



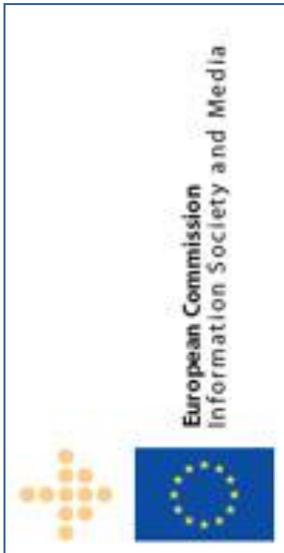
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Abstract: *This report documents the strategy, plan, and progress leading to the development of specific applications and tools that in tandem with the rest of gCube technology will be used to realize the Virtual Research Environments that are expected to serve the needs of the Ecosystem Approach Community of Practice.*

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DISCLAIMER



iMarine (RI – 283644) is a Research Infrastructures Combination of Collaborative Project and Coordination and Support Action (CP-CSA) co-funded by the European Commission under the Capacities Programme, Framework Programme Seven (FP7).

The goal of iMarine, *Data e-Infrastructure Initiative for Fisheries Management and Conservation of Marine Living Resources*, is to establish and operate a data infrastructure supporting the principles of the Ecosystem Approach to Fisheries Management and Conservation of Marine Living Resources and to facilitate the emergence of a unified Ecosystem Approach Community of Practice (EA-CoP).

This document contains information on iMarine core activities, findings and outcomes and it may also contain contributions from distinguished experts who contribute as iMarine Board members. Any reference to content in this document should clearly indicate the authors, source, organisation and publication date.

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DELIVERABLE SUMMARY

This deliverable, of type Other, captures the EA-CoP validation effort of Virtual Research Environments (VRE's) and related components from M20-M33.

The purpose of the deliverable is to track the progress of VRE delivery to meet the Objectives set out in the iMarine Business Cases.

The Deliverable is implemented through a wiki, which evolved over the project's life cycle.

The overall validation conclusion is that the delivered components meet most expectations while adding a significant number of unplanned but more than welcome features, and that the project remains on schedule to meet its objectives.

In addition, the communities are aware of their role to ensure the further development of these VREs by providing guidance to the development teams in terms of requirements and other desiderata, by aligning their infrastructures with iMarine services, and by exploitation of the VREs.

Previous validation for concrete exploitation scenario's led to specifications for existing and new VREs, e.g. for taxonomic name reconciliation, enrichment of species occurrence data with environmental data, code lists management, statistical data management and analysis, and advanced reporting. These were the main subjects in the M33 validation.

EXECUTIVESUMMARY

The Virtual Research Environments Validation Reports detail the plan and activities of the Ecosystem Approach Community of Practice (EA-CoP) to validate the iMarine Virtual Research Environments (VRE) including the gCubeApps and delivered EA-CoP services.

The plan does not cover community applications, data sources porting, community tools adaptation, and user interfaces testing required for the iMarine Data e-infrastructure to serve the needs of the EA-CoP. These are beyond the scope of the validation.

This deliverable captures the EA-CoP activities of Month 13 to Month 35 of the project, and covers the validation of delivered components. This report contains references to wiki pages on the VRE Validation summarizes EA-CoP validation results:

http://wiki.i-marine.eu/index.php/Ecosystem_Approach_Community_of_Practice:_Validation

This page first introduces the validation objectives, then explains the plan, and continues with the results of individual validation rounds.

In addition to the wiki ages, the validation activity can be followed though TRAC tickets related to EA-CoP activity. For a good understanding of their contents, and to enable better insight in project activities, we recommend browsing the reports.

- <https://issue.imarine.research-infrastructures.eu/report/9>
- <https://issue.imarine.research-infrastructures.eu/report/10>
- <https://issue.imarine.research-infrastructures.eu/report/11>
- <https://issue.imarine.research-infrastructures.eu/report/12>

VRE validation is based on a FURPS approach, and involves representatives of the EA-CoP behind the requirements for a component. The objective is not one of testing, but of validation, i.e. does the delivered arrangement of services through a VRE satisfy the needs, and are we progressing towards achieving the objectives formulated in the Business Case?

This is the final version of this Deliverable that will be produced. However, the Wiki page for validation, and the set of TRAC tickets implementing it will continue to evolve, and follow the evolving EA-CoP desiderata.

GLOSSARY

AquaMaps: The VRE for the generation and management of species distribution maps based on the well-known AquaMaps algorithm.

BiodiversityLab: a VRE designed to provide a collection of applications that allow scholars to perform complete experiments about single individuals or groups of marine species.

BiodiversityResearchEnvironment: A gCubeApp with facilities to access and manage Biodiversity data.

BiOnym: a service" developed in iMarine to compare a set of scientific names against taxonomic reference lists such as the Catalogue of Life. The comparison checks the "correctness" of the set of scientific names.

Chimaera: a portal in the iMarine infrastructure facilitating access to data and information on fisheries of the western Indian Ocean.

Code list manager: A component of ICIS to create, manage and exploit code lists for the classification, description and translation of codes in datasets.

Cotrix: the code list management tools developed parallel to ICIS to meet community demands.

Curation: The entire process of data validation and harmonization until time-series production.

Documents workflow: a VRE for Document life-cycle management. It exploits the capabilities provided by the **gCube Business Documents Workflow Management Suite** (BDWM Suite).

EcologicalModelling: A gCubeApp implementing a range of options to produce species distribution and biodiversity map, combined with a GIS to view, store and share the results.

EGIP: The **European Geothermal Information Platform** VRE combines the Virtual Workspace and the Social Network facilities, provide a collaborative, standard-oriented data publication environment, including semantic technologies with a data catalog, the iMarine GEOExplorer, and the iMarine Statistical Manager.

FCPPS: VRE for the production management of Fisheries Country Profiles. The reporting tool manages the work-flow and formatting with the FAO FiMES schema in a multi-user environment.

FishFinder: A VRE for the production management of Marine Species Fact Sheets. The reporting tool manages the work-flow and formatting with the FAO FiMES schema in a multi-user environment. In addition, it must be able to load existing fact-sheets, and be able to operate as a stand-alone component.

FLOD: Fisheries Linked Open Data

gCubeApp: An 'Open' VRE, offering less advanced facilities than a VRE.

GEO-Explorer: A (large) component in the e-infrastructure

Harmonization: The transformation of a data-set to comply with a standard structure and code-lists.

ICIS: The VRE for the management of tabular data, specifically geared towards Time Series.

Occurrence data: An observation of the presence (sometimes also absence) of a species or other taxonomic entity in a dataset. These data are often contained in a repository that can be queried using de-facto standards for species observational data.

OpenSDMX: An FAO initiative to leverage parts of the SDMX standard to operate in or close to the iMarine e-infrastructure. The JAVA components aim to assist community members in the production and management of statistical data sets.

R: A free an open source statistical package integrated in the iMarine e-infrastructure. R is the OS tool most widely used in the target communities.

SDMX: An international Standard for the exchange of statistical (mainly aggregated) datasets.

SocialIsti: This non-iMarine workspace serves the data and file sharing needs of scientists at ISTI in Pisa, developed around the iMarine WorkSpace.

SpeciesExplorer: A powerful component in the iMarine e-infrastructure for the retrieval and download of information contained in this infrastructure on species.

SpeciesProductsDiscovery: A service for BC2 to discover occurrence data in hosted or remote repositories.

SPREAD: The Spatial Reallocation of Aquatic capture Data aims to apply geospatial information to capture time-series to increase the understanding of spatial patterns in fishing activity.

TabularDataLab: This VRE is a working environment for the management of tabular data. It offers a suite to import, curate, analyse and publish tabular data resources in a collaborative way, including code lists.

TLO: Top Level Ontology; a data resource integration fisheries related data from FLOD, ECOSCOPE, WoRMS, FishBase and DBpedia.

THREDDS: Thematic Realtime Environmental Distributed Data Services project is developing middleware to bridge the gap between data providers and data users. The goal is to simplify the discovery and use of scientific data and to allow scientific publications and educational materials to reference scientific data.

VME-DB: An FAO initiative to support the collection, management and sharing of relevant information on Vulnerable Marine ecosystems, contained in an information system supported by a database.

VMS: A Vessel Monitoring System produces specific type of Vessel Transmitted Information containing particulars on the vessel and its surroundings in a defined file format.

VTI: Vessel Transmitted Information; any type of information transmitted by vessels to identify their activity and position.

VesselActivityAnalyzer: a VRE with facilities to *perform data mining on Vessel trajectories*.

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1 VALIDATION PROCEDURE

1.1 PREPARATION AND DOCUMENTATION

According to the *Description of Work*, the conception and validation of concrete applications serving the business cases is part of the WP3 activity. The goal of the validation activity is to

- document status and issues on harmonization approaches, and
- validate implemented policies and business cases, their functionality and conformance to requirements.

The approach taken in iMarine builds on the experience gained in the validation efforts of the preceding D4Science-II project, where the FURPS model was adopted to generate templates against which to 'benchmark' the performance of a component.

FURPS is an acronym representing a model for classifying software quality attributes (functional and non-functional requirements):

- **Functionality** - Feature set, Capabilities, Generality, Security;
- **Usability** - Human factors, Aesthetics, Consistency, Documentation;
- **Reliability** – Frequency, Severity, Recoverability, Predictability, Accuracy, Mean time to failure;
- **Performance** - Speed, Efficiency, Throughput, Response time;
- **Supportability** - Testability, Extensibility, Adaptability, Maintainability, Compatibility, Serviceability, Localizability.

Validation in iMarine is based on requirements and specifications produced by the EA-CoP, aligned with iMarine Board Work Plan objectives. This implies that the validation is not equivalent to testing individual component behavior and performance in the e-Infrastructure, but assesses to progress towards achieving a Board objective. This gives the validation an important role in one of the Board main activities priority setting to improve the sustainability of the e-Infrastructure.

Validation thus focuses on project outputs, and does not intend to influence the underlying software architecture, development models, software paradigms or code base.

A validation is triggered by the release of a software component, part thereof, or data source that is accessible by project partners through a GUI in the e-Infrastructure.

1.2 THE PROCEDURE

Once a VRE is released, Board Members that have expressed interest in the component (through the Board Work Plan) are alerted by the WP3 Leader, and the validation commences with the compilation of a set of questions, based on the above FURPS criteria.

The feed-back is collected by the WP3 Leader, discussed with the technical Director or other project representatives, and, when necessary, enhancement tickets are produced, with a clear reference to the released component.

If the released VRE is validated the first time, the Round 1 results are discussed with the validators and the EA-CoP representatives they represent. If needed, the iMarine project is asked to add or edit

modifications to the delivered functionality. If these modifications exceed the level of enhancement tickets, a Round 2 validation is foreseen, which can be followed by other rounds until a satisfactory level of completeness has been achieved.

1.3 REPORTING ON THE WIKI

This deliverable describes a living document; the validation wiki.

The pages are available here:

http://wiki.i-marine.eu/index.php/Ecosystem_Approach_Community_of_Practice:_Validation

Validation results are documented in this wiki. In addition, when validation results in an error, specific 'Issue tickets' can be entered in the project TRAC system. If a validator encounters a functionality, usability, or performance issue, specific 'enhancement tickets' can be produced in liaison with the WP3 Leader. Supportability issues are usually discussed in other for a, such as PEB or the cluster calls.

2 VALIDATION RESULTS: OVERALL SUMMARY

In one sentence, the M33 status of the validation reveals that the project is well on track in meeting its main objectives before the project closes.

As expected, the bulk of the validation work was towards VRE functionality, with some efforts devoted to user community software validation (WPS and Cotrix, for instance). The validation focused on those VRE's that already were equipped with data access components, and enriched in this project phase with data processing facilities for biodiversity (e.g. Ecological Modeling) and statistical data (e.g. Tabular Data Lab).

The VRE's are built on a complete e-infrastructure, which is not subject to EA-CoP validation. The entire validation effort never revealed any issues related to the architecture, design, or operation of the underlying components. The infrastructure services data streams, storage, user access, security etc. These functionalities are not validated, but since no issues were reported, they can be considered to have received silent approval of the EA-CoP. Some comments from the validation are worth mentioning here:

- The continued improvements to the workspace are impressive, and allow for much better collaboration on data and results. Most P1 validation recommendations were implemented;
- The messaging system vastly reduces the effort to share large dataset, or simple messages. After P1 the features were further enriched with additional email and social tools;
- The concept of Experiments was introduced, and this was considered an important step to attract 'light' users (data experiments rather than data ownership). Taking away the data collection and metadata management burdens allows users to focus more time on the experiment itself, and the improved speed of processing (e.g. 20 times faster) further saves them time and effort;
- The live access and search of biodiversity data was considered very useful, and was recommended to be made available at generic level;
- The integration of community developed software and data in the infrastructure proved very easy. Datasets for SmartFish, TLO, FLOD; algorithms for SPREAD; frameworks and applications such as BiOnym and Cotrix and parts of VME-DB all found their way into the iMarine infrastructure;
- Some key components are still under validation, and e.g. the Tuna Atlas Use case of FAO is largely validated, but some final requirements are missing, and were added in September;
- The validated components have already shown their value, as evidenced by the many papers published, and have also been proposed to support other projects and programs.

iMarine technologies serve a plethora of use-cases, and services may re-appear used across business cases. The validation efforts recognize it aims at moving targets that often are a subset of a business case that is likely to evolve. The validation is thus not an atomic or isolated effort. It is rather an interactive and collaborative assessment of capabilities and value-add services.

The validation efforts were spread out over the entire project, and continued until project end.

Community tools, i.e. tools that are built in a EA-CoP context, and later brought to the project as data providers or components for integration were not targeted for validation. The project trusted that community tools like Cotrix, FLOD, Chimaera, TLO, etc. had already been validated in the communities.

3 VALIDATION RESULTS: VRE'S, EXPERIMENTS AND GCUBEAPPS

3.1 STATISTICAL DATA MANAGEMENT FOCUSED VRE'S AND RESOURCES

ICIS import, curation, and time series production have been validated successfully. The EA-CoP produced desiderata in P1 that were implemented to add analytical and harmonization features. This resulted in a completely new environment, the TabularDataLab that hosts the Tabular Data Manager.

- [Tabular Data Lab](#)

The need for a collaborative and interoperable facility for code list and reference data was repeatedly mentioned in all validations and beyond. This resulted in the development of Cotrix; a flexible and pluggable set of features to communicate with 'any' repository of codelists, manage them, and share them.

- [Cotrix](#)

The ICIS specialization for Vessel Transmitted Information (VTI) was validated earlier. It is a demo VRE, and requires further customization. The EA-CoP produced desiderata covering the exchange of data from remote data-centers to other organizations, and the NEAFC2ICES data exchange was developed.

- [VTI](#)

The SPatial Re-allocation of Aquatic species Data (SPREAD) builds on ICIS to re-allocate time-series to other geospatial resolutions. It necessitated the development of community components that were integrated in the iMarine statistical service.

- [SPREAD](#)

ICIS already offers statistical analysis with R and the statistical service. The statistical service was equipped in 2014 with the capability to run R scripts, and this was validated in the SPREAD use case. In another context, R was successfully used a.o. to analyze Length Weight frequencies of marine species, and to assess the suitability of iMarine components to improve FAO stock assessment software and other experiments.

- [Statistical analysis with R](#)

3.2 REPORTING VRE'S

FCPPS Reporting was already validated in December 2011, and completed successfully. The additional changes to e.g. document work-flow and desktop integration were welcomed by the community. The tool will now be adapted to several specific application scenarios. FCPPS provided the base for two new VRE's.

FishFinderVRE, validated in January 2013, enables the production of Marine Species Fact Sheets. The reporting tool manages the work-flow and formatting with the FAO FiMES schema in a multi-user environment. In addition, it must be able to load existing fact-sheets, and be able to operate as a stand-alone component.

- [FishFinder](#)

The new reporting VRE for the Vulnerable Marine Ecosystem reporting (VME DB) is a further customization of FCPPS. The VME DB integrates with an online mapping system to provide FAO with the capability to add, edit and share fact-sheets on VME's in a collaborative fashion. It is fully validated in July 2014 and released.

- [VME DB](#)

3.3 BIODIVERSITY DATA FOCUSED VRE'S

The AquaMaps VRE validation completed in November 2012, and is exploited since then. No additional validation comments are required in this report.

- Species distribution map generation with [AquaMaps VRE](#)

The other biodiversity related tools released earlier in the project were further enriched with datasets and several GIS oriented features for discovery and display. These were already validated.

- [BiodiversityResearchEnvironment](#)

The BiodiversityResearchEnvironment community was focused mainly on developing and validating. The results of the P1 validation led to further prioritization of features with the community. This increased focus towards 3 key services; Trendlyzer targeting a specific community, StatisticalManager features to provide a flexible and community extendable processing environment, and FacetedSearch as a search over the Semantic KB produced in iMarine. The BiodiversityLab serves as the VRE offering these services to Biological Sciences Practitioners. Once the features were implemented, the service was enriched with other features for e.g. storing, visualizing and geo-viewing, the BiodiversityLab was released, and, following review recommendation, it was also used e.g. to establish on-line training facilities which were used in several training courses for biology students.

- [BiodiversityLab](#)

The same feature set was used to establish another targeted VRE for the community of Biologists (often overlapping with BiodiversityLab practitioners) who focus more on producing spatial explicit data analysis. Here, the VRE provides facilities to predict marine species distributions; manage several versions of the same datasets, to process those datasets efficiently and to produce Probabilistic Niche Models by exploiting several computational backends: a single multi-core server, distributed services offered by the D4science infrastructure and cloud resources, both commercial and private.

- [Ecological Modeling](#)

Taxonomists often have issues with different names used for the same species, and they were lacking a powerful tool to match names against Taxonomic Authority Files. This led to a collaboration with FAO, that has such a framework for matching (vessel) names, and this was modified and integrated in the iMarine infrastructure. The BiOnym framework thus consists of a collaboratively adjusted set of tools and algorithms that are integrated into the iMarine infrastructure. It aims specifically at taxonomists with larger data-sets, and much less at individual name matching. The validation also included members from the iMarine Board and Extended Board. These concluded the suitability of BiOnym for scientists, but also that user interface and performance need to be improved if additional communities are to be supported as well:

- [BiOnym](#)

3.4 OTHER VRE'S, APPLICATIONS, AND DATASETS

During the iMarine project, new requests for environments, applications, and other resources emerged that were supported by repurposing existing resources to new uses. This also validated the re-usability and cost-effectiveness of components in the e-Infrastructure.

3.4.1 NEW VRE'S

Two new environments based on iMarine technology serving very different communities were identified, analyzed and released. Though not validated in the context of iMarine, they illustrate how new communities can be served nearly out-of-the-cube:

The first serves the data and file sharing needs of scientists at ISTI in Pisa, developed around the iMarine WorkSpace. Although not related to the iMarine project, the required facilities could be quickly delivered as a spin-off of the iMarine project. The activity demonstrated that the infrastructure is capable to heed exploitation demands; the infrastructure is suitable to be quickly adjusted to the needs of a new community, users can be managed autonomously, and serving a considerable number of users is feasible without adding substantial resources.

- SocialISTI

The second redeploys geospatial data discovery, access and management facilities developed geosciences. It was only released in September 2014, and will assist Italian and European geoscientists with their data management. The development time was a mere two weeks. The scope is beyond the iMarine validation effort, but it again exemplifies the flexible and adaptable nature of the infrastructure and its capacity to quickly deliver cost-effective data management solutions. The EGIP VRE combines the Virtual Workspace and the Social Network facilities, provide a collaborative, standard-oriented data publication environment, including semantic technologies with a data catalog, the iMarine GEOExplorer, and the iMarine Statistical Manager.

- EGIP

3.4.2 OTHER APPLICATIONS

Other applications are based on existing services in the community use the iMarine infrastructure to gain access to stable, scalable, managed, and cost-effective resources.

The first example is the SmartFish project's Chimaera portal that uses the infrastructure to store and expose data through an infrastructure based website. For the content composition it relies on integrated semantic services of the Fisheries Linked Open Data set FLOD. SmartFish was established with FAO project funding, and assists practitioners in the fisheries management domain with access to information and data published in three unique existing information systems. These systems are: WIOFish: a regional knowledge base of western Indian Ocean fisheries, FIRMS: an international knowledge base including fisheries and resources from the western Indian Ocean, and StatBase: a database containing fisheries statistics provided by western Indian Ocean countries. Chimaera was validated in the spring of 2014.

- [SmartFish / Chimaera](#)

Although already mentioned above as a VRE above, it is also available as a separate product. It was developed with several communities beyond the iMarine project horizon in mind. The functionality is the same, and it demonstrated that iMarine application are not technically limited to one environment, but can find a habitat in other infrastructures as well. This reduces the risk to new teams, and increases the pool of potential developers and communities considerably

- [Cotrix](#)

3.4.3 DATASETS AND SERVICES

The iMarine infrastructure is also used to host community driven knowledge bases that were created to better integrate the disparate datasets of the community. These data sources are not validated as separate entities, yet several comments emerged during validations that warrant a quick reference to these products.

The first is developed by FAO and focuses on bringing Fisheries information in a Linked Open Data environment, and use this resource to enrich existing content (with uri's) and retrieve information through semantic searches. The Fisheries Linked Open Data initiative now comprises relevant FAO Fisheries reference data and supports e.g. the data retrieval, including maps, in Chimaera. FLOD is a work in

progress, as the data and requirements in FAO are dynamic. The services that were integrated in the iMarine infrastructure were validated in the Spring of 2014 through the Chimaera validation.

- [FLOD](#)

The Top Level Ontology combines data covered by several ontologies and offers the services to search information across these data sources. It was conceived with IRD and developed by FORTH to support semantic fact-sheets in the IRD Tuna Atlas. It combines data from IRD's Ecoscope, FAO FLOD, WoRMS, and FishBase. Version 4 was Delivered in July 2014, with marineTLOimarine with 151 classes and 116 properties.

- [TLO](#)

Another feature of iMarine is the capacity to integrate and / or interoperate with services. The background technologies designed to better support the infrastructural and external services are described in other WP Deliverables, and are not per se part of the validation activity. There are several cases where the community interacts more directly with services, and in some of these cases a validation was performed. The infrastructure offers a generic layer where users can select data, an algorithm, and computing resources. In addition, users can track the progress of individual computations and store processing settings, products, and logs. This enables scientists to perform reproducible science, and iMarine would offer a very innovative and powerful offer to scientist. The validation of the framework revealed that all elements are made available to the community, yet the complete integration requires further effort. The main need is to understand the requirements for reproducibility, citation, storage, and performance, and how much the community is willing to pay for these. Then infrastructure developers can implement these requirements relying on the existing framework that already supports the above requirements. This is evidenced in several publications and on-line services, such as the recently released MaxEnt.

The two most relevant ones from a community perspective are WPS for IRD, and SPREAD in the Statistical Service for FAO. These community specific WPS services now number 16, and are available from either IRD (mdst-macroes.ird.fr:8084) or Terradue (wps01.i-marine.d4science.org). They serve specific needs of the semantic fact-sheets community related to tuna fisheries data and are developed and maintained by these 2 consortium partners. Serving the needs of these well-defined users, the validation was done successfully directly on the services.

- [WPS](#)

SPREAD, the algorithm to re-allocate species data from one geospatial resolution to another, relies on knowledge on the relation between geospatial areas, typically contained in intersections, and the species information related to one or more species characteristics. It was made available through the Statistical manager, and validated at the level of technology integration, as it not a community facing tool.

- [Spread](#)

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