directories within EDMED are assembled into a single centralised system managed by the BODC and are made available here and via the Sea-Search. Important, well populated European scale metadata holding.	Metadata	No	No	No	No	No
EU-SEALED	EUMARSIN, EUROCORE and EUROSEISMIC, www.eu-sealed.net	Searchable catalogue of over 220.000 seafloor samples Three projects Seafloor samples Cores, Seismic and sonar Euroseismics provides detailed web GIS features. Hosts data from contributing agencies rather than interoperates to acquire. Offers an online data purchase option	Metadata	Data download (pilot)	Map based search	Documents	No	Demo of download
Crown Estates	Crown Estates www.thecrownestate.co.uk/40_aggregates_04_02_07	Documents relating to marine aggregates, cables, energy, fish farms, offshore wind farms, pipelines. Marine sector licences and the licence areas are available from Marine Estate. See also Windbase	Metadata	No	GIS (not online) – planned	Documents	No	No
SNS2	Southern North Sea Sediment Transport Study www.sns2.org	Sediment movement in the southern North Sea. HR Wallingford based project to support SMP and dredging application licensing. Built on earlier ABP/GeoData Southern North Sea database study. Difficult search criteria and no map search. Provides for online update.	Metadata (FGDC)	No	No	Documents	No	No

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
CCO	Channel Coastal Observatory www.channelcoast.org.uk	Coastal survey and research data for the South Coast, supported by Defra and coastal authorities. Real-time and near real-time data feeds from survey instruments, project and source metadata for surveys and aerial photographic coverage.	Metadata	Data	Spatial Data	Documents	No	Yes
ICES	International Council for the Exploration of the Sea www.ices.dk	ICES Oceanographic and Database Services Marine ecosystem information for the North Atlantic. Comprehensive range of data management, metadata and data display and download (through full download or searchable download selection). Operate as ICES Environmental Data Centre. Linked with other major initiatives (e.g. HELCOM).	Metadata	Data	No – but image maps	Documents	Yes	Yes
IACMST	Inter-Agency Committee on Marine Science and Technology	IACMST maintains an overview of marine activities across Government. Global Ocean Observing Action Group (GOOSAG) defining a coordinated UK marine monitoring programme and the national contribution to Global Ocean Observing System (GOOS). The Marine Environmental Data Action Group (MEDAG) initiates activities relating to the development, management and exchange of data inventories.	No	Info exchange	No	No IACMST publications (pdf)	No	No
UK Marine Portal	UK Marine portal www.marineuk.com	Database of marine related companies and websites	No	No	No	Information Events, companies etc	No	No
EN	English Nature www.english-nature.co.uk/pubs/gis/gis_register.asp	Data about environmental designations and habitats Nature on the map	Yes	Data	Maps	Documents	No	Yes (Spatial)
MAGIC	MAGIC www.magic.gov.uk	Environmental data mapping and download	Metadata	Data	Maps	Documents	No	Yes
EA	What's in Your Backyard http://216.31.193.171/asp/1_introduction.asp	Online access to EA data – water quality, flooding, flow	Metadata	Data	Maps	No	No	Yes
CCW	Landmap http://landmap.ccw.gov.uk/map/Map.aspx	Geological and habitat mapping for Wales – example of land based programme. EU supported programme to develop online information for Wales on landscape decision-making. Still under construction. Has relevance to marine / seascape approaches	No	No	Maps	Documents	No	No
SCOPAC	Standing Conference on Problems Associated with the	Downloadable documents and maps for the south coast of England covering all data areas.	No	No	non GIS map	Documents	No	No

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
	Coastline (SCOPAC) www.scopac.org.uk				images			
BMAPA	British Marine Aggregate Producers Association (BMAPA) www.bmapa.org	Downloadable documents about all aspects of marine aggregates. Also supplies licence areas from Marine Estates	No	No	Licence areas	Documents	No	No
EMSAGG	European Marine Sand and Gravel Group (EMSAGG) www.ciria.org/emsagg	Downloadable documents of relevance to the marine sand and gravel industry. CIRIA based service	No	No	No	Documents	No	No
JNCC	Joint Nature Conservation Committee [JNCC] www.jncc.gov.uk	Joint Nature Conservation Committee Agency supporting other initiatives, NBN, etc Developing new initiatives under Mapping European Seabed Habitats' or MESH – online metadata catalogue (see below)	See NBN Plans to deliver GIS layers for international sites					
MESH	Mapping European Seabed Habitats. http://www.searchmesh.net	EU Interreg IIIB programme for the mapping of European seabed habitats. Aims to be a metdatabse of mapping studies	Yes	No	Planned	Documents	Planned	Planned
MCEU	Marine Consents and Environment Unit (MCEU)	Consents information – on Public register and with GIS data to become available shortly.	No		Planned	Documents	No	No
CEFAS	CEFAS www.cefasc.co.uk	Centre for Environment, Fisheries and Aquaculture Science, CEFAS, is a UK-based research and consultancy centre. We provide services in fisheries science and management, environmental monitoring and assessment, fish farming, fish health, disease and hygiene to clients around the world.						
	iSEA	an interactive mapping server providing online access to environmental and fisheries data for the UK shelf and beyond. (currently unavailable)	Yes	Yes User selectable by area and date range	Yes W. Europe)	No	No	Yes (map output)
	WAVENET	real time wave data from around the coast of England and Wales.	No	Yes	No (overview map)	No	No	Yes (via login)
	National Marine Monitoring Programme	spatial data for contaminants in UK coastal waters. Covering themes of marine pollution – chemistry, bology and biological effects	No	Yes	No (overview map selection)	Yes	No	Yes (docs)

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
	Southern North Sea Data www.cefas.co.uk/monitoring/page-b4.asp	from CEFAS automated <i>in situ</i> instrumentation for monitoring a range of physico-chemical and environmental variables. Basic and advanced data options. Uk and S North sea buoy data	No	Yes	No (overview map)	No	No	Yes
BMAPA	British Marine Aggregate Producers Association www.bmapa.org	Resources for the British Marine Aggregate sector. Primary resources of relevance are Zoning Charts and archive of research and assessment reports.	No	No	No Zoning Charts available	Yes (pdf)	No	Yes (docs)
SEISCAN	http://www.soc.soton.ac.uk/CHD/seisweb/SEISCAN.html	SEISCAN was a MAST III funded project to rescue early seismic reflection profiles, that exist only as paper records, computer scanning and archiving to a CD-ROM database of image files.	Yes	Yes	No	No	No	Yes
MIRO	Mineral Industry Research Organisation [MIRO] www.miro.co.uk	Industry funded research and information organisation for the international minerals industry. Specialises in assisting member organisations to locate, develop and transfer innovative technology.	No	No	No	Yes Past and ongoing MIRO projects	No	Yes (reports)
CIRIA	www.ciria.org.uk	Provider of performance improvement products and services in the construction and related industries. Host to the European Marine Sand and Gravel Group http://www.ciria.org/emsagg/	No Publication database	No	No	No (purchase)	No	No
CEDA	Central Dredging Association [CEDA] www.dredging.org	CEDA, an independent, non-profit, non-governmental, professional society, aims to provide such a forum for all those involved with any kind of activity related to dredging and who live or work in Europe, Africa or the Middle-East.	No	No	No	Documents Guideline Bibliography	No	No
MAGIS	Marine Sand and Gravel Information Service [MAGIS] www.sandandgravel.com	Electronic market and central focal point for information and data on the marine sand and gravel, dredging and concrete industries. Links to dredging related information, many through OPL. See also Dredgeline. Operated by MARIS (Marine Information Service) http://www.maris.nl/magis.htm	No	Licence sites and holders	Extraction licences online GIS	Online project reports	No	No
WODA	World Organisation of Dredging Associations [WODA] www.woda.org	A non-profit professional organisation, dedicated to the exchange of knowledge and information related to dredging, navigation, marine engineering and construction.	No	No	No	Documents policies	No	No
EH	English Heritage www.english-heritage.org.uk	English Heritage make sure that the historic environment of England is properly maintained and cared for	No	No	No	Documents	No	No

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
Marine Estate	The Marine Estate www.crownestate.co.uk/estates/marine	The Crown Estate owns around 55% of the foreshore (between mean high and mean low water) and approximately half of the beds of estuarial areas and tidal rivers in the United Kingdom. It also owns the seabed out to the 12 mile territorial limit, including the rights to explore and exploit the natural resources of the UK Continental Shelf, excluding oil, gas and coal. Other CE sites include management of data/GIS.	No	No	Yes	Dredging areas diagrams (pdf)	No	No
UKOOA	United Kingdom Offshore Operators Association [UKOOA] www.ukooa.co.uk	UK Offshore Operators Association (UKOOA) is the representative organisation for the UK offshore oil and gas industry. Its members are companies licensed by the Government to explore for and produce oil and gas in UK waters.	See DEAL for online information sources					
UKHO	United Kingdom Hydrographic Office [UKHO] www.ukho.gov.uk	The UKHO is a government Trading Fund and part of the Ministry of Defence. Our primary activity is the provision of navigational products and services to the Royal Navy and the merchant marine in compliance with Safety Of Life At Sea (SOLAS) Regulations. Commercial services site for data (e.g. charts, wrecks)	No	No	UKHO Hydrospatial vector data and ECDIS raster charts	NO	NO	NO
MCA	Maritime and Coastguard Agency [MCA] www.mcga.gov.uk	The MCA is responsible throughout the UK for implementing the Government's maritime safety policy. That includes co-ordinating search and rescue at sea through Her Majesty's Coastguard, and checking that ships meet UK and international safety rules.	No	Lists	None	Documents Guidance and regulations	No	
Dredgeline	CEDA, IADC and VBKO funded online database – hosted by MAGIS http://www.dredgeline.net/	Dredgeline is an on-line bibliographical reference database. It provides an easy access to the vast body of knowledge existing worldwide in the fields of dredging and dredged material managements Oilfield Publications Limited. Grey literature, research reports, conference proceedings, Documents from TUDelft Library	None	Bibliographic reference	None	Documents Listing + Conference proceedings Grey literature	No	No
E2-D2	<i>(Environmental Effects & Dredging and Disposal)</i> http://www.wes.army.mil/el/e2d2/	US Army Corp of Engineers dredging environmental impacts information. Bibliographic search engine for environmental and dredging literature c 5000 references from the Dredging Operations Technical Support Program (DOTS). Maintained by Wetlands and Coastal Ecology Branch of the Environmental Laboratory, U.S. Army Engineer Research and Development Center.	None	Bibliographic references	None	No download	No	No

Database	Name	Information	Metadata (standard)	Data view	GIS output / search	Project Documents	Interoperability	Data download
OceanPortal	OceanPortal http://ioc.unesco.org/oceanportal/index.php	UNESCO supported OceanPortal is a high-level directory of Ocean Data and Information related web sites. Major linked resource sites	No	No	No	Yes	Yes	No
SeaNET	http://www.seanet-workshop.org/index.html	EU funded programme. MARIS based system operating on the same IT framework as MAGIS. Sharing of North Sea hydrological and meteorological fixed monitoring locations and data. No operational datasets or data download at present. No British partner.	No – information on parameters measured	No	Yes – locations of monitoring stations	No	No	No
SIMORC	System of Industry Metocean data for the Offshore and Research Communities	Searchable metadata index and a database of the metocean data sets collected by the oil & gas industry. Not operational – aims for 2007. Global, quality assured, metocean data collected by oil and gas industry. Coordinated by MARIS.	Not operational at present					



Defra is responsible for the Aggregate Levy Sustainability Fund (ALSF) and appointed CEFAS to distribute the Marine Environment Protection Fund (MEPF) element of the ALSF.

The ALSF has three main objectives:

1. Minimising the demand for primary aggregates.
2. Promoting environmentally friendly extraction and transport.
3. Reducing the effect of local aggregate extraction.

Information about the ALSF MEPF programme can be found on the website <http://www.alsf-mepf.org.uk/default.htm>

Further information about the Marine GIS is available on the website <http://www.marinealsf.org.uk>



The ALSF MEPF programme is administered by CEFAS
<http://www.cefass.org.uk>



Defra is responsible for the Aggregate Levy Sustainable Fund
<http://www.defra.gov.uk/environment/waste/aggregates/>