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DISCLAIMER

BlueBRIDGE (675680) is a Research and Innovation Action (RIA) co-funded by the European Commission under the Horizon 2020 research and innovation programme

The goal of BlueBRIDGE*, Building Research environments for fostering Innovation, Decision making, Governance and Education to support Blue growth*, is to support capacity building in interdisciplinary research communities actively involved in increasing the scientific knowledge of the marine environment, its living resources, and its economy with the aim of providing a better ground for informed advice to competent authorities and to enlarge the spectrum of growth opportunities as addressed by the Blue Growth societal challenge.

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

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GLOSSARY

ABBREVIATION	DEFINITION
CoP	Community of Practice.
EBIAT	Earnings Before Interest Alter Taxes – an aquaculture investment indicator.
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization – an aquaculture investment indicator.
FCR	Feed Conversion Rate – an aquaculture performance indicator.
GPD	Growth Rate per Day – an aquaculture performance indicator.
IRR	Internal Rate of Return – an aquaculture investment indicator.
LTD	Life To Date – a qualifier for aquaculture performance indicators, e.g. LTD SGR.
MR	Mortality Rate – an aquaculture performance indicator.
NPV	Net Present Value – an aquaculture investment indicator.
SFR	Suggested Feeding Rate – an aquaculture performance indicator.
SGR	Specific Growth Rate – an aquaculture performance indicator.
Virtual Laboratory	A VRE conceived to serve the needs arising in a specific research question and/or in a given region / area and /or in a given Community of Practice.
VLab	Virtual Laboratory.
VRE	Virtual Research Environment - an innovative, web-based, community-oriented, comprehensive, flexible, and secure working environment conceived to serve the needs of a given community engaged in a (research) task.
WP	Work Package.

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DELIVERABLE SUMMARY

Virtual Research Environments and Virtual Laboratories are among the key products the BlueBRIDGE project is called to develop and to deliver to serve its target communities and application scenarios. The deployment and operation of a Virtual Research Environment is a task that involves the reuse of existing technologies as well as the development of new technologies aiming at offering new facilities. The development of the technology, both the generic as well as that which is oriented to serve the specific needs of a given community/target scenario, is captured by other deliverables. This report describes the activities performed to provide the BlueBRIDGE community with the set of Virtual Research Environments (VREs) and Virtual Laboratories (VLabs) hosted by the BlueBRIDGE portal during the entire duration of the project. A total of **66** VREs / VLabs have been deployed and operated, overall serving **more than 3000 users** across **32 countries** and **124 different organizations**. Such VREs / VLabs include "private" ones (66% circa), i.e. environments whose membership is by invitation only, "restricted" ones (15% circa), i.e. environments that users can request to join yet the requests have to be explicitly approved by the managers, and "open" ones (18% circa), i.e. environments that any user can request to join and no approval is needed. The 45% circa of the served users is exploiting "open" environments, the 34% circa is exploiting "private" environments, and the 19% circa is exploiting "restricted" environments. During the project, **more than 980 requests for support, incident or bug have been resolved** (441 requests for support and 546 requests for incidents and bugs).

EXECUTIVE SUMMARY

Virtual Research Environments (VREs) and Virtual Laboratories (VLabs) are "systems" specifically conceived to provide their users with a web-based set of facilities (including services, data and computational facilities) to accomplish a set of tasks by dynamically relying on the underlying infrastructure. VREs and VLabs are among the key products to be developed and delivered by the BlueBRIDGE project to support the target communities and application scenarios, namely *Blue Assessment, i.e.,* supporting the collaborative production of scientific knowledge required for assessing the status of fish stocks and producing a global record of stocks and fisheries; *Blue Economy, i.e.,* supporting the production of scientific knowledge for analysing socio-economic performance in aquaculture; *Blue Environment, i.e.,* supporting the production of scientific knowledge for fisheries & habitat degradation monitoring; and, *Blue Skills, i.e.,* boosting education and knowledge bridging between research and innovation in the area of protection and management of marine resources, giving them a new volume and thematic and geographical reach.

From the development and operation perspective there is no major difference between VREs and VLabs, they are based on the same enabling technology and are governed by the same procedures and policies. The rationale leading to name them differently results from the willingness to highlight their diversity in scope. VREs are devised to serve larger communities and cases than VLabs. In essence, VREs are dedicated to discussing and developing various approaches and solutions to be applied to concrete cases and scenarios. VLabs are devised to serve specific communities and practitioners confronting a given research question.

The development of VREs and VLabs is based on three main activities: (i) the development of software artefacts that realise a set of functions (including those needed for accessing certain datasets), (ii) the deployment of these artefacts in an operational infrastructure, and (iii) the final deployment and operation of well-defined Virtual Research Environments and Virtual Laboratories by exploiting the facilities offered by the deployed infrastructure and its services.

This report documents the last of the above three activities – i.e. the exploitation of the services and technologies offered by the underlying infrastructure to serve the needs of defined scenarios – as implemented in the context of the entire BlueBRIDGE project from September 2015 to February 2018. It complements and extend the content of D4.3 BlueBRIDGE VREs Operation Activity: Interim Report that reported on the activity and results up to November 2016.

As of February 2018, a total of **9 VREs and 57 VLabs** were created and operated. In particular, the following *9 VREs / VLabs were inherited from iMarine*[1]: **Bay of Bengale Large Marine Ecosystem Hilsa Assessment WG VRE** was deployed to provide the members of the Hilsa Assessment Working Group[2] with a working environment giving access to data and technical information for this fish species stock assessment; **BiodiversityLab** was deployed to support the needs of scholars willing to perform experiments (e.g. species distribution maps production, species data inspection) on single individuals or groups of marine species; **BiOnym** was deployed to provide scientists dealing with species names with a service (ByOnym) to compare a set of scientific names against taxonomic reference lists including recognised ones; **FAO Tuna Atlas** was deployed to offer facilities for harmonising and standardizing multiple data source on tuna and bill-fish catches to feed 2 FAO tools: the Atlas of Tuna and Billfish Catches, the global tuna catches by stock; **iSearch** was deployed to provide its users with information retrieval and semantic web facilities for seamlessly discovering information objects from heterogeneous data sources; **Scalable Data Mining** was deployed to provide its users with a rich array of ready-to-use data analytics methods including niche modelling,

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[1] http://www.i-marine.eu

[2] The WG is convened on an ad-hoc base. The group counts some 15 members and is led by a consultant contracted through the BOB-LME project. Currently the project is awaiting approval of its second phase.

supervised machine learning workflows, Bayesian models; *Tabular Data Lab* was deployed to provide its users with a working environment supporting the management of tabular data, i.e. to import, curate, analyse, visualize and publish tabular data resources in a collaborative way; *Vulnerable Marine Ecosystem (VME) DB* was deployed to support the development and storage of Fact Sheets on VMEs; *WECAFC-FIRMS* was deployed to support national data collection and regional data sharing through FIRMS to support priority regional fishery management plans in the WECAFC area. During the project, these VREs / VLabs have been updated to rely on the latest services and facilities resulting from BlueBRIDGE developments. Among the enhancements, worth to cite the new version of the data analytics framework and its support for Open Science practices, the enhanced version of the geospatial data catalogue, the new resource catalogue as well as the enhancements for collaboration and communication based on social networking.

The following *57 VREs / VLabs were original creation of the BlueBRIDGE project*.

In particular, the following 9 originates from the *Blue Assessment* domain: *CWP Secretariat* was conceived to support the development and maintenance of the catalogue of the Coordinating Working Parties (CWP) on Fisheries Statistics; *French Tropical Tuna Atlas* was conceived to support the handling of public domain data from various French (Tuna) Regional Fisheries Management Organizations (T-RFMOs); *Global Record of Stocks and Fisheries (GRSF)* was deployed to provide its users with unified access to authoritative stocks and fisheries records resulting from the aggregation of data from multiple sources performed by the GRSF Admin VRE; *GRSF Admin* was deployed to support the production of the authoritative stocks and fisheries records populating the GRSF VRE; *ICCAT (ICCAT_BFT-E)* was deployed to provide the International Commission for the Conservation of Atlantic Tunas with a demonstrative / training environment with the BlueBRIDGE capacities and capabilities on stock assessment; IOTC SS3 was conceived to host codes necessary to run the Stock Synthesis version 3 (SS3) stock assessment model (a widely-used statistical catch-at-age model) and make it available as-a-Service as well as to visualize and store the standardized outputs; SDI Lab was conceived to support a workshop gathering data managers (around 30 people) from different French institutes (e.g. CNRS, INRA, IRD) to discuss methods to set up a workflow for spatial metadata, data and related services; *Stock Assessment* was deployed to support the needs and discussions arising in the context of Task 5.1, i.e. to support the design and development of innovative stock assessment workflows and methods. In the second period it was transformed in a VLab to showcase the methods and approaches developed; *Stocks & Fisheries Knowledge Base* was deployed to support the needs and discussions arising in the context of Task 5.2, i.e. to support the development of methods and approaches for the development of a global knowledge base of stock and fisheries (the GRSF).

The following 14 originates from the *Blue Economy* domain: *Alieia VRE*, *ARDAG Aquaculture, Ellinika Psaria VRE*, *Forky's VRE*, *GALAXIDI Marine Farm*, *iLKNAK Aquaculture*, *KIMAGRO Fishfarming*, *MARKELLOS Aquaculture*, *NHREUS Aquaculture*, *STRATOS Aquacultures* were deployed to serve the homonymous aquaculture company by providing each of them with a set of aquafarming assessment tools to perform evaluation growth analysis and techno economic investment analysis; *Performance Evaluation in Aquaculture* was deployed to support the needs and discussions arising in the context of Task 6.1, i.e. to support the development of methods and approaches for understanding the performance of an aquafarm; *SIASPA: Strategic Investment Analysis and Scientific Planning/Alerting* was deployed to provide its users with an environment offering a geospatial multi-factor optimization and alerting platform for intelligent identification of locations of interest for investors and stakeholders seeking optimization of intended investments and scientists seeking areas that are becoming of environmental importance; *Strategic Investment Analysis* was deployed to support the needs and discussions arising in the context of Task 6.2, i.e. to support the development of methods and approaches for supporting the identification of locations of interest for aquafarm investors and stakeholders; *Sustainable Blue Economy* was conceived to offer a complete set of tools developed for the Blue Economy domain, targeting stakeholders, investors, researchers and others.

The following 2 originates from the *Blue Environment* domain: *Aquaculture Atlas Generation* was deployed to support the needs and discussions arising in the context of Task 7.1, i.e. to support the development of methods and approaches for the effective and efficient production of aquaculture products (maps of human activity and natural zones) contributing to an aquaculture atlas compliant with FAO National

Aquaculture Sector Overview (NASO) standards. In a second phase the VRE has been transformed in a VLab and opened to users beyond the project consortium to showcase the tools specifically developed; *Protected Area Impact Maps* was deployed to support the needs and discussions arising in the context of Task 7.2, i.e. to support the development of methods and approaches for reporting on marine features that are important for biodiversity such as seagrass, mangroves, reefs and geomorphology (seamounts, canyons, etc.) as well as human use features which may pose threats to biodiversity (aquaculture) in marine managed areas. In a second phase it has been transformed in a VLab to showcase the tools specifically developed to an audience going beyond the project consortium.

The following 20 originates from the *Blue Skills* domain: *Aquaculture Training Lab* was deployed to provide its users with a demonstrative / training environment of the aquafarming assessment tools to perform the evaluation growth analysis and techno economic investment analysis; *Blue Datathon* was created to support the datathon co-organised by the RDA-Europe and BlueBRIDGE from June 15 to 16, 2017, in Heraklion, Crete, Greece; *ICES Bayesian Network Analysis, ICES DALSA: ICES Training Course on Data Limited Stock Assessment*, *ICES DASC: ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes*, *ICES FIACO: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics*, *ICES FIACO 2017: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics*, *ICES Introduction to Abundance Estimation from Fisheries Acoustic surveys*, *ICES Introduction to Stock Assessment*, *ICES Introduction to the R Environment 2017*, *ICES Loogbook Data: ICES Training Course on WMS and EU logbook Data*, *ICES MSE: ICES Training Course on Management Strategy Evaluation*, *ICES MSY: ICES Training Course on Methods for setting proxy Maximum Sustainable yeld reference points*, *ICES Online Oceanography*, *ICES SA: ICES Training Course on Stock Assessment Advanced*, *ICES TCRE: ICES Training Course in the R Environment*, *ICES TCSSM: ICES Training Course on Social Science Methods for Natural Scientists* have been created to support the homonymous ICES courses; *InfraTraining* was created to showcase the basic facilities of the underlying infrastructure; *Knowledge Bridging* was deployed to serve the needs and discussions arising in the context of the Blue Skills project objective / activity; *SDG Indicator 14.4.1* was developed to support the FAO training workshop on "Best-practices for the implementation and reporting of SDG Indicator 14.4.1 - Percentage of biologically sustainable fish stocks" by Dr. Yimin YE, FAO FIAF Branch Chief at FAO Headquarters.

The following 12 were created to support other project activities (e.g. the cooperation and collaboration among the consortium members, the willingness to offer generic environments): *Analytics Lab* was deployed to provide its users with a small collection of generic Machine Learning (ML) and Statistical Processing algorithms for Big Data including Bayesian Methods (e.g. Feed Forward Neural Network Trainer, Feed Forward Neural Network Regressor), Data Clustering (e.g. Dbscan, Kmeans, Lof, Xmeans), and Time Series Analysis; *Aquabiotech* was deployed to support the AquaBioTech Group, an international research and development, engineering, technology provider and consulting company located in Malta to study the nutrition dispersion and retention in the environment surrounding a local fish farm; *Blue Commons* was deployed to serve the needs and discussions arising in the context of the Blue Commons project objective / activity; *Blue Uptake* was deployed to serve the needs and discussions arising in the context of the Blue Uptake project objective / activity; *BlueBRIDGE-EAB* was deployed to serve the needs and discussions arising in the context of the project External Advisory Board; *BlueBRIDGE Project* was deployed to serve the needs and discussions arising in the context of the project; *BlueBRIDGE PSC* was deployed to serve the needs and discussions arising in the context of the Project Steering Committee; *BlueBRIDGE Review* was deployed to support project review events and facilitate the communication between project consortium and the reviewers; *DRuMFISH* (cf. Sec. 3.18) was designed to support the activities of the DRuMFISH[3] Lorient meeting (21-23 March 2017) focussing on CMSY and its usage to produce Harvesting Control Rules and exploitation/profitability scenarios for fisheries; *R Prototyping Lab* was deployed to provide its users with a complete development and integration environment for R including BlueBRIDGE data analytics platform (Dataminer, SAI) and RStudio®; *RStudio Lab* was deployed to provide its users with a development environment for R based solely on RStudio®, *Sinay* (cf. Sec. 3.57) was designed to support the Sinay

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[3] DRuMFISH is an EU Project aiming at advising on the status and management of data-poor stocks in mixed fisheries.

company aiming at (a) produce model-based habitat maps of cetaceans, (b) produce model-based noise footprint maps of selected offshore activities, (c) assess risk and potential impacts.

Such VREs / VLabs include "private" ones (66% circa), i.e. environments whose membership is by invitation only, "restricted" ones (15% circa), i.e. environments users can request to join yet the requests have to be explicitly approved by the managers, and "open" ones (18% circa), i.e. environments any user can request to join and no approval is needed.

These VREs / VLabs are serving **more than 3000 users** in total spread across **32 countries** and **124 different organizations**. The 45% circa of the served users is exploiting "open" environments, the 34% circa is exploiting "private" environments, and the 19% circa is exploiting "restricted" environments. The **top 10 countries** are: France (12.39%), Italy (11.23 %), Greece (9.79 %), UK (7.92%) Denmark (7.34%), Norway (5.33%), Germany (5,00%), Spain (4.84 %), Ireland (3.39%), Netherland (2.74 %). The **top 10 organisations** are: International Council for the Exploration of the Sea - ICES (4.12%), National Research Council of Italy - CNR (3.61%), The International Centre for Research on the Environment and the Economy - ICRE8 (3.48%), Institute of Marine Research - IMR (3.09%), Institut de recherche pour le développement - IRD (2.97%), Food and Agriculture Organization of the United Nations - FAO (2.96%), Centre for Environment, Fisheries and Aquaculture Science - CEFAS.gov.uk (2.19%), Marine Institute Foras na Mara - Marine.ie (2.06%), French Research Institute for Exploitation of the Sea - Ifremer (1.93%), Wageningen University - (WUR.NL) (1.90%).

During the project, more than **980 requests for support, incident or bug have been resolved** (441 requests for support and 546 requests for incidents and bugs).

1   INTRODUCTION

BlueBRIDGE WP4 "VREs Deployment and Operation" is called to deploy and operate the Virtual Research Environments and Virtual Laboratories identified and enacted by the technology resulting from WP5 Supporting Blue Assessment: VREs Development, WP6 Supporting Blue Economy: VREs Development, WP7 Supporting Blue Environment: VREs Development, WP8 Support Blue Skills: VREs Development as well as those enabled by the technology developed in WP9 VRE Commons Development and WP10 Interfacing Infrastructures.

Virtual Research Environments and Virtual Laboratories [7] are "systems" aiming at providing their users with web-based working environments offering the entire spectrum of facilities (including services, data, and computational facilities) needed to accomplish a given task by dynamically relying on the underlying infrastructure. VREs and VLabs are the key products to be delivered by the BlueBRIDGE project to meet the needs of its target community and scenarios. From the development and operation perspective there is no major difference among VREs and VLabs; they are based on the same enabling technology and are governed by the same procedures and policies.[4] The rationale leading to name them differently results from the willingness to highlight their diversity in scope. VREs are devised to serve larger communities and cases than VLabs. In essence, VREs are dedicated to discussing and developing various approaches and solutions to be applied to concrete cases and scenarios by VLabs. VLabs are devised to serve specific communities and practitioners confronting a given research question.

This deliverable details the activity leading to the deployment and operation of a series of Virtual Research Environments and Virtual Laboratories addressing the needs of the cases and scenarios falling under the domain of the "blue pillars": *Blue Assessment, i.e.,* supporting the collaborative production of scientific knowledge required for assessing the status of fish stocks and producing a global record of stocks and fisheries; *Blue Economy, i.e.,* supporting the production of scientific knowledge for analysing socio-economic performance in aquaculture; *Blue Environment, i.e.,* supporting the production of scientific knowledge for fisheries & habitat degradation monitoring; and, *Blue Skills, i.e.,* boosting education and knowledge bridging between research and innovation in the area of protection and management of marine resources, giving them a new volume and thematic and geographical reach. The expectations and plans characterising VREs / VLabs are captured by dedicated deliverables: D5.3 Blue Assessment VRE Specification: Revised Version [5], D6.3 Blue Economy VRE Specification: Revised Version [9], Blue Environment VRE Specification: Revised Version [10].

This activity leads to the deployment and operation of a total of *9 VREs and 57 VLabs* during the project. Overall, these VREs / VLabs are serving the needs of *more than 3000 users* in total spread across *32 countries* and *124 different organizations* (cf. Sec. 3).

The remainder of this report is organised as follows: Section 2 describes the policies and procedures governing the planning and deployment of Virtual Research Environments and Virtual Laboratories. Section 3 describes the Virtual Research Environments and Virtual Laboratories that have been deployed and operated during the period. For each Virtual Research Environment / Virtual Laboratory, the deliverable describes the goal and the main facilities offered to their users. Section 4 reports conclusions.

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[4] Because of this, in the remainder of the report, the terms "VRE" and "VLab" are used like synonymously.

2   VRES PLANNING AND PROCEDURES

Deployment and operation of VREs and VLabs is a collaborative effort involving the WP4 team called to deploy and configure the technology to create VREs / VLabs expected by the "blue pillars" as well as the work packages working to develop the enabling technology, i.e. (i) WP5-8 that focus on designing and developing technology specific to Blue Assessment, Blue Economy, Blue Environment, and Blue Skills VREs and (ii) WP9-10 that design and develop generic solutions supporting all the VREs.

The characterisation of the VREs and VLabs expected to serve the needs and objectives of Blue Assessment, Blue Economy, Blue Environment, and Blue Skills is captured by a series of specific deliverables [2][5][9][10]. The procedure leading to the creation of a VRE from the WP4 perspective is described in the section below.

2.1   PROCEDURE

The procedure leading to VRE deployment is a consolidated one, i.e. it is the procedure inherited from the D4Science infrastructure and described in the D4Science Wiki:

https://wiki.d4science.org/index.php?title=Virtual_Research_Environments_Deployment_and_Operation

For the needs of BlueBRIDGE, it was decided to support this activity by the project activity tracker. A specific **VRE tracker** has been created with the goal of capturing the entire process from specification to operation. The following statuses are supported:

- **New**: the specification of the VRE is produced by the VRE designer / requester. This specification must contain:
    - VRE name and abstract;
    - Membership policy, i.e. whether the VRE is open or restricted, who is allowed to invite members;
    - VRE expected datasets;
    - VRE expected functionalities;
    - VRE due date;

- **Planned**: the WP4 team is fine with the specification, i.e. the specification contains enough details to proceed with the creation, and acknowledges that the creation of the VRE is feasible by the due date initially requested (or liaise with the designer / requester to find a mutually suitable date);

- **Available**: the VRE is up and running and ready to be validated by the VRE designer / requester;

- **Released**: the VRE has been validated and the target community can start using it;

- **Removed**: the VRE has been disposed of request of its manager;

- **Rejected**: the requested VRE cannot be created as the requirements outlined for it cannot be satisfied.

2.2   PLAN

The actual plan is captured by a series of tickets and is available via a dedicated live report in the activity tracker:

https://support.d4science.org/projects/bluebridge/issues?query_id=48

A screenshot of this report is available in Figure 1. The report collects all the tickets leading to the creation / update of a VRE / VLab, clusters them by the current status of the request, and clearly indicate the percentage completed with respect to the planned task. By relying on this facility, the key players involved in the activity are immediately informed of any possible issue or action performed or to be performed.

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✔ #	Tracker ▲	Status	Priority	Subject	Assignee	Updated	% Done	Due date	Sprint
⊟ **New** 2									
⊟ **Planned** 4									
⊟ **In Progress** 2									
☐ 5886	VRE	In Progress	Normal	GRSF_Admin	Leonardo Candela	Nov 28, 2016 09:36 AM		Nov 25, 2016	WP05
☐ 1679	VRE	In Progress	Normal	ICES Stock Assessment VRE	Scott Large	Nov 21, 2016 02:05 PM		Oct 01, 2016	WP05
⊟ **Available** 5									
☐ 4840	VRE	Available	High	Blue Economy VRE: Forky's	Gerasimos Antzoulatos	Nov 07, 2016 03:21 PM			WP06
☐ 1620	VRE	Available	Normal	Blue Economy VRE 2.1 - Strategic Investment analysis and Scientific Planning/Alerting VRE	Massimiliano Assante	Nov 23, 2016 10:35 AM		Nov 11, 2016	WP06
☐ 4838	VRE	Available	Urgent	Blue Economy VRE: Alieia	Gerasimos Antzoulatos	Nov 07, 2016 03:21 PM			WP06
☐ 4841	VRE	Available	High	Blue Economy VRE: Ellinika Psaria	Gerasimos Antzoulatos	Nov 07, 2016 03:21 PM			WP06
☐ 1675	VRE	Available	Normal	GRSF VRE; Global Record of Stocks and Fisheries	Anton Ellenbroek	Nov 07, 2016 11:29 AM			WP05
⊟ **Released** 15									
☐ 5688	VRE	Released	Immediate	Blue Economy/Blue Skills: AquacultureTrainingLab	Leonardo Candela	Nov 11, 2016 08:52 AM			WP08
☐ 4894	VRE	Released	High	BlueBridge RStudio VRE	Massimiliano Assante	Oct 10, 2016 07:15 PM			WP08
☐ 3145	VRE	Released	Normal	Create VRE for ICES training course on Social Science Methods for Natural Scientists	Massimiliano Assante	May 19, 2016 09:12 AM		May 02, 2016	WP04
☐ 2338	VRE	Released	Normal	Deploy BlueBRIDGE EAB VRE	Leonardo Candela	Feb 22, 2016 03:48 PM		Feb 22, 2016	WP04
☐ 1676	VRE	Released	Normal	ICES Training Course in the R Environment (TCRE)	Mike Drew	Feb 22, 2016 03:48 PM		Jan 11, 2016	WP08
☐ 1547	VRE	Released	Normal	ICES training course, Data Limited Stock Assessment	Massimiliano Assante	Sep 08, 2016 06:24 PM		Aug 31, 2016	WP08
☐ 1546	VRE	Released	Normal	ICES training course, Stock Assessment Advanced	Anna Davies	Oct 24, 2016 04:11 PM		Oct 31, 2016	WP08
☐ 5535	VRE	Released	Normal	ICES training course: Stock Assessment Advanced	Anna Davies	Oct 25, 2016 02:09 PM		Oct 31, 2016	WP08
☐ 5016	VRE	Released	High	RPrototypingLab Deployment	Leonardo Candela	Oct 03, 2016 09:25 AM			WP04
☐ 5536	VRE	Released	Normal	Request for ICES training course, Principles and methods of broadband/wideband technologies: application to fisheries acoustics	Anna Davies	Oct 25, 2016 05:06 PM		Oct 28, 2016	WP08
☐ 5493	VRE	Released	Normal	Revise FAO Tuna Atlas VRE: Enlarge the pool of DataMiner Algorithms and make SAI available	Roberto Cirillo	Nov 07, 2016 02:41 PM		Oct 17, 2016	WP05
☐ 4846	VRE	Released	High	VRE Creation for ICCAT BFT-E	Roberto Cirillo	Sep 22, 2016 04:44 PM		Sep 12, 2016	WP08
☐ 4611	VRE	Released	Normal	VRE request for ICES training course on Data Limited Stock Assessment	Massimiliano Assante	Sep 08, 2016 06:24 PM		Aug 31, 2016	WP08
☐ 4612	VRE	Released	Normal	VRE request for ICES training course on Design and analysis of statistically sound catch sampling programmes	Massimiliano Assante	Sep 08, 2016 06:24 PM		Aug 31, 2016	WP08
☐ 5136	VRE	Released	High	WECAFC-FIRMS: Add TabMan and Dataminer	Anton Ellenbroek	Nov 17, 2016 04:39 PM		Nov 04, 2016	WP05
⊟ **Removed** 4									
☐ 1677	VRE	Removed	Normal	Ecopath VRE	Jeroen Steenbeek	Oct 18, 2016 08:03 PM		Oct 01, 2016	WP05
☐ 1549	VRE	Removed	Normal	ICES training course, Design and analysis of statistically sound catch sampling programmes	Anna Davies	Oct 18, 2016 08:04 PM			WP08
☐ 1545	VRE	Removed	Normal	ICES training course, Management Strategy Evaluation	Massimiliano Assante	Sep 05, 2016 05:13 PM		Sep 09, 2016	WP08
☐ 1779	VRE	Removed	High	IRD BFT Assessment	Julien Barde	Oct 03, 2016 09:13 AM		Oct 01, 2016	WP05

Figure 1. VRE Plan Report

3   VRES CREATION, DEPLOYMENT AND OPERATION

This section briefly describes the facilities used by VRE creators for the actual deployment of VREs / VLabs, reports the complete list of deployed and operated VREs / VLabs, and offers a characterisation of each available VRE / VLab.

The act of definition and deployment of a new VRE / VLab is supported by a wizard (cf. Figure 2) that enables authorised users to transform the opened requests according to the procedure described in Sec. 2 into an actual specification and then, automatically, into a working VRE / VLab made available by the BlueBRIDGE gateway [3]. Through the wizard, the user is requested to specify: (i) the descriptive information characterising the expected VRE / VLab (i.e. name, description, duration), and (ii) the functionalities and datasets to be made available in the specific VRE / VLab by selecting among the available ones. The resulting list of functionalities is derived from the feasible functionalities crated thanks to the software version and services hosted by the underlying infrastructure (a detailed record of the software resulting from BlueBRIDGE is documented in a dedicated report [8]).
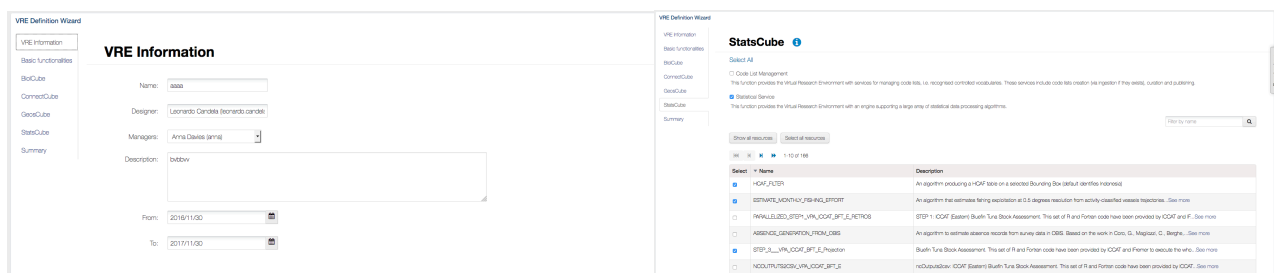
Figure 2. VRE Creation Wizard Screenshots

A total of ***66 VREs / VLabs were created and/or operated*** to serve the needs arising in the context of the BlueBRIDGE project (the complete list is in Table 1). In particular, the following *9 VREs / VLabs were inherited by iMarine*[5]: *Bay of Bengale Large Marine Ecosystem Hilsa VRE* (cf. Sec. 3.7); *BiodiversityLab* (cf. Sec. 3.8); *BiOnym* (cf. Sec. 3.9); *iSearch* (cf. Sec. 3.44); *Scalable Data Mining* (cf. Sec. 3.53); *TabularDataLab* (cf. Sec. 3.63); *Tuna Atlas* (cf. Sec. 3.64); *Vulnerable Marine Ecosystem (VME) DB* (cf. Sec. 3.65); *WECAFC-FIRMS* (cf. Sec. 3.66).

The following *57 VREs / VLabs* were original creations of the BlueBRIDGE project. In particular, the following 9 VREs / VLabs originated from Blue Assessment [5]: CWP Secretariat (cf. Sec. 3.17), French Tropical Tuna Atlas (cf. Sec. 3.21), Global Record of Stocks and Fisheries (GRSF) (cf. Sec. 3.23), GRSF Admin (cf. Sec. 3.24), ICCAT BFT-E (cf. Sec. 3.25), IOTC SS3 (cf. Sec. 3.43), SDI Lab (cf. Sec. 3.55), Stock Assessment (cf. Sec. 3.58), Stocks & Fisheries Knowledge Base (cf. Sec. 3.59)

The following 14 VREs / VLabs originated from Blue Economy. In particular, Alieia VRE (cf. Sec. 3.1), ARDAG Aquaculture (cf. Sec. 3.6), Ellinika Psaria VRE (cf. Sec. 3.19), Forkys VRE (cf. Sec. 3.20), GALAXIDI Marine Farm (cf. Sec. 3.22), iLKNAK Aquaculture (cf. Sec. 3.41), KIMAGRO Fishfarming (cf. Sec. 3.45), MARKELLOS Aquaculture (cf. Sec. 3.47), NHREUS Aquaculture (cf. Sec. 3.48), Performance Evaluation in Aquaculture (cf. Sec. 3.49), STRATOS Aquacultures (cf. Sec. 3.61), SIASPA: Strategic Investment Analysis and Scientific Planning/Alerting (cf. Sec. 3.56), Strategic Investment Analysis (cf. Sec.3.60) Sustainable Blue Economy (cf. Sec. 3.62).

The following 2 VREs / VLabs originated from Blue Environment: Aquaculture Atlas Generation (cf. Sec. 3.4), Protected Area Impact Maps (cf. Sec. 3.50).

The following 20 VREs / VLabs originated from Blue Skills[6]: Aquaculture Training Lab (cf. Sec. 3.5), Blue Datathon (cf. Sec. 3.11), ICES Bayesian Network Analysis (cf. Sec. 3.26), ICES DALSA: ICES Training Course on

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[5] http://www.i-marine.eu

[6] However, in addition to the listed ones other VREs has been exploited to support Blue Skills training events, e.g. Analytics Lab.

Data Limited Stock Assessment (cf. Sec. 3.27), ICES DASC: ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes (cf. Sec. 3.28), ICES FIACO: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics (cf. Sec. 3.29), ICES FIACO 2017: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics (cf. Sec. 3.30), ICES Introduction to Abundance Estimation from Fisheries Acoustic surveys (cf. Sec. 3.31), ICES Introduction to Stock Assessment (cf. Sec. 3.32), ICES Introduction to the R Environment 2017 (cf. Sec. 3.33), ICES Loogbook Data: ICES Training Course on WMS and EU logbook Data (cf. Sec. 3.34), ICES MSE: ICES Training Course on Management Strategy Evaluation (cf. Sec. 3.35), ICES MSY: ICES Training Course on Methods for setting proxy Maximum Sustainable yeld reference points (cf. Sec. 3.36), ICES Online Oceanography (cf. Sec. 3.37), ICES SA: ICES Training Course on Stock Assessment Advanced (cf. Sec. 3.38), ICES TCRE: ICES Training Course in the R Environment (cf. Sec. 3.39), ICES TCSSM: ICES Training Course on Social Science Methods for Natural Scientists (cf. Sec. 3.40), InfraTraining (cf. Sec. 3.42), Knowledge Bridging (cf. Sec. 3.46), SDG Indicator 14.4.1 (cf. Sec. 3.54).

The following 12 VREs / VLabs originated from other project activities: Analytics Lab (cf. Sec. 3.2), Aquabiotech (cf. Sec. 3.3), Blue Commons (cf. Sec. 3.10), Blue Uptake (cf. Sec. 3.12), BlueBRIDGE EAB (cf. Sec. 3.13), BlueBRIDGE Project (cf. Sec. 3.14), BlueBRIDGE PSC (cf. Sec. 3.15), BlueBRIDGE Review (cf. Sec. 3.16), DRuMFISH (cf. Sec. 3.18), R Prototyping Lab (cf. Sec. 3.51), RStudio Lab (cf. Sec. 3.52), Sinay (cf. Sec. 3.57).

In Figure 3, the number of VREs and VLabs operated per month is reported. During the first months of the project, available VREs and VLabs include those inherited by iMarine and those created for supporting project activities. From August '16 on, new VLabs began being deployed thanks to the new technology and facilities produced and released by BlueBRIDGE.
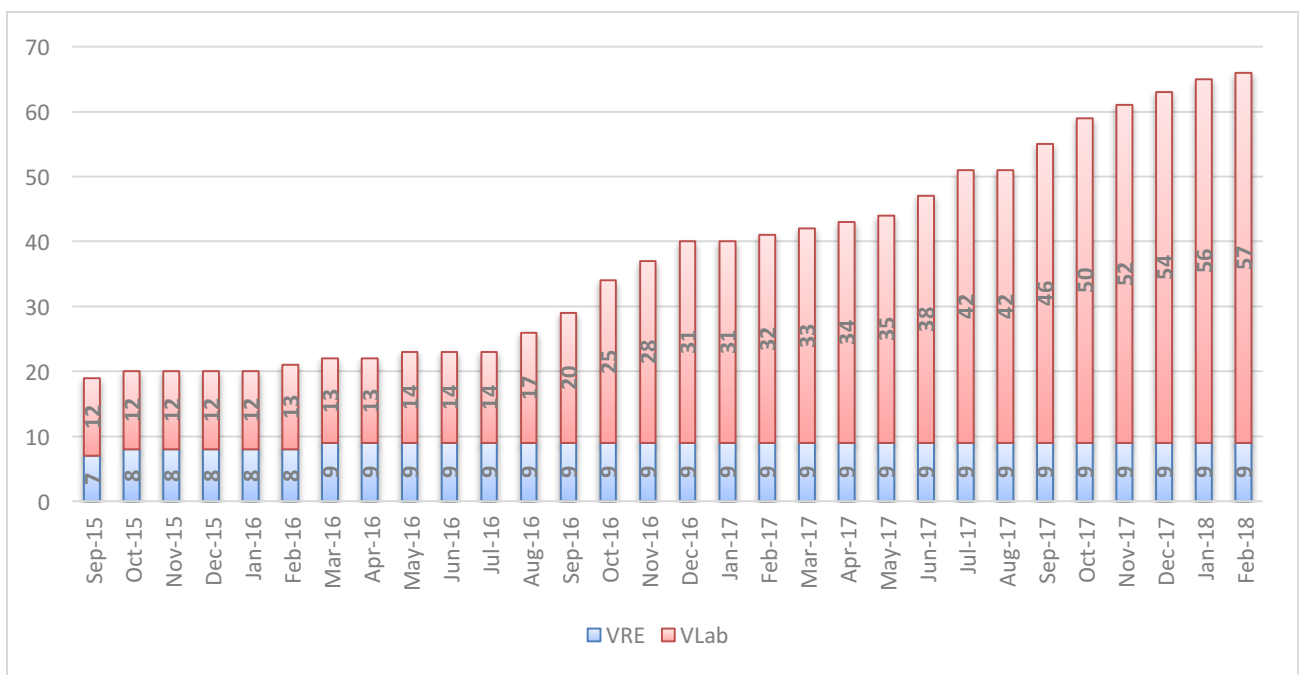
Figure 3. Number of VREs and VLabs supported by BlueBRIDGE

In Figure 4 it is reported the distribution of VREs / VLabs with respect to the membership policy. It can be observed that 66% circa of the VREs / VLabs (44 out of 66) is "private", i.e. membership is by invitation only. This is because the developed environments are conceived to serve the needs of known communities of practices. The 15% circa (10 out of 66) of the deployed VREs / VLabs is "restricted", i.e. users can request to join yet the requests have to be explicitly approved by the managers. Finally, the 18% of VREs / VLabs are "open", i.e. any user can request to join and no approval is needed.
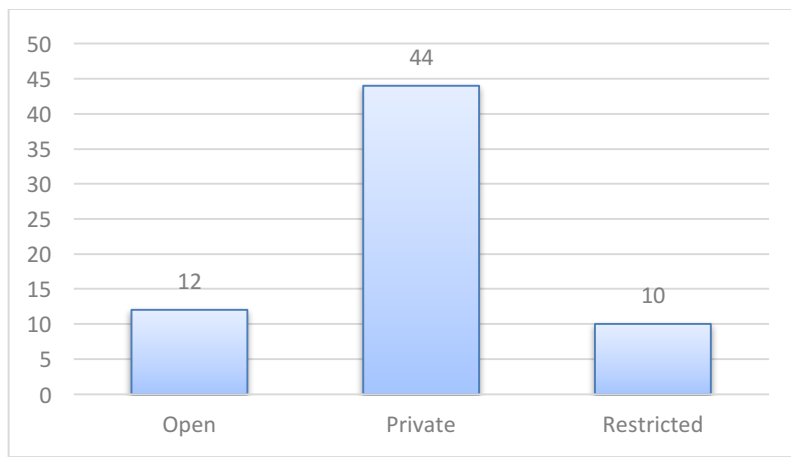
Figure 4. Number of VREs / VLabs by membership typology

In Figure 5, the overall number of users benefitting from the facilities offered by the existing VREs / VLabs is reported, i.e. in February '18 the 66 existing VREs / VLabs are serving **more than 3000 users**. Detailed figures per VRE / VLab are reported in the VRE / VLab dedicated sections of this document.
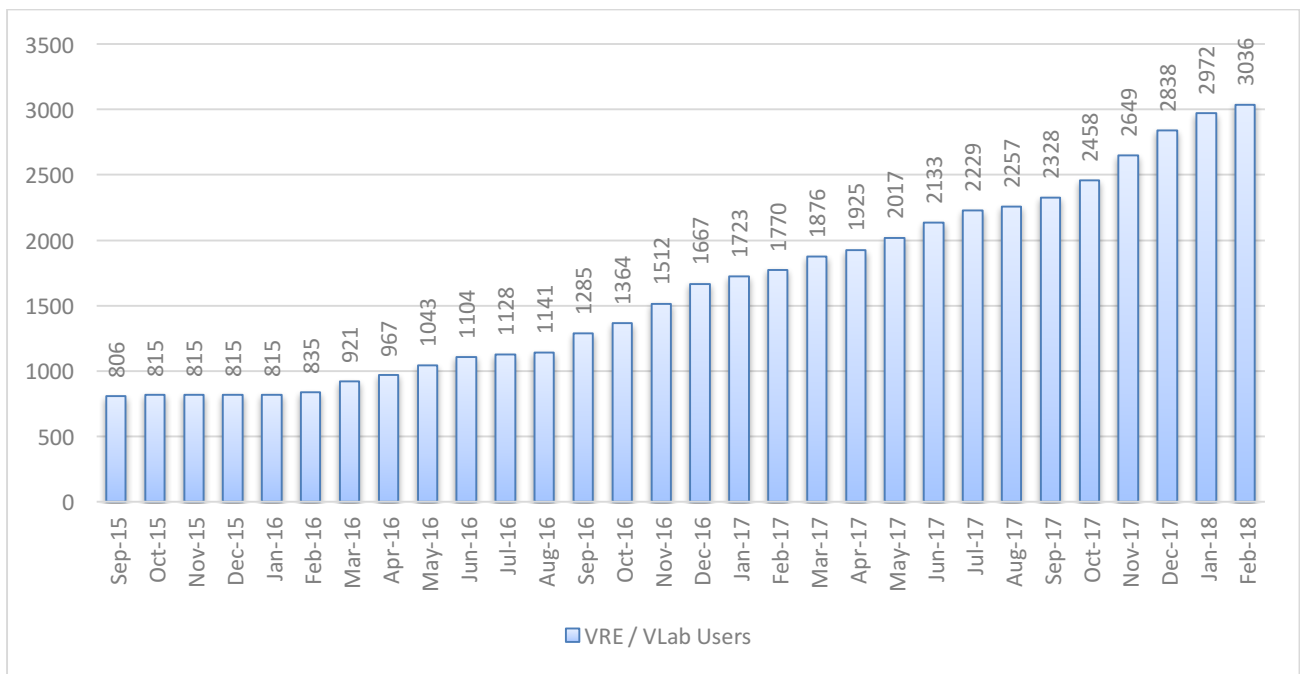
Figure 5. Number of users served by BlueBRIDGE VREs and VLabs

Figure 6 reports the distribution of users with respect to VRE / VLab membership policy: the 45% circa of the served users (1384 out of 3036) is exploiting "open" environments, the 34% circa (1053 out of 3036) is exploiting "private" environments, and 19% circa (599 out of 3036) is exploiting "restricted" environments.
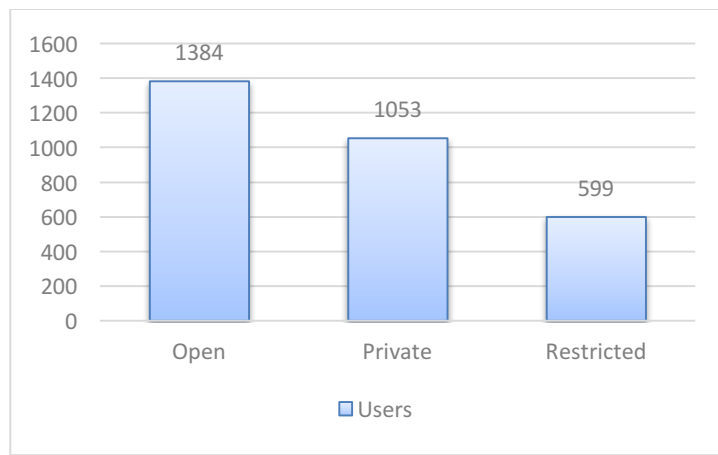
Figure 6. Number of users per VRE / VLab membership typology

By analysing the email addresses of the users (which is what they are using to log in the VREs / VLabs), it can be observed that: 58.50 % of the users is exploiting an email address that can be attributed to national domains (e.g., .it, .fr, .gr), 27.80 % of the users is exploiting an email address that can be attributed to commercial domains, while the remaining 13.70 % of the users is exploiting an email address belonging to .org, .edu, .gov domains. The users exploiting an email address that can be assimilated to national domains are spread across 32 countries. The **top 10 countries** are: France (12.39%), Italy (11.23 %), Greece (9.79 %), UK (7.92%) Denmark (7.34%), Norway (5.33%), Germany (5,00%), Spain (4.84 %), Ireland (3.39%), Netherland (2.74 %). The total number of recognised organisations / institutions is 124. The **top 10 organisations** are: International Council for the Exploration of the Sea - ICES (4.12%), National Research Council of Italy - CNR (3.61%), The International Centre for Research on the Environment and the Economy - ICRE8 (3.48%), Institute of Marine Research - IMR (3.09%), Institut de recherche pour le développement - IRD (2.97%), Food and Agriculture Organization of the United Nations - FAO (2.96%), Centre for Environment, Fisheries and Aquaculture Science - CEFAS.gov.uk (2.19%), Marine Institute Foras na Mara - Marine.ie (2.06%), French Research Institute for Exploitation of the Sea - Ifremer (1.93%), Wageningen University - (WUR.NL) (1.90%).

The operation of VREs and VLabs requires the management of requests for support, of issues and malfunctions. Figure 7 reports the tickets closed per month for these typologies of tickets. During the project, a total of **987 of such tickets have been resolved** (441 requests for support and 546 requests for incidents and bugs).
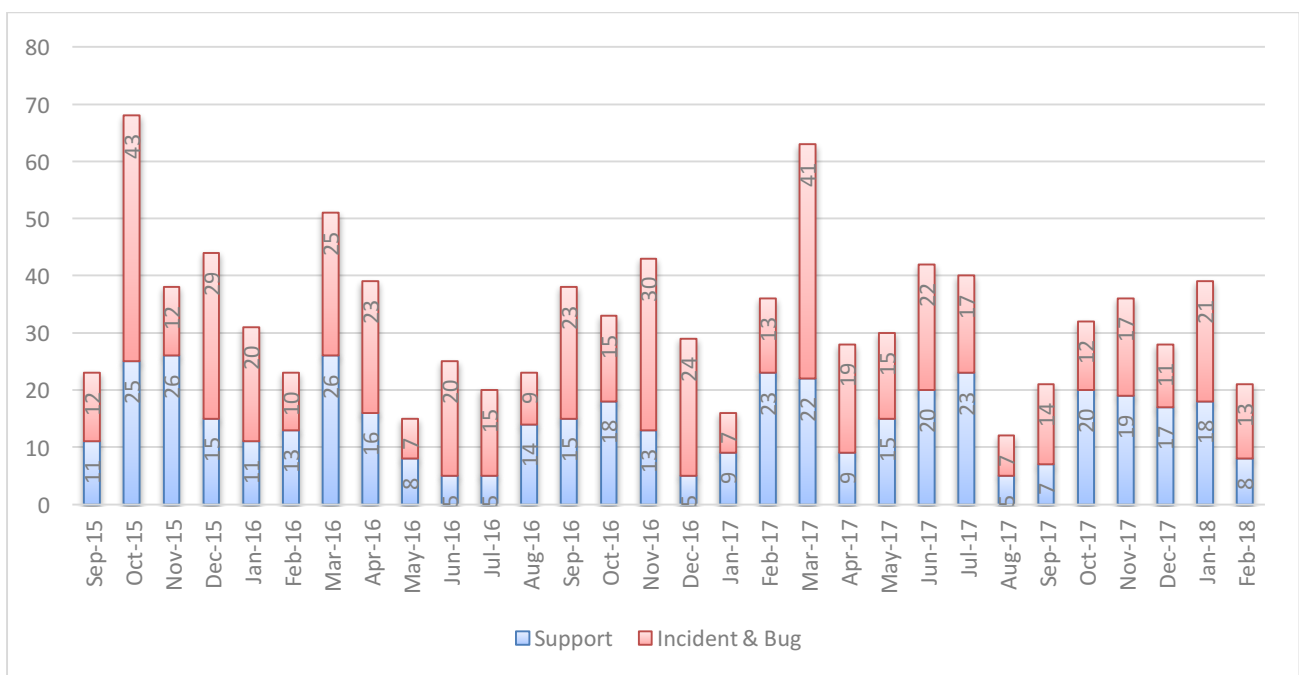
Figure 7. Tickets closed per Month

Table 1 reports the complete list of VREs (9) and VLabs (57) created and/or operated during the entire project. In total 65 VREs / VLabs have been created / operated during the project lifetime.

Table 1. BlueBRIDGE Virtual Research Environments and Virtual Laboratories

VRE / VLab Name	Type	Start date	Membership	#Users
Alieia VRE	VLab	Oct. '16	Private	12
Analytics Lab	VLab	Dec. '16	Open	106
Aquabiotech	VLab	Jul. '17	Private	8
Aquaculture Atlas Generation	VLab	Nov. '16	Restricted	35
Aquaculture Training Lab	VLab	Nov. '16	Restricted	279
ARDAG Aquaculture	VLab	Sep. '17	Private	6
Bay of Bengale Large Marine Ecosystem Hilsa Assessment WG VRE	VLab	Sep. '15	Private	3
Biodiversity Lab	VLab	Sep. '15	Open	402
Bionym	VLab	Sep. '15	Open	124
Blue Commons	VRE	Sep. '15	Private	35
Blue Datathon	VLab	Jun. '17	Open	45
Blue Uptake	VRE	Sep. '15	Private	33
BlueBRIDGE EAB	VRE	Mar. '16	Private	26
BlueBRIDGE Project	VRE	Sep. '15	Private	99
BlueBRIDGE PSC	VRE	Sep. '15	Private	10
BlueBRIDGE Review	VLab	Dec. '16	Private	15
CWP Secretariat	VLab	Dec. '17	Restricted	8
DRuMFISH	VLab	Feb. '17	Private	27
Ellinika Psaria VRE	VLab	Oct. '16	Private	11
Forkys VRE	VLab	Oct. '16	Private	11
French Tropical Tuna Atlas	VLab	Jan. '18	Private	5
GALAXIDI Marine Farm	VLab	Sep. '17	Private	4
Global Record of Stocks and Fisheries (GRSF)	VLab	Oct' 16	Private	13
GRSF Admin	VLab	Nov. '16	Restricted	32
ICCAT BFT-E	VLab	Aug. '16	Restricted	38
ICES Bayesian Network Analysis	VLab	Oct. '17	Private	21
ICES DALSA: ICES Training Course on Data Limited Stock Assessment	VLab	Aug. '16	Private	27
ICES DASC: ICES Training Course on Design and Analysis of Statistically Sound Catch Sampling Programmes	VLab	Aug.'16	Private	17
ICES FIACO: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics	VLab	Oct. '16	Private	28

VRE / VLab Name	Type	Start date	Membership	#Users
ICES FIACO 2017: ICES Training Course on Principles and Methods of broadband/wideband technologies: application to Fisheries Acoustics	VLab	Oct. '17	Private	27
ICES Introduction to Abundance Estimation from Fisheries Acoustic surveys	VLab	May '17	Private	36
ICES Introduction to Stock Assessment	VLab	Apr. '17	Private	34
ICES Introduction to the R Environment 2017	VLab	Jul. '17	Private	31
ICES Loogbook Data: ICES Training Course on WMS and EU logbook Data	VLab	Oct. '17	Private	25
ICES MSE: ICES Training Course on Management Strategy Evaluation	VLab	Jul. '17	Private	27
ICES MSY: ICES TRaining Course on Methods for setting proxy Maximum Sustainable yeld reference points	VLab	Dec. '16	Private	84
ICES Online Oceanography	VLab	Feb. '18	Open	11
ICES SA: ICES Training Course on Stock Assessment Advanced	VLab	Oct. '16	Private	26
ICES TCRE: ICES Training Course in the R Environment	VLab	Dec. '15	Private	37
ICES TCSSM: ICES Training Course on Social Science Methods for Natural Scientists	VLab	Apr. '16	Private	29
iLKNAK Aquaculture	VLab	Sep. '17	Private	6
InfraTraining	VLab	Mar. '17	Restricted	10
IOTC SS3	VLab	Sep. '17	Restricted	38
iSearch	VLab	Sep. '15	Open	59
KIMAGRO Fishfarming	VLab	Oct. '17	Private	3
Knowledge Bridging	VLab	Sep. '15	Private	26
MARKELLOS Aquaculture	VLab	Jun. '17	Private	6
NHREUS Aquaculture	VLab	Jul. '17	Private	4
Performance Evaluation in Aquaculture	VRE	Sep. '15	Private	27
Protected Area Impact Maps	VLab	Sep. '15	Open	71
R Prototyping Lab	VLab	Sep. '16	Open	127
RStudio Lab	VLab	Sep. '16	Restricted	81
Scalable Data Mining	VLab	Sep. '15	Open	171
SDG Indicator 14.4.1	VLab	Nov. '17	Restricted	29
SDI Lab	VLab	Jan. '18	Private	31
SIASPA: Strategic Investment Analysis and Scientific Planning/Alerting	VLab	Nov. '16	Open	32
Sinay	VLab	Nov. '17	Private	10
Stock Assessment	VLab	Sep. '15	Private	63

VRE / VLab Name	Type	Start date	Membership	#Users
Stocks & Fisheries Knowledge Base	VRE	Sep. '15	Private	37
Strategic Investment Analysis	VRE	Sep. '15	Private	26
STRATOS Aquacultures	VLab	Jun. '17	Private	5
Sustainable Blue Economy	VLab	Dec. '17	Open	42
Tabular Data Lab	VLab	Sep. '15	Open	193
Tuna Atlas	VLab	Sep. '15	Restricted	49
Vulnerable Marine Ecosystem (VME) DB	VLab	Sep. '15	Private	18
WECAFC-FIRMS	VLab	Sep. '15	Private	24

A brief description of each available VRE / VLab is reported in the following sections.

All the VREs are provided with:

- A *shared workspace* to enable every user to store and organise the information objects he/she is interested in working with. In addition to that, the user is allowed to collaborate with other users by sharing objects and messages;

- A *VRE Management facility* to enable authorized users (i.e. VRE Managers) to manage other users using or wanting to access the VRE. VRE Managers can (i) authorize users for access to the VRE, (ii) assign or withdraw roles to users, (iii) remove users, and (iv) send communications to the current users;

- A *social networking facility* to enable users to use the common facilities typical of social networks – e.g., posting news, commenting on posted news – yet adapted to the settings of working environments like those characterising BlueBRIDGE. Users can post news as well as applications;

- A *notification facility* to alert users on relevant activities as they happen. These notifications offer a sense of anticipation and create a productivity boost. Users receive an alert (through a priori selected channels, e.g., email, web portal, twitter) notifying them when something of interest has happened in their VRE(s);

- A *members facility* to provide users with a list of VRE co-workers, i.e. the list of members partaking in the VRE and contributing to it;

- A *messaging facility* to provide users with a common email environment as-a-Service. The distinguishing feature is represented by its integration with the rest, e.g., it is possible to send any information object residing in the workspace (regardless of how "big" and "complex" it may be) as an attachment without consuming bandwidth.

3.1   ALIEIA VRE

The Alieia VRE (actually a VLab) supports the performance evaluation, benchmarking and decision making process of Alieia, a Greek aquafarming company, to improve its profitability and minimise environmental impacts. It enables Alieia aquafarmers to: (a) evaluate and optimise their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to Alieia members only.

This VLab is available at: https://bluebridge.d4science.org/web/alieiavre

This VLab stems from the Blue Economy needs [9]. It has been in *operational* status since *October '16* and it is currently serving *12 users*.

A screenshot of the VLab is available in Figure 8. It shows the home page and the menu items for accessing the VLab facilities.

Figure 8. Alieia VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 9 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
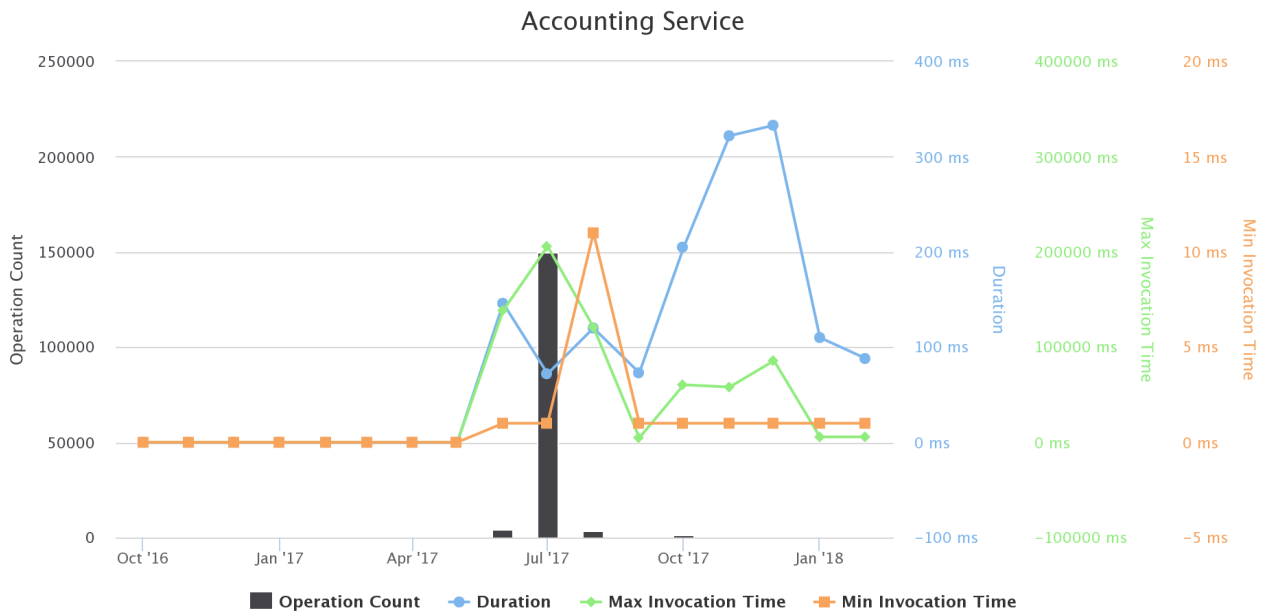
Figure 9. Alieia VRE / VLab Operations by Month

3.2   ANALYTICS LAB

The Analytics Lab has been conceived to provide its users with a small collection of generic Machine Learning (ML) and Statistical Processing algorithms for Big Data including Bayesian Methods (e.g. Feed Forward Neural Network Trainer, Feed Forward Neural Network Regressor), Data Clustering (e.g. Dbscan, Kmeans, Lof, Xmeans), and Time Series Analysis.

The Analytics Lab is available at https://bluebridge.d4science.org/web/analyticslab

This VLab has been in **operational** status since **December '16** and it is currently serving **106 users**. A screenshot of the VLab is available in Figure 10. It shows the home page and the menu items for accessing the VLab facilities.
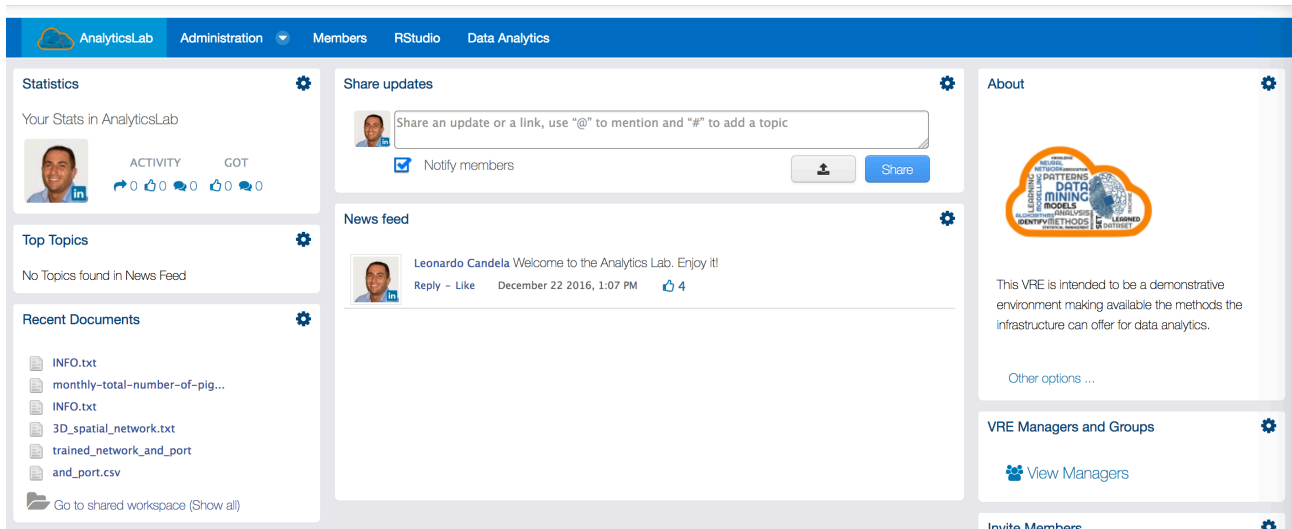
Figure 10. Analytics Lab VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the Data Miner service and interactively execute a large array of data analytics tasks on datasets. As of February '18

this environment has been configured to give access to **8 diverse algorithms** including data clustering methods (e.g. DBSCAN, k-means) and time series analysis;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files within the workspace.

Figure 11 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 11. Analytics Lab VRE / VLab Operations by Month

3.3 AQUABIOTECH

Aquabiotech VRE supports AquaBioTech Group, an international research and development, engineering, technology provider and consulting company located in Malta to study the nutrition dispersion and retention in the environment surrounding a local fish farm. The AquaBioTech Group undertakes a variety of aquaculture, fisheries, marine surveying, aquarium and aquatic environmental projects through its regional offices and partners throughout the world. The vast majority of the company's work is related to the marine or aquatic environment, encompassing aquaculture developments, market research / intelligence, through to project feasibility assessments, finance acquisition, project management, technology sourcing and technical support and training. This VRE has been specifically set up for AquaBioTech Group.

The Aquabiotech VRE / VLab is available at https://bluebridge.d4science.org/web/aquabiotech

This VLab has been in **operational** status since **July '17** and it is currently serving **8 users**. A screenshot of the VLab is available in Figure 12. It shows the home page and the menu items for accessing the VLab facilities.
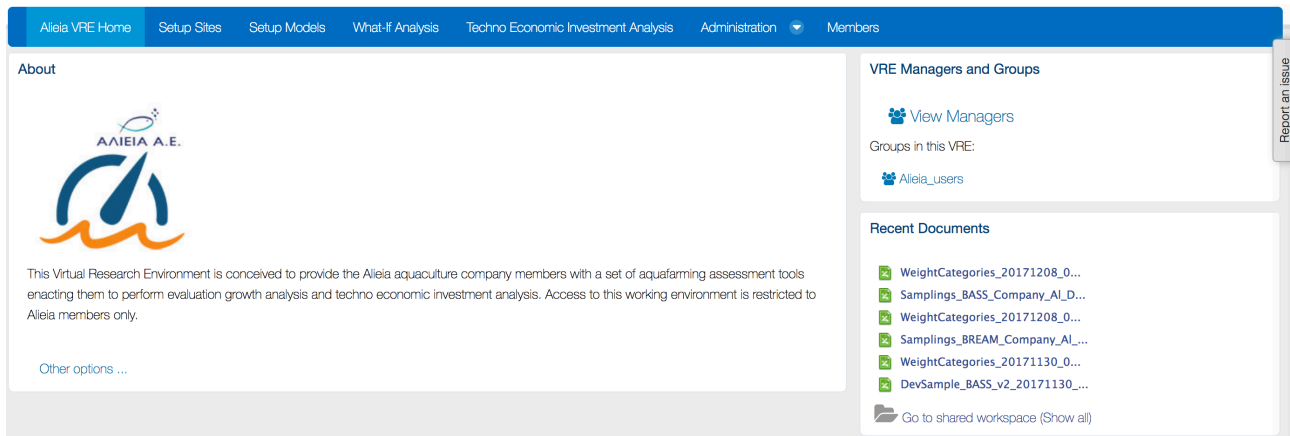
Figure 12. Aquabiotech VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstock is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 13 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
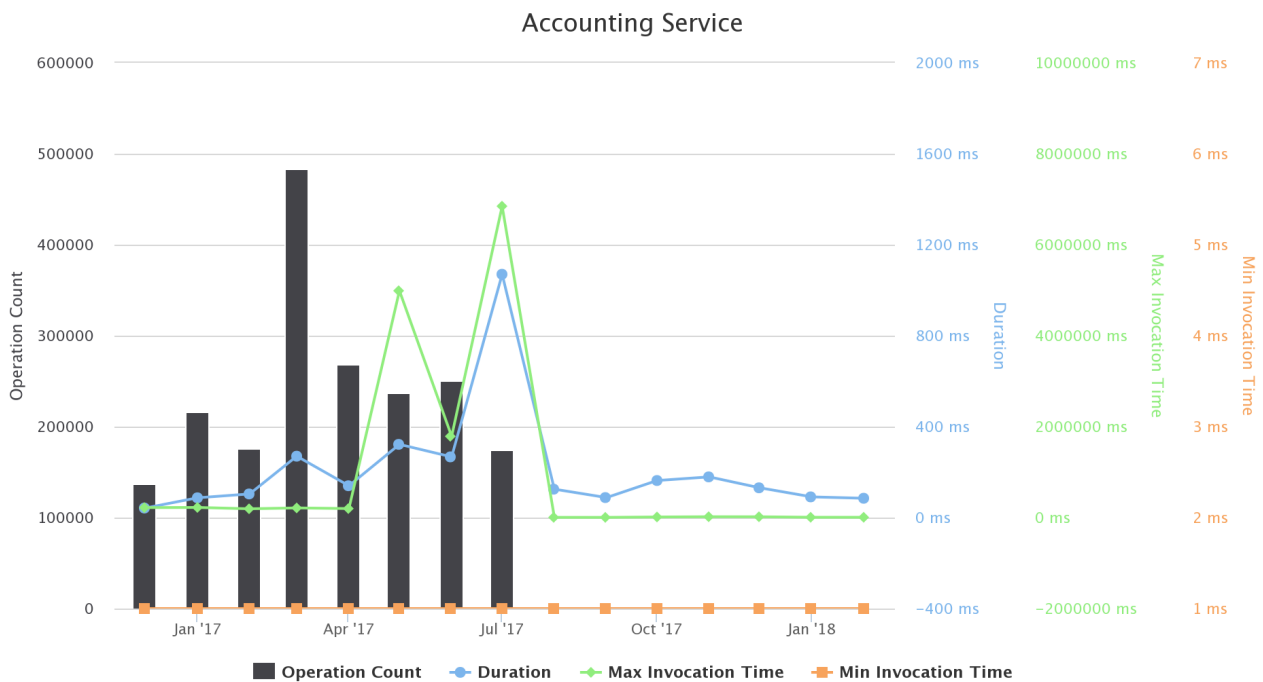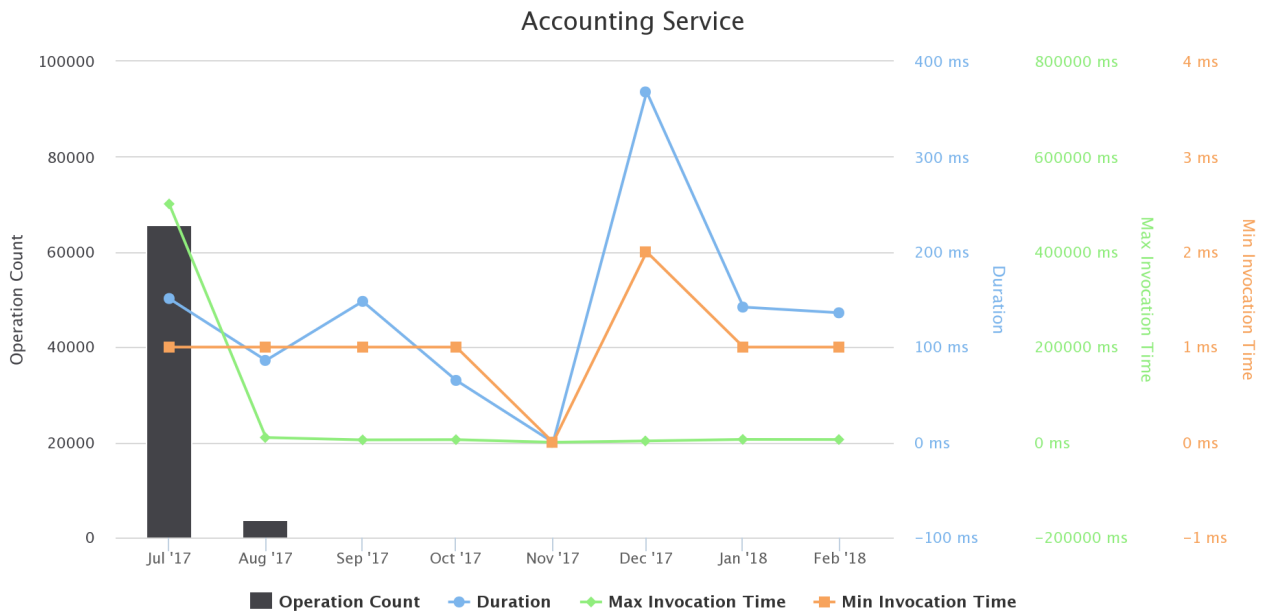
Figure 13. Aquabiotech VRE / VLab Operations by Month

3.4 AQUACULTURE ATLAS GENERATION

This Virtual Research Environment was initially conceived to support the activity and discussions occurring in the context of the Task 7.1 [10], i.e. on how to apply SARTOOL and related software to analyse Earth Observation (Copernicus) datasets through a human validation of output and produce OGC compliant data. The VRE discusses on how to produce aquaculture products (maps of human activity and natural zones) contributing to an aquaculture atlas compliant with FAO National Aquaculture Sector Overview (NASO) standards. Aqua-farming sector scientists, managers, farmers and decision makers that are in charge of the validation, thanks to the VRE will be equipped with: (a) open data combining performance, environment, regional and socio-economic datasets, (b) a framework to support performance analysis and benchmarking, and (c) a fundamental baseline set of indicators and models providing the performance metrics in question. In a second phase the VRE has been transformed into a VLab and open to users beyond the project consortium to showcase the tools specifically developed.

The Aquaculture Atlas Generation VLab is available at https://bluebridge.d4science.org/web/aquacultureatlasgeneration

This VLab stems from the Blue Environment VRE [10]. It has been in "*operational*" state since **November '16** and is currently serving **35 users**. A screenshot of the VRE is available in Figure 14. It shows the home page and the menu items for accessing the VRE facilities.
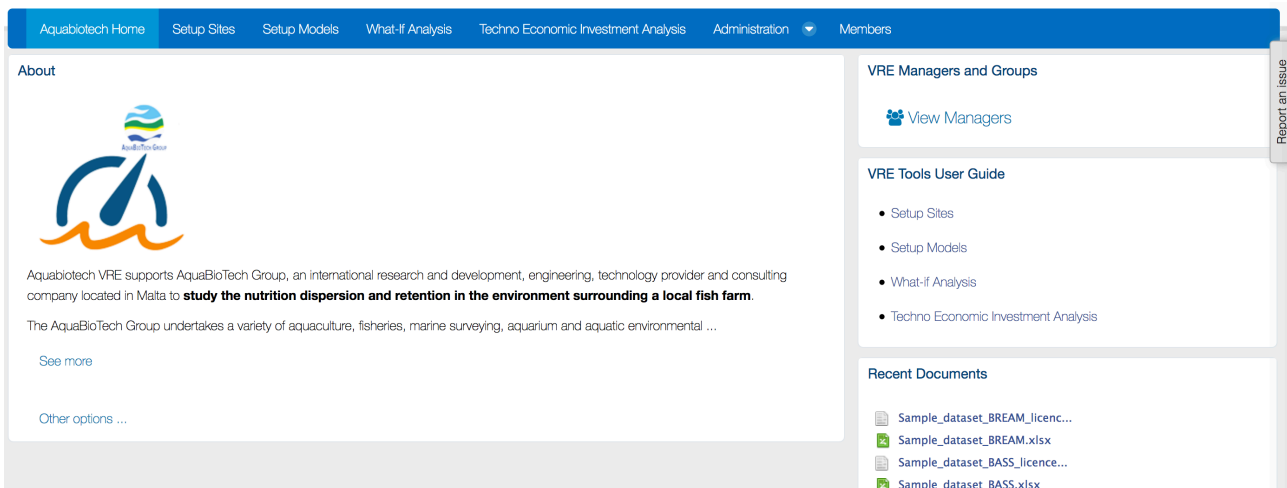
Figure 14. Aquaculture Atlas Generation VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Aquaculture Atlas Production System*: a facility enabling users to identify and assess (for authorised users only) aquaculture farms. In particular, the tool visualizes the results of fish cage detection algorithms based on VHR optical images (ACUITY toolbox) and make it possible for users to editing map features and to generate output as FAO NASO Maps;

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the Data Miner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to **4 specific algorithms**, i.e. those underlying the Aquaculture Atlas Production System facility (Geographic Proximity Tool, AAPS Public Publisher, AAPS Staging Publisher, AAPS NASO Publisher);

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files within the workspace;

- *Context Specific Catalogue:* a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **5 datasets**, the datasets stemming from the Greece and Indonesia cases [10][13].

Figure 15 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks, e.g. actions performed by the users via the GUI leading to the invocation of services.
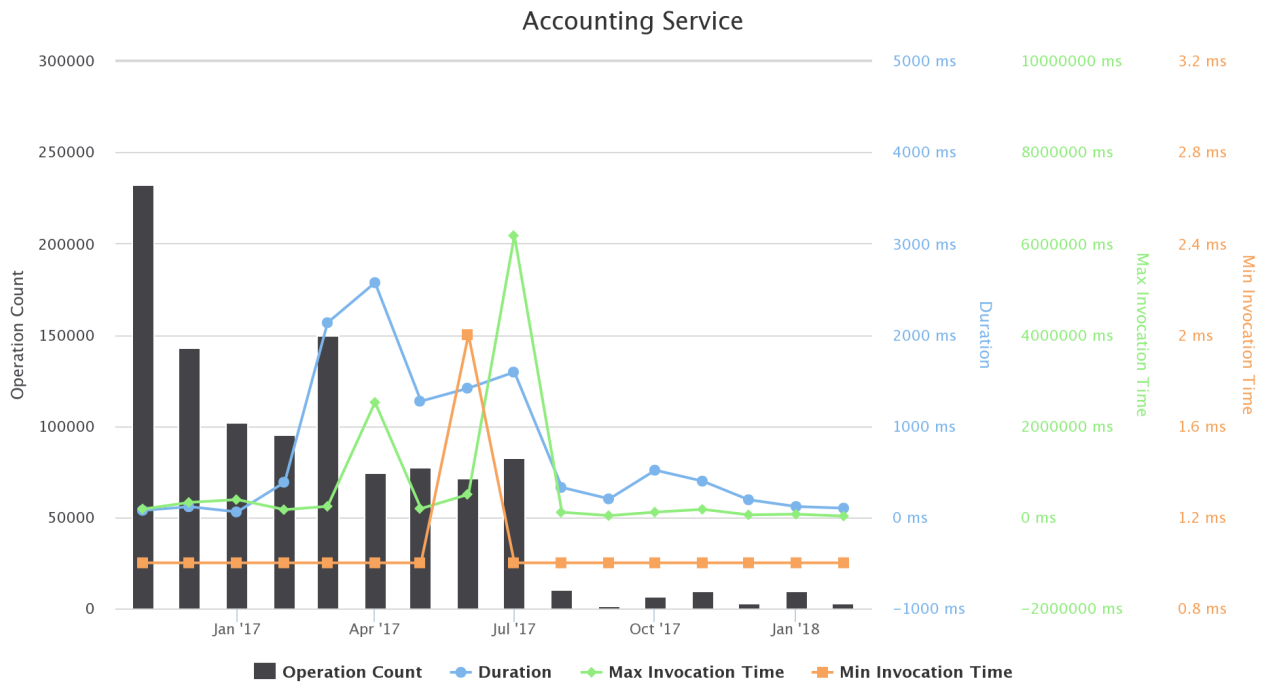
Figure 15. Aquaculture Atlas Generation VRE / VLab Operations by Month

3.5   AQUACULTURE TRAINING LAB

This Virtual Research Environment (actually VLab) was conceived to provide its users with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis. Access to this working environment is restricted to authorized members only.

The Aquaculture Training Lab is available at https://bluebridge.d4science.org/web/aquaculturetraininglab

This VLab stems from the Blue Economy VREs [9]. It has been in *operational* state from *November '16* and it is currently serving *279 users*. A screenshot of the VLab is available in Figure 16. It shows the home page and the menu items for accessing the VLab facilities.

Figure 16. Aquaculture Training Lab VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstock is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 17 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 17. Aquaculture Training Lab VRE / VLab Operations by Month

3.6   ARDAG AQUACULTURE

The ARDAG Aquaculture VLab supports the performance evaluation, benchmarking and decision making process of ARDAG Aquaculture company to improve its profitability and minimise environmental impacts. It enables ARDAG Aquaculture company members to: (a) evaluate and optimise their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their

performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to ARDAG Aquaculture company members only.

The VLab is available at https://bluebridge.d4science.org/web/ardag_aquaculture

This VLab has been in **operational** status since **September '17** and it is currently serving **6 users**. A screenshot of the VLab is available in Figure 10. It shows the home page and the menu items for accessing the VLab facilities.
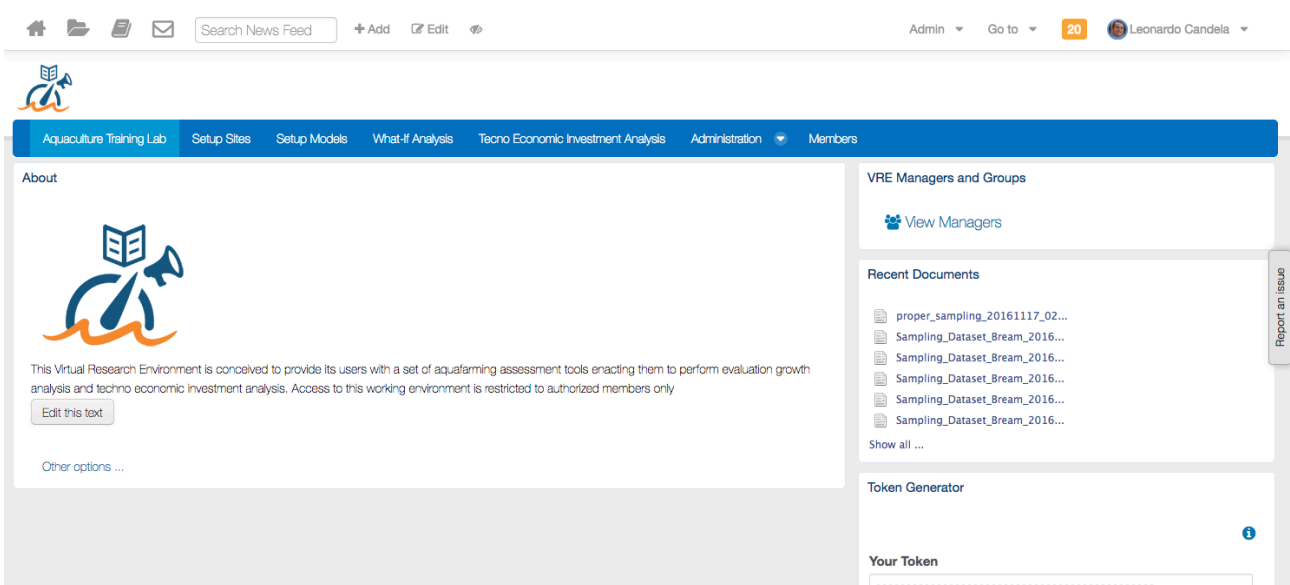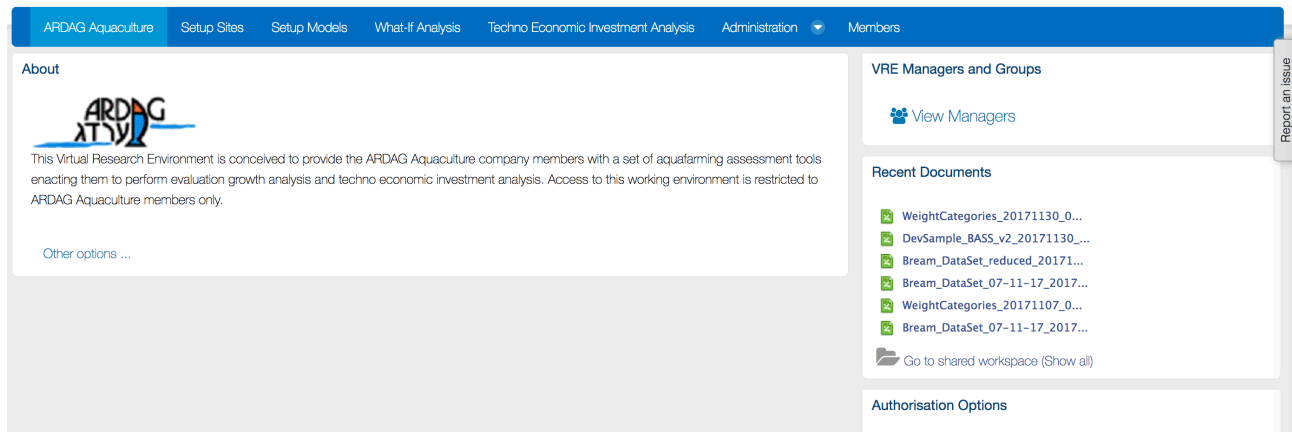

Figure 18. ARDAG Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 19 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
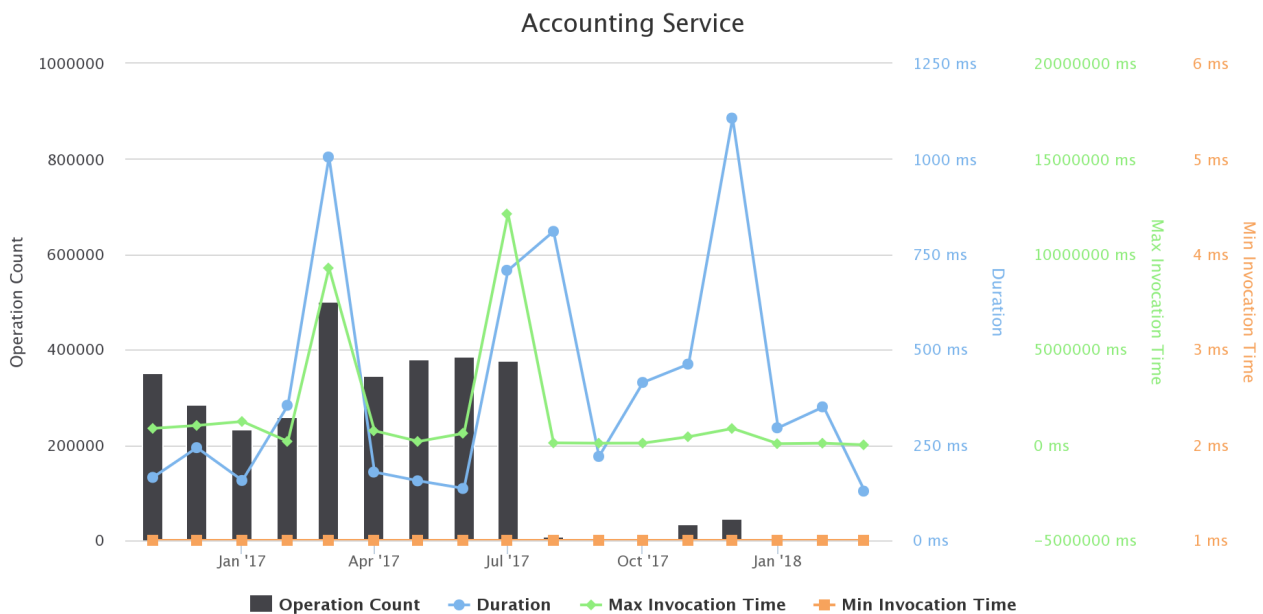
Figure 19. ARDAG Aquaculture VRE / VLab Operations per Month

3.7 BAY OF BENGALE LARGE MARINE ECOSYSTEM HILSA ASSESSMENT WG VRE

The BOBLME Hilsa Assessment Working Group VRE provides data and technical information to the members of the Hilsa Assessment Working Group (Hilsa AWG). This group is called to perform stock assessment for the Hilsa fish species, and it is convened on an ad-hoc base. The members need a facility to upload, share, harmonize and standardize their tabular data of fisheries from BOBLME countries that can be nation-wide or from a specific region. Such datasets are quite diverse in quality and quantity. After uploading and preparing their data, they also need a facility for the analysis; typically, R based stock assessment software. The group counts some 15 members and is led by a consultant contracted through the BOB-LME project[7]. Currently the project is awaiting approval of its second phase.

The VRE is not a part of the BOBLME project, and it is offered as a service for feasibility testing. In fact, every time the working group is convened there may be different persons and institutes that need to evaluate if the environment is suitable for the group specific tasks and operation policies. The accessibility and sharing of data in the VRE remains a responsibility of the Hilsa AWG.

The Bay of Bengale Large Marine Ecosystem Hilsa Assessment WG is available at https://bluebridge.d4science.org/web/boblme_hilsaawg

This BOBLME was inherited by iMarine thus it has been **operational** since **September 2015** from the perspective of BlueBRIDGE. It is currently serving **3 users**[8]. A screenshot of the VLab is available in Figure 20. It shows the home page and the menu items for accessing the VLab facilities.

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[7] http://www.boblme.org/

[8] This figure sounds very low yet this is not a real issue because the VRE will be "re-activated" once the stock assessment activities under the BOBLME project umbrella will resume. In fact, the BOBLME project currently has no activities, it is awaiting approval of its second phase which was delayed.
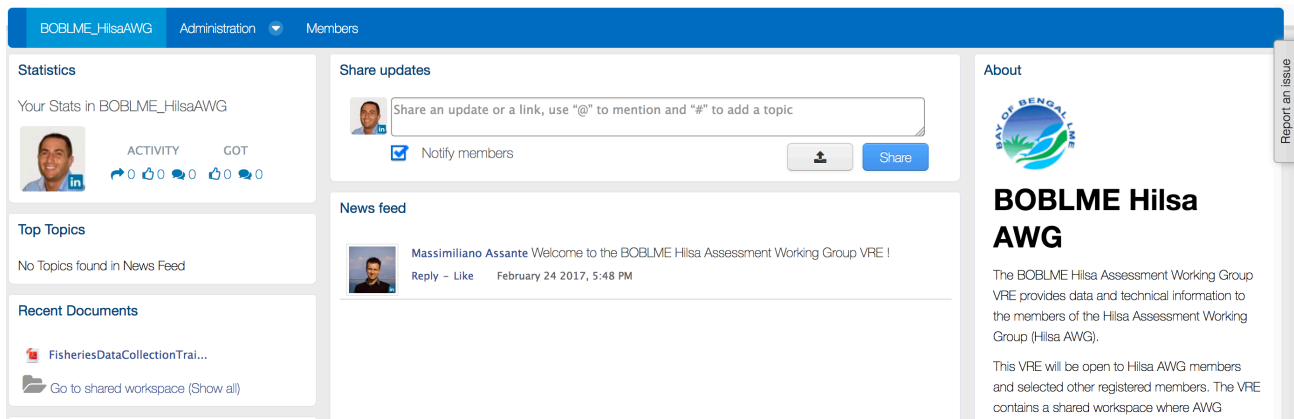
Figure 20. BOBLME Hilsa Assessment Working Group VRE / VLab Home Page Screenshot

This VRE is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. A lot of facilities initially deployed have been removed (e.g., Tabular Data Manager, geospatial data viewers) waiting for the specification from the Hilsa AWG.

Figure 21 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
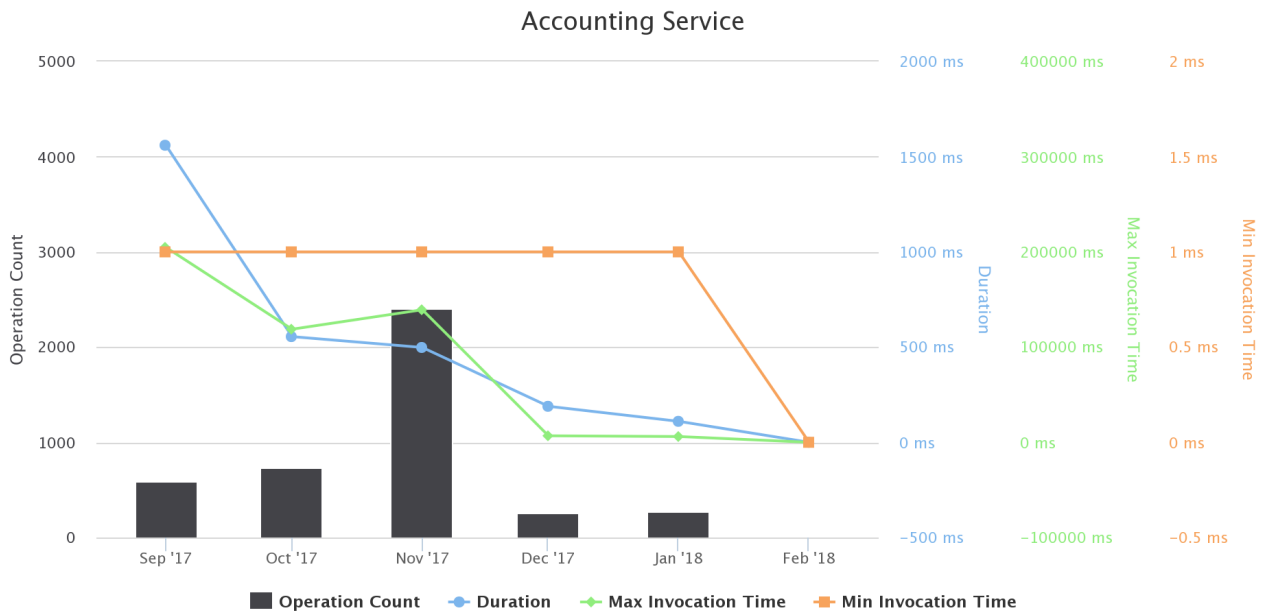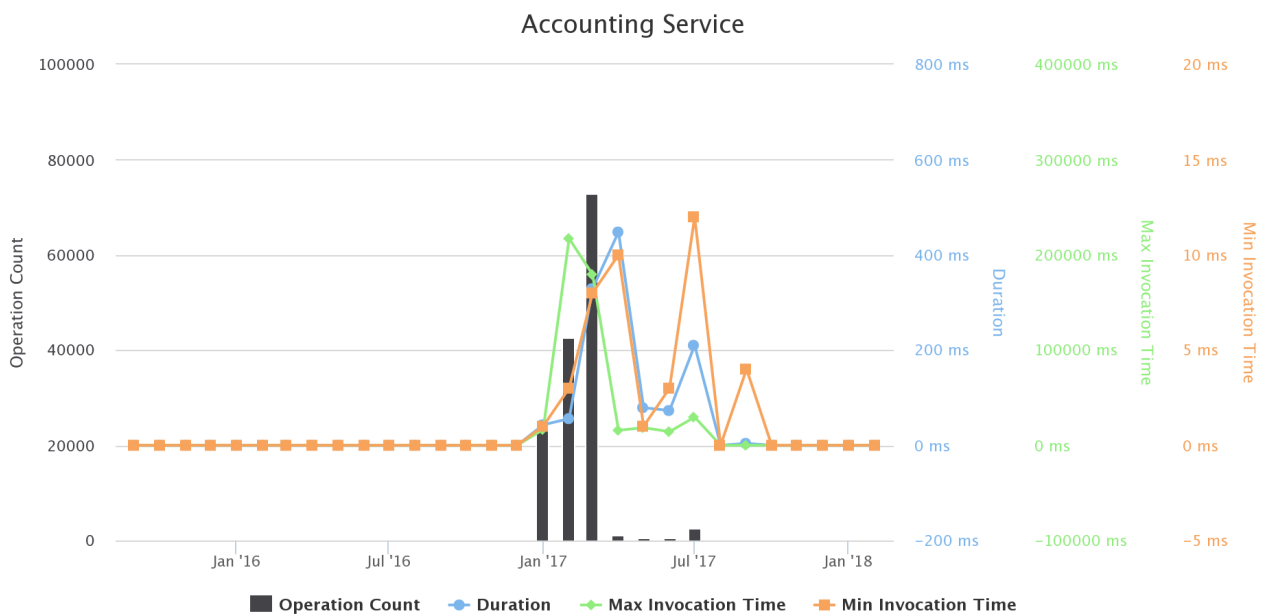

Figure 21. BOBLME Hilsa Assessment Working Group VRE / VLab Operations per Month

3.8 BIODIVERSITY LAB

The Biodiversity Lab is a VLab designed to provide a collection of applications that allow scholars to perform complete experiments involving single individuals or groups of marine species. The VRE allows to: (a) inspect species maps; (b) produce a species distribution map by means of either an expert system (AquaMaps) or a machine learning model (e.g. Neural Networks); (c) analyse species observation trends; (d) inspect species occurrence data; (e) inspect species descriptions and characteristics; (f) perform analysis of climatic changes and of its effect on species distribution; (g) produce GIS maps for geo-spatial datasets; (h) discover Taxa names; (i) cluster occurrence data; and (l) estimate similarities among habitats.

The Biodiversity Lab VLab is available at https://bluebridge.d4science.org/web/biodiversitylab

This VLab was inherited by iMarine and thus it has been **operational** since **September 2015** from the perspective of BlueBRIDGE. It is currently serving **402 users**. A screenshot of the VLab is available in Figure 22. It shows the home page and the menu items for accessing the VLab facilities.

Figure 22. Biodiversity Lab VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VLab is specifically equipped with the following capabilities:

- *Species Data Discovery*: a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a) GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, ITIS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Species View*: a facility enabling users to discover and browse species products (namely species distribution maps). This facility supports discovery mechanisms ranging from simple search based on species names to very specific search criterion, and it offers a comprehensive set of products visualisation approaches;

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps that have been generated and published. This facility relies on the GeoExplorer portlet, and makes it possible to effectively exploit the generated maps and to perform comparisons and analysis of the diverse distributions by enabling map overlay, transects production and values inspection;

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to more than **150 diverse algorithms**, e.g. clustering, geospatial data processing, charts production, taxon name matching;

- *Context Specific Catalogue*: a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **53 items**, mainly geospatial datasets including species distribution maps;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace;

- *Semantic-based data discovery*: a facility enabling users to search and browse the MarineTLO Data Warehouse;

- *Giant Squid timeline*: a facility enabling to browse literature and other source of information on the Giant Squid species.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. In particular, this VLab is benefitting from the new data analytics framework and its support for Open Science practices, the facility to support the integration of new algorithms / methods, the data catalogue, and the RStudio ® integration.

Figure 23 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
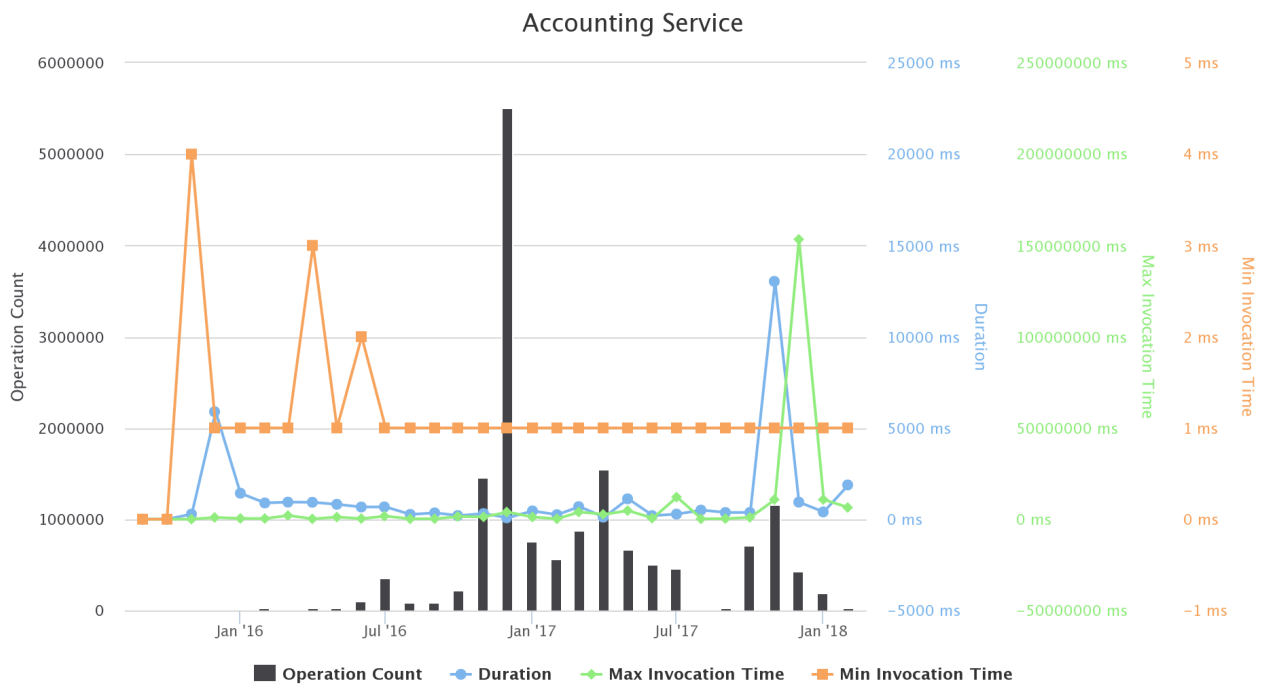
Figure 23. Biodiversity Lab VRE / VLab Operations by Month

3.9   BIONYM

The BiOnym VLab provides its users with a service" developed in the iMarine context to compare a set of scientific names against taxonomic reference lists including recognised ones like Catalogue of Life. The goal of the comparison is to check the "correctness" of the set of scientific names with respect to the target taxa names and possibly to suggest their correct spelling.

The BiOnym VLab is available at https://bluebridge.d4science.org/web/bionym

This VLab was inherited by iMarine, and thus it is considered *operational* since *September 2015* from the perspective of BlueBRIDGE. It is currently serving *124 users*. A screenshot of the VLab is available in Figure 24. It shows the home page and the menu items for accessing the VLab facilities.
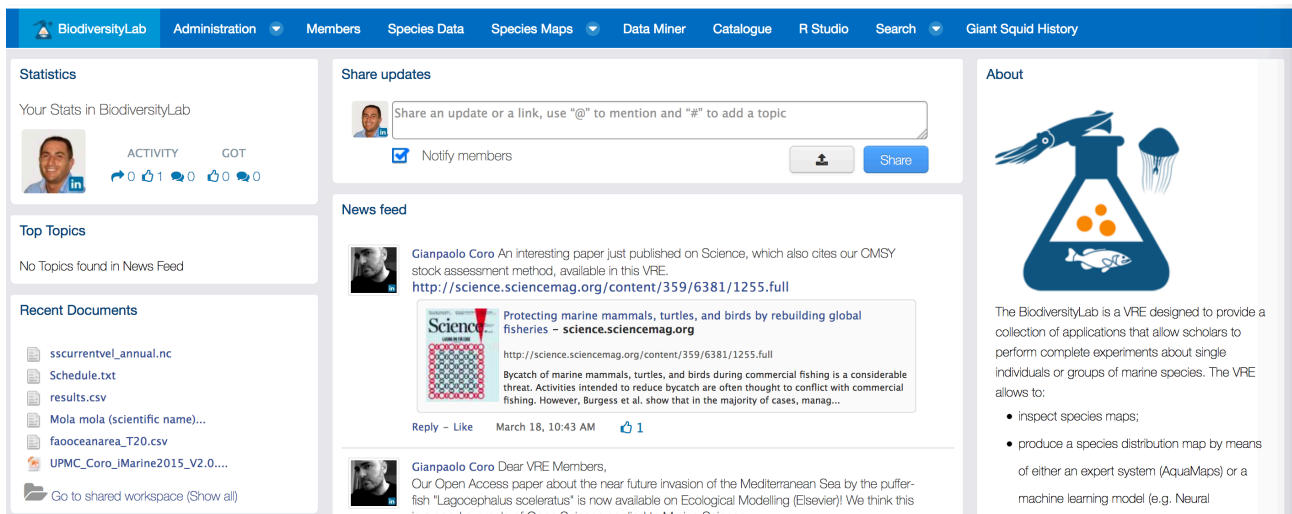
Figure 24. BiOnym VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VLab is specifically equipped with the following capabilities:

- *Taxa Name Processing*: a facility enabling users to execute various BiOnym workflows, namely: (a) *BiOnym* to activate several taxa names matching algorithms; (b) *BiOnym Biodiv* that applies in sequence the following Matchers: GSay (thr:0.6, maxRes:10), FuzzyMatcher (thr:0.6, maxRes:10), Levenshtein (thr:0.4, maxRes:10), Trigram (thr:0.4, maxRes:10); and (c) *BiOnym Local* a fast version of BiOnym.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. In particular, this VLab is benefitting from the new data analytics framework and its support for Open Science practices for executing the BiOnym algorithms.

Figure 25 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
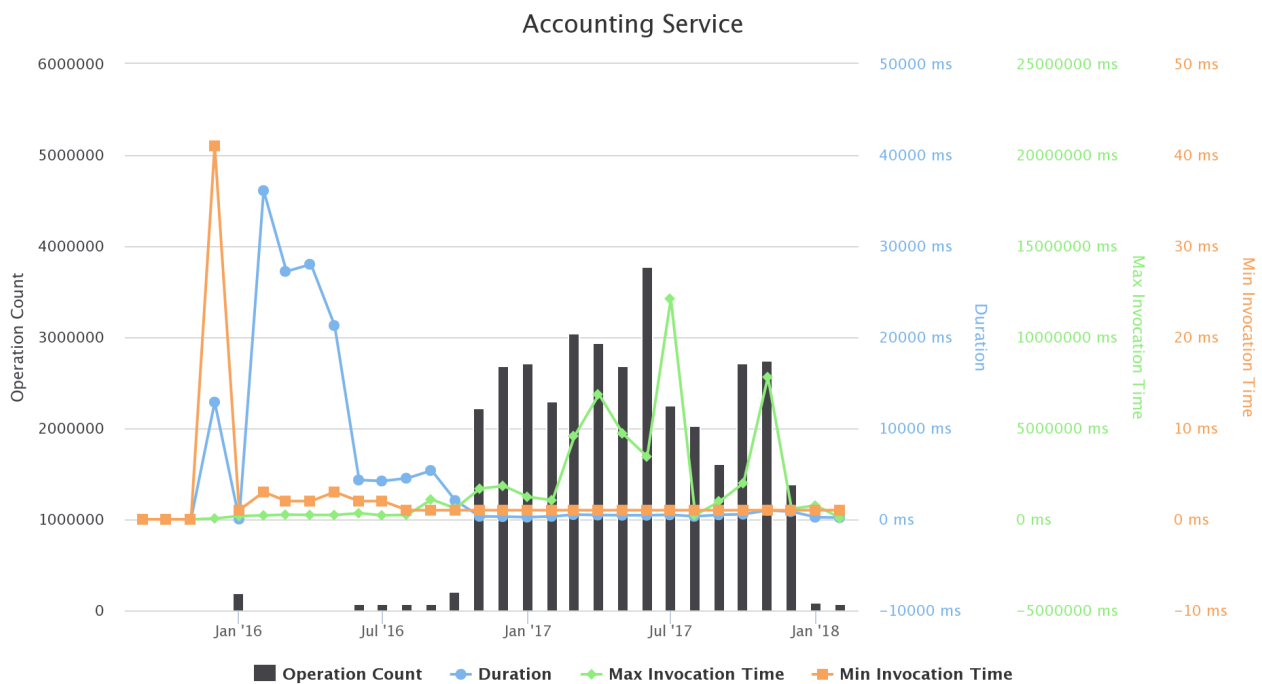
Figure 25. BiOnym VRE / VLab Operations by Month

3.10 BLUE COMMONS

Blue Commons is dedicated to the members of WP4, WP9 and WP10. They are in charge of developing, releasing and operating the VRE facilities requested by WP5-8 as well as of extending and consolidating the gCube technology enabling the integration of existing infrastructures (including computing and data infrastructures) into a coherent and organised federation that can be easily managed by guaranteeing the operation autonomy of the single resources.

The Blue Commons VRE is available at https://bluebridge.d4science.org/web/bluecommons

This VRE has been in **operational** status since **September '15** and it is currently serving **35 users**. A screenshot of the VRE is provided in Figure 26. It shows the home page and the menu items for accessing the VLab facilities.

Figure 26. Blue Commons VRE / VLab Home Page Screenshot

This VRE is equipped with VRE basic facilities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 27 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.


Figure 27. Blue Commons VRE / VLab Operations per Month

3.11 BLUE DATATHON

This VLab has been created to support the datathon co-organised by the RDA-Europe and BlueBRIDGE from June 15 to 16, 2017, in Heraklion, Crete, Greece.

https://bluebridge.d4science.org/web/blue-datathon

This VLab has been in **operational** status since **June '17** and it is currently serving **45 users**. A screenshot of the VLab is available in Figure 28. It shows the home page and the menu items for accessing the VLab facilities.
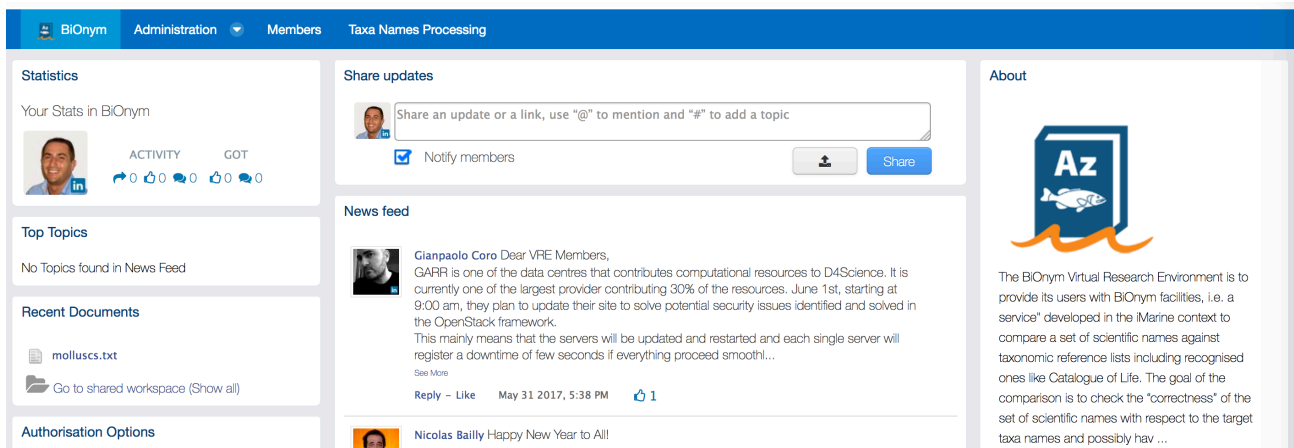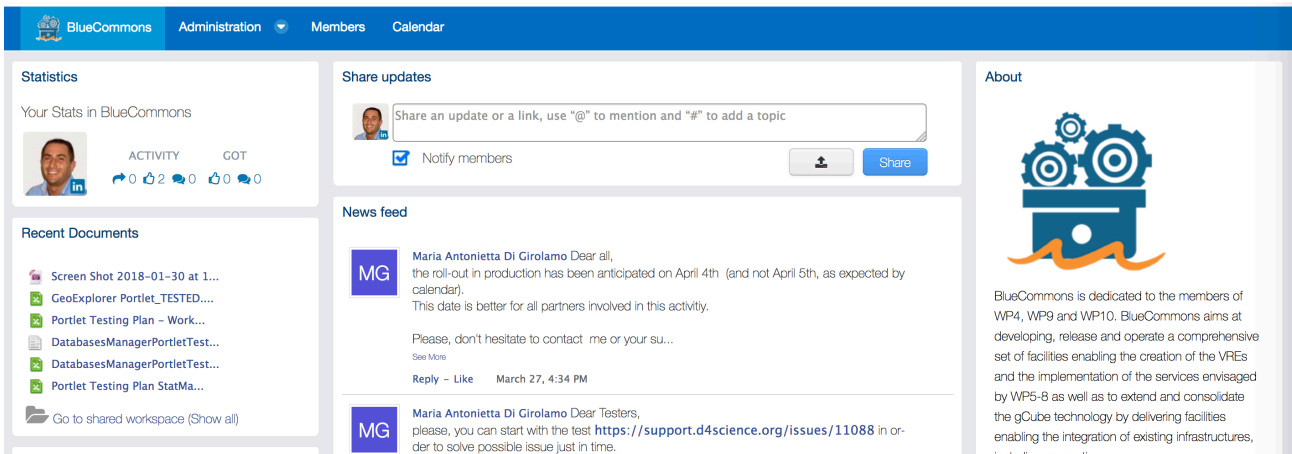

Figure 28. Blue Datathon VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Species Data Discovery*: a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a) GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, IT IS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps that have been generated and published. This facility relies on the GeoExplorer portlet, and makes it possible to effectively exploit the generated maps and to perform comparisons and analysis of the diverse distributions by enabling map overlay, transects production and values inspection;

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to more than **100 diverse algorithms**, e.g. data clustering, charts production, geospatial dataset processing, time series analysis;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 29 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
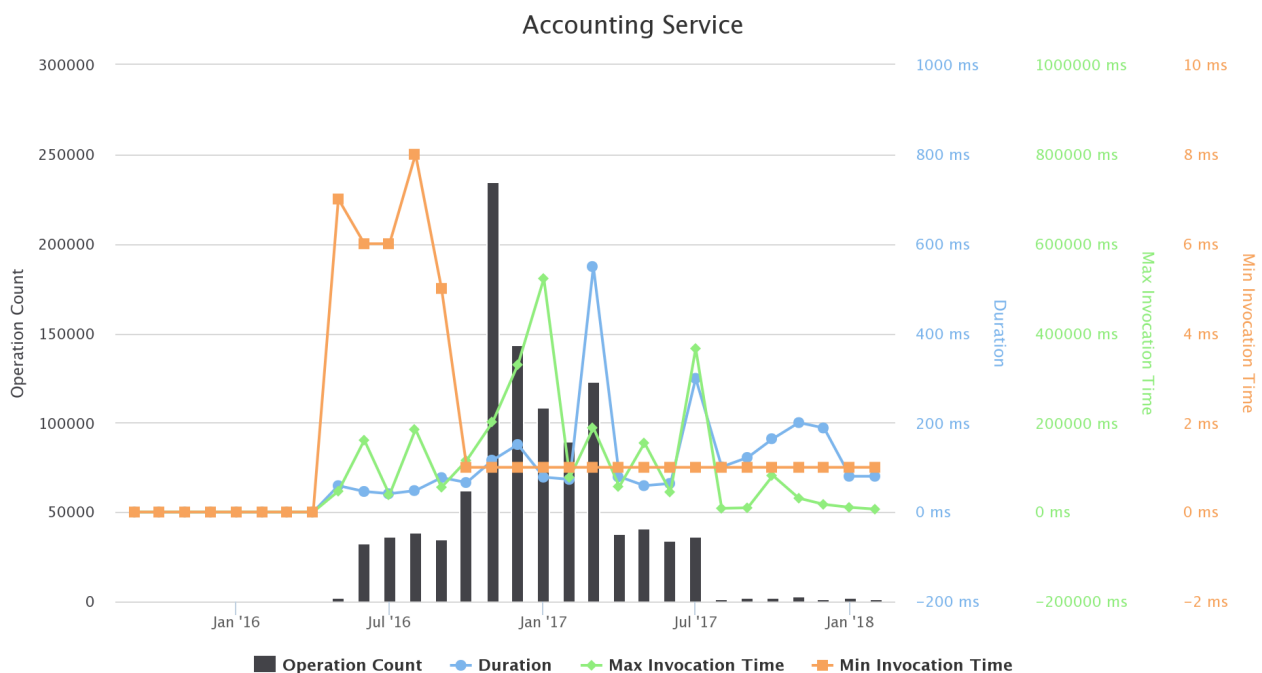

Figure 29. Blue Datathon VRE / VLab Operations per Month

3.12 BLUE UPTAKE

This Virtual Research Environment was conceived to support the BlueBRIDGE Blue Uptake activity, the goal of which is to raise awareness of BlueBRIDGE and its offer.

The Blue Uptake VRE is available at https://bluebridge.d4science.org/web/blueuptake

This VRE has been in **operational** status since **September '15** and it is currently serving **33 users**. A screenshot of the VRE is in Figure 30. It shows the home page and the menu items for accessing the VRE facilities.
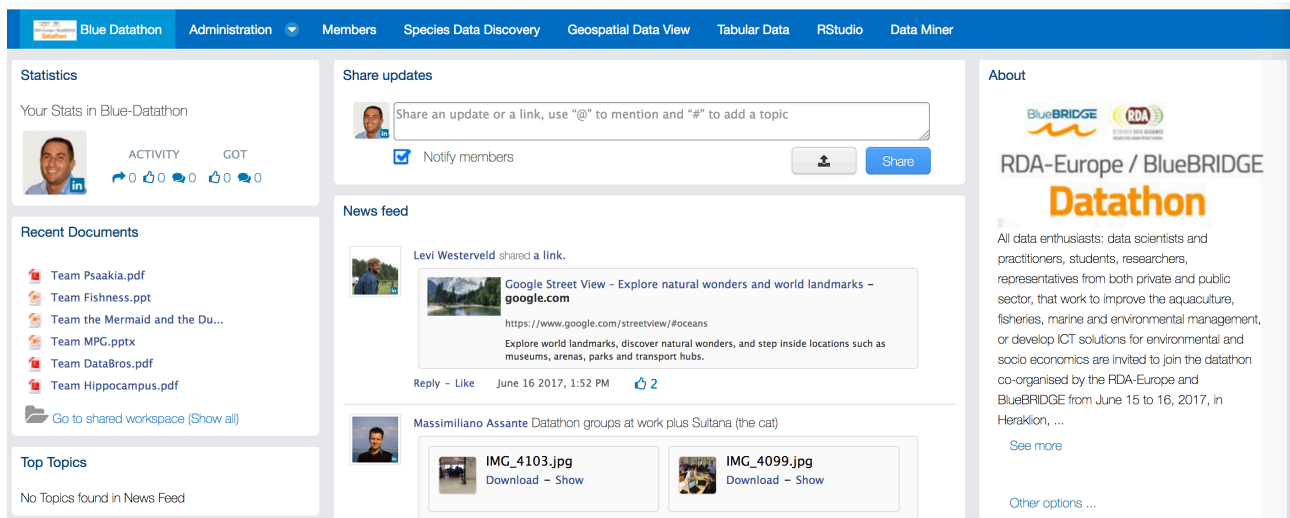
Figure 30. Blue Uptake VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *BlueBRIDGE Wiki*: a facility enabling users to access the project Wiki;

Figure 31 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

Figure 31. Blue Uptake VRE / VLab Operations per Month

3.13 BLUEBRIDGE EAB

This VRE is dedicated to supporting the activity of the BlueBRIDGE External Advisory Board (EAB). This board serves as a tremendous ally in the quest for superior project governance by providing non-binding but informed guidance. It is composed of key internationally-recognised experts. By this environment, members of the EAB are regularly informed on project progress.

The BlueBRIDGE-EAB is available at: https://bluebridge.d4science.org/web/bluebridge-eab

This VRE has been in *operational* status since *March '16* and it is currently serving *26 users*. A screenshot of the VRE is provided in Figure 32. It shows the home page and the menu items for accessing the VLab facilities.

Figure 32. BlueBRIDGE-EAB VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Resource Catalogue*: a facility enabling EAB members to access the BlueBRIDGE products catalogue. As of February 2018, this catalogue give access to more than *70,000 items* including datasets, virtual research environments, services, and "research objects".

The rationale leading to making the data catalogue available is based on the fact that by having it available EAB members are acquainted with the "products" published by the project and can comment on them. In the future, the project might decide to make available by this VRE specific services and facilities to collect feedback and advices on them.

Figure 33 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
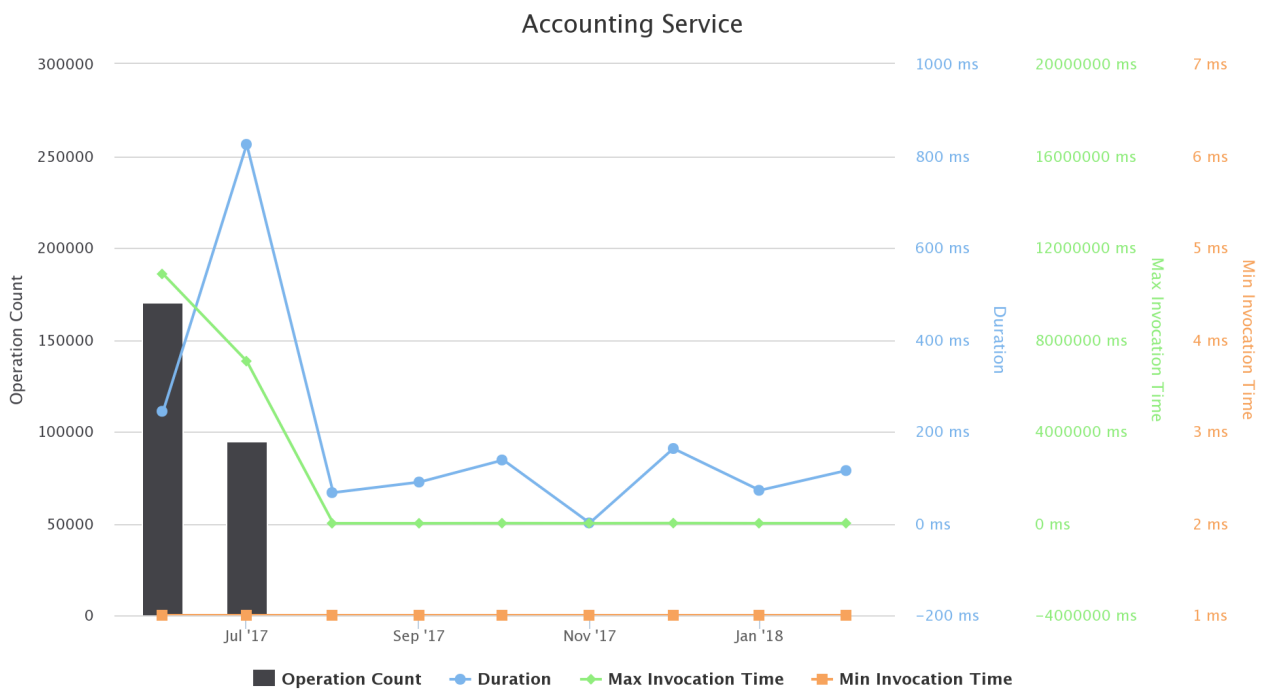

Figure 33. BlueBRIDGE EAB VRE / VLab Operations per Month

3.14 BLUEBRIDGE PROJECT

This VRE was devised to support the BlueBRIDGE project activities and discussions. Only members of the BlueBRIDGE consortium have access to this VRE.

The BLUEBRIDGE Project VRE is available at https://bluebridge.d4science.org/web/bluebridgeproject

This VRE has been in **operational** status since **September '15** and it is currently serving **99 users**, namely the BlueBRIDGE Consortium members. A screenshot of the VRE is provided in Figure 34. It shows the home page and the menu items for accessing the VRE facilities.
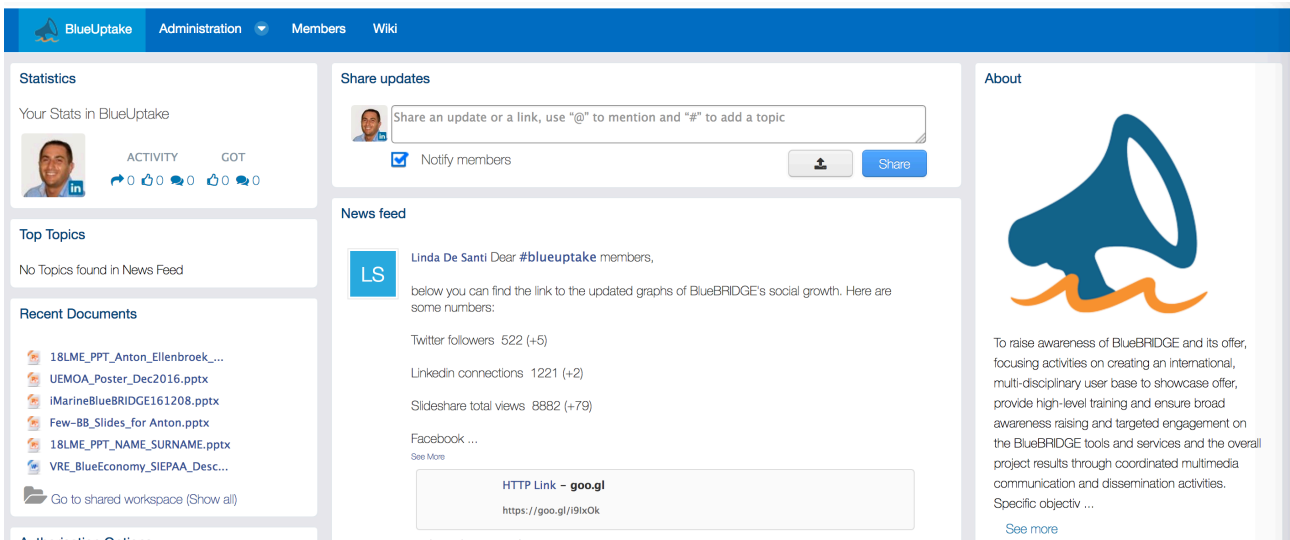

Figure 34. BlueBRIDGE Project VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *BlueBRIDGE Wiki*: a facility enabling users to access the project Wiki;
- *BlueBRIDGE Issue Tracking System*: a facility enabling users to access the project issue tracking system;
- *Resource Catalogue*: a facility enabling EAB members to access the BlueBRIDGE products catalogue. As of February 2018, this catalogue give access to more than **70,000 items** including datasets, virtual research environments, services, and "research objects".

Figure 35 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
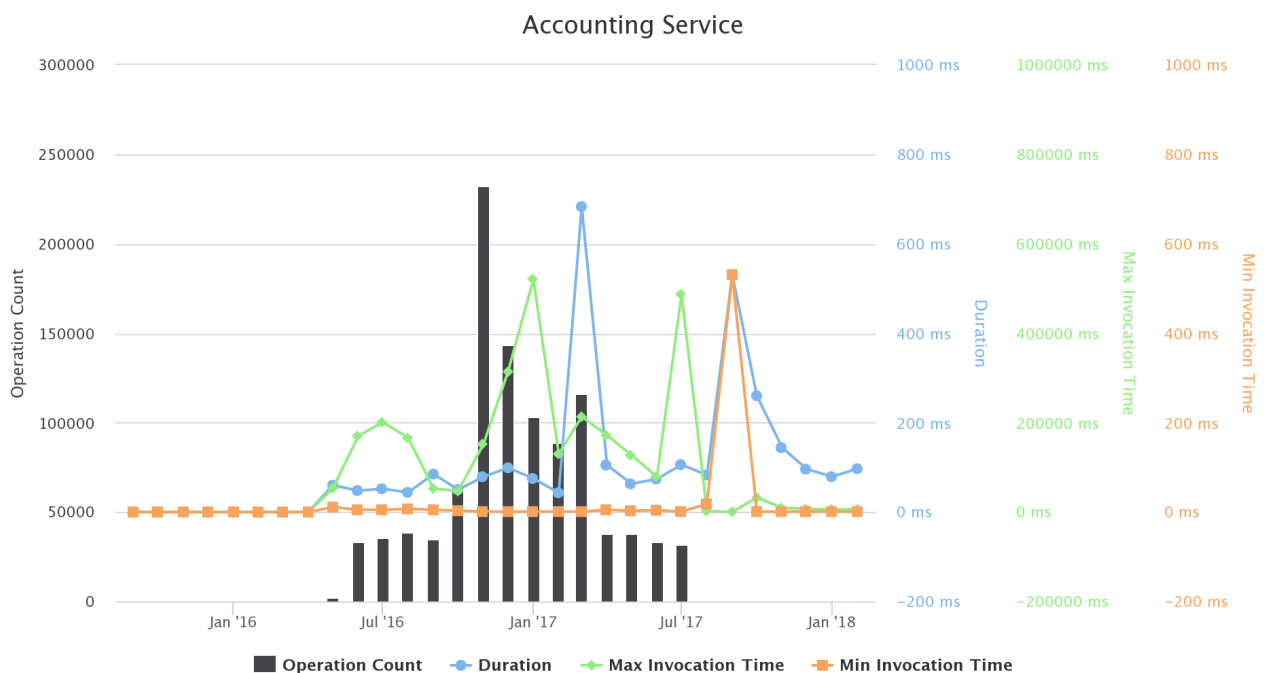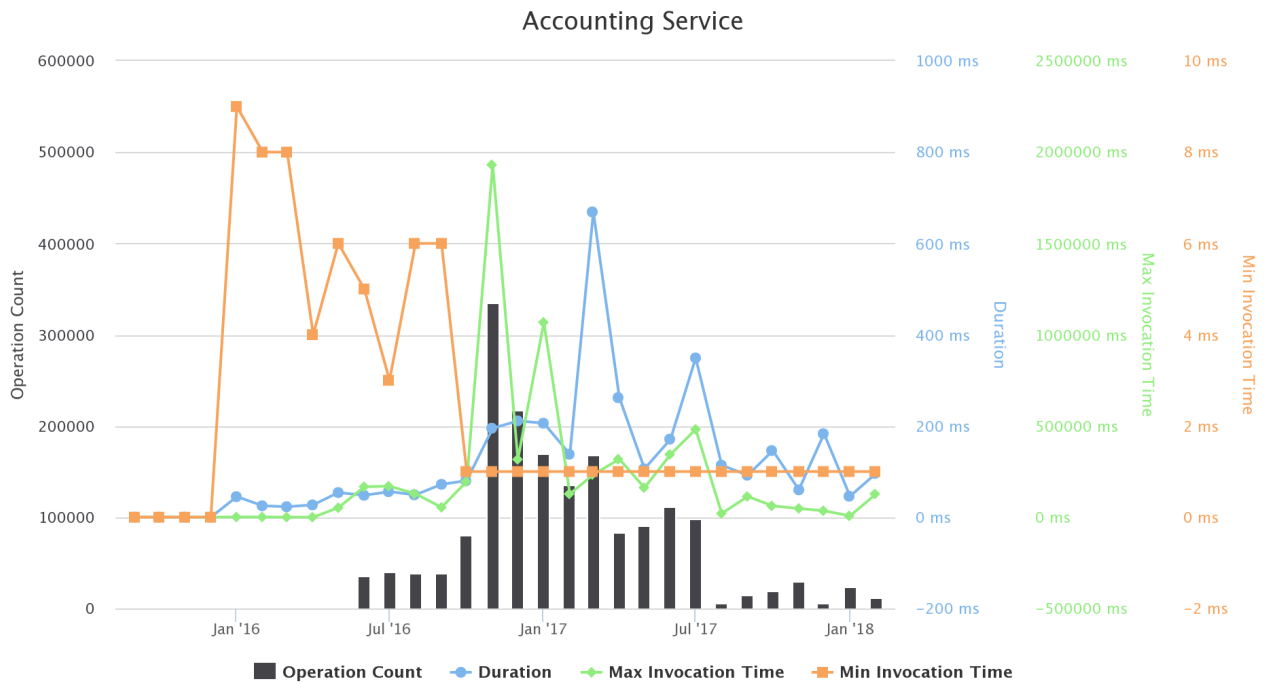
Figure 35. BlueBRIDGE Project VRE / VLab Operations per Month

3.15 BLUEBRIDGE PSC

This VRE is dedicated to supporting the Activity of the BlueBRIDGE Project Steering Committee (PSC) members.

The BLUEBRIDGE-PSC VRE is available at https://bluebridge.d4science.org/web/bluebridge-psc

This VRE has been in *operational* status since *September '15* and it is currently serving *10 users*, namely the BlueBRIDGE PSC members. A screenshot of the VRE is in Figure 36. It shows the home page and the menu items for accessing the VLab facilities.

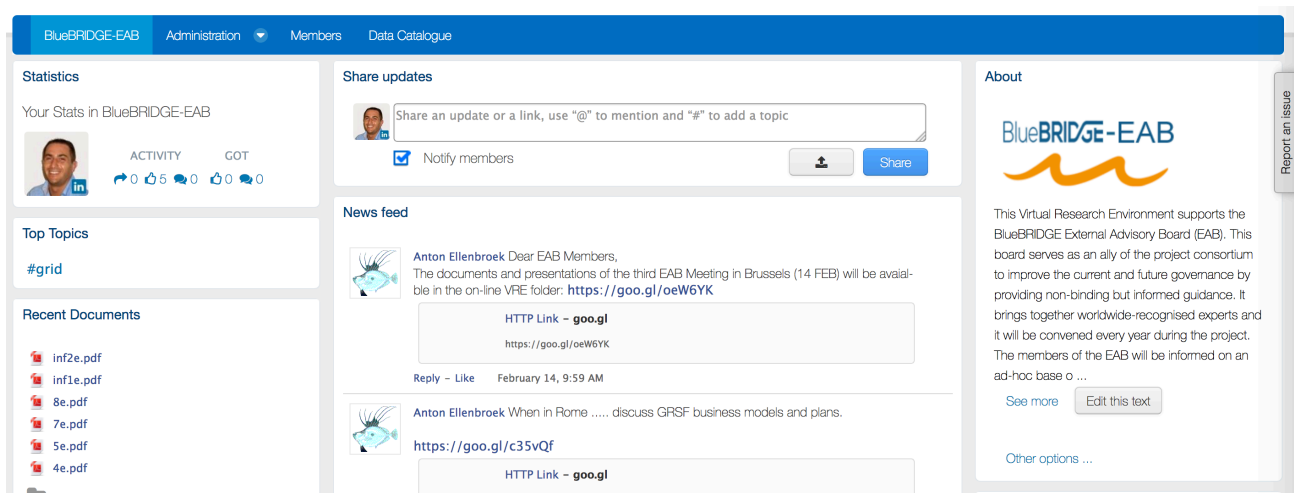**Figure 36. BlueBRIDGE-PSC VRE / VLab Home Page Screenshot**

This VRE is equipped with the basic VRE facilities, and primarily works as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 37 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
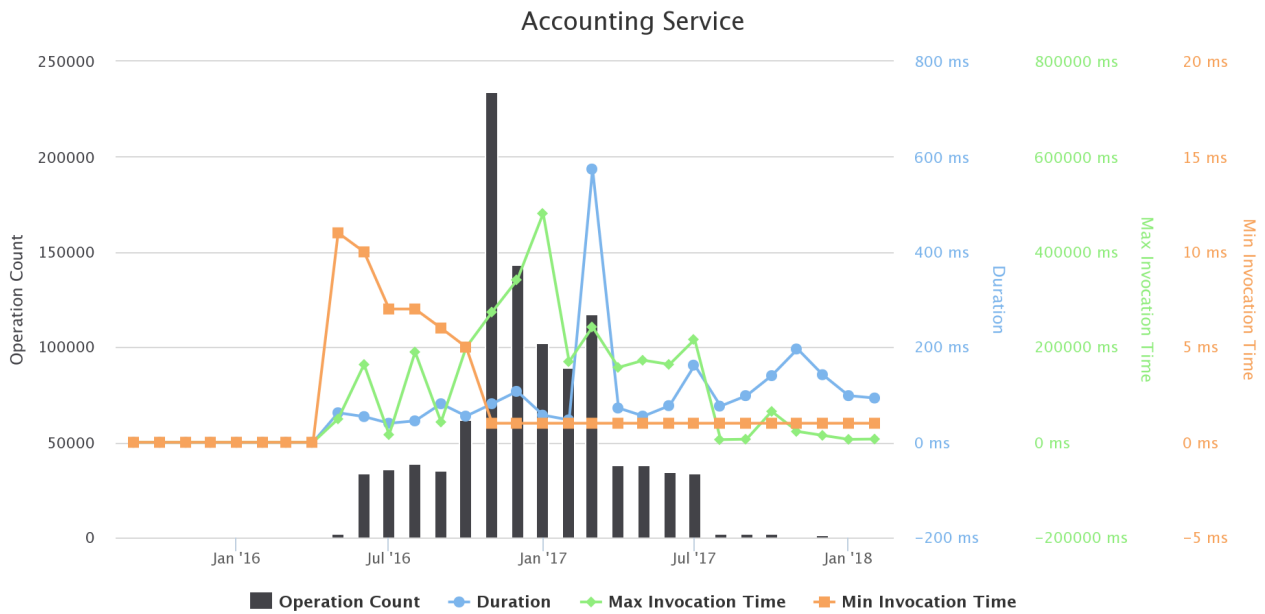
Figure 37. BlueBRIDGE PSC VRE / VLab Operations per Month

3.16 BLUEBRIDGE REVIEW

https://bluebridge.d4science.org/web/bluebridgereview

This VLab has been in *operational* status since *December '16* and it is currently serving *15 users*, namely the BlueBRIDGE PSC members, EC representatives and BlueBRIDGE Reviewers. A screenshot of the VRE is in Figure 38. It shows the home page and the menu items for accessing the VLab facilities.

Figure 38. BlueBRIDGE Review VRE / VLab Home Page Screenshot

This VRE is equipped with the basic VRE facilities, and primarily works as a workspace for sharing objects of interest (e.g. BlueBRIDGE Deliverables), a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 39 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
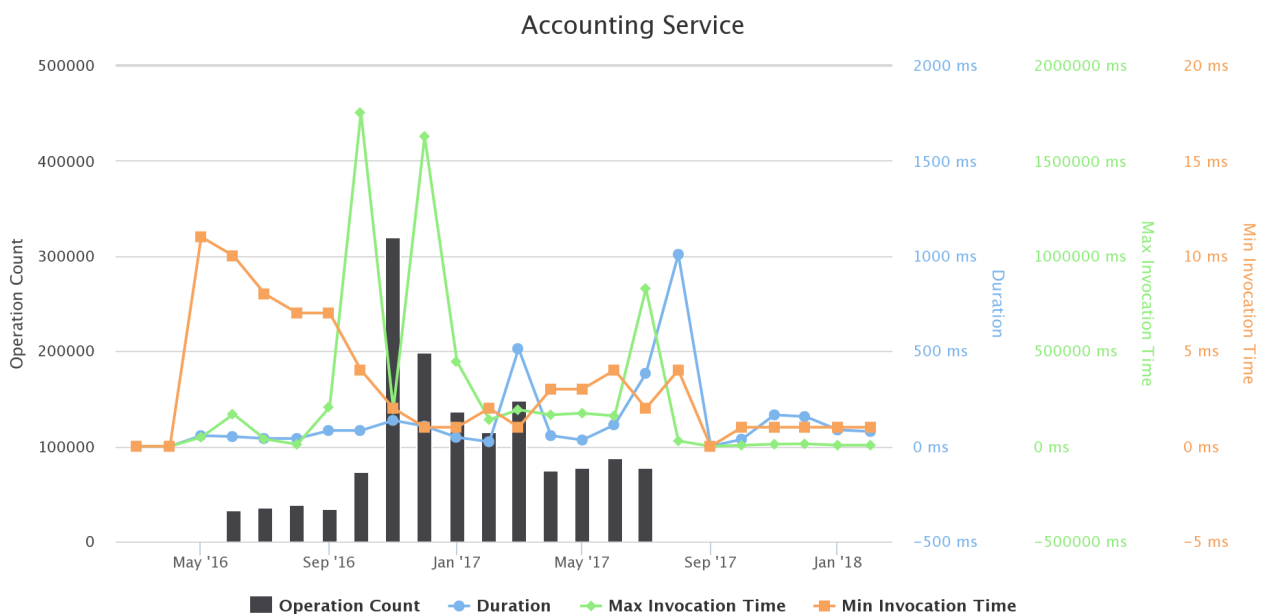
Figure 39. BlueBRIDGE Review VRE / VLab Operations per Month

3.17 CWP SECRETARIAT

This VLab is conceived to support the development and maintenance of the catalogue of the Coordinating Working Parties (CWP) on Fisheries Statistics, a catalogue initiated upon recommendations from the CWP ad-hoc Task Group on reference data harmonization. The catalogue is a listing of available CWP global DSDs, CWP standards, and codelists used by CWP parties and other resources. The catalogue is expected to be updated routinely by FAO, the CWP secretariat.

The VLab is available at https://bluebridge.d4science.org/web/cwp_secretariat

This VLab has been in **operational** status since **December '17** and it is currently serving **8 users**. A screenshot of the VRE is in Figure 40. It shows the home page and the menu items for accessing the VLab facilities.
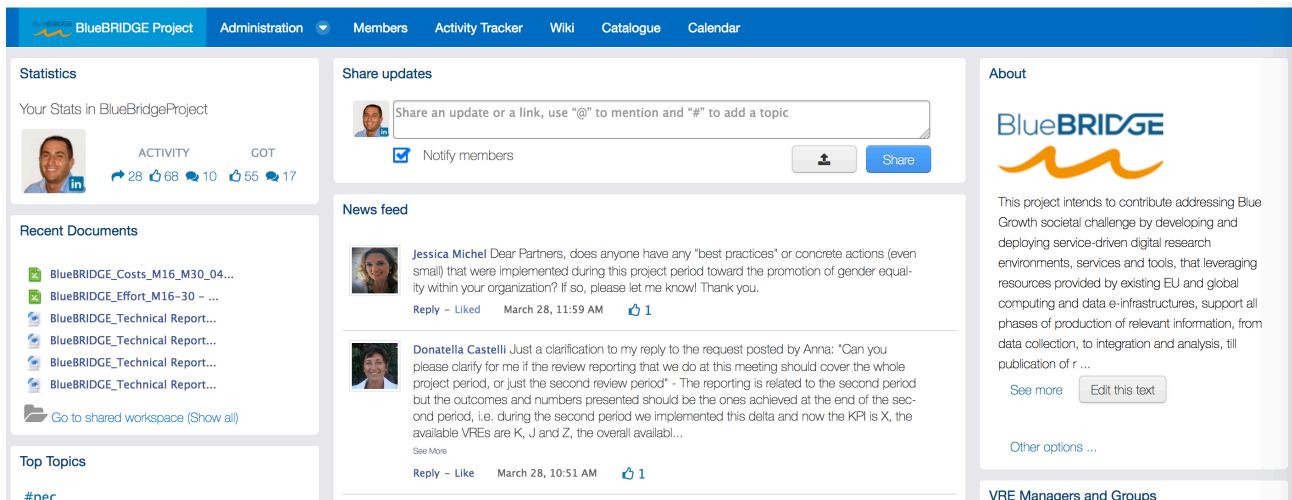

Figure 40. CWP Secretariat VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Context Specific Catalogue*: a facility enabling users to search, browse and access the CWP products (DSDs, CWP standards, and codelists). As of February '18 This catalogue gives access to more than **400 products**.

Figure 41 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
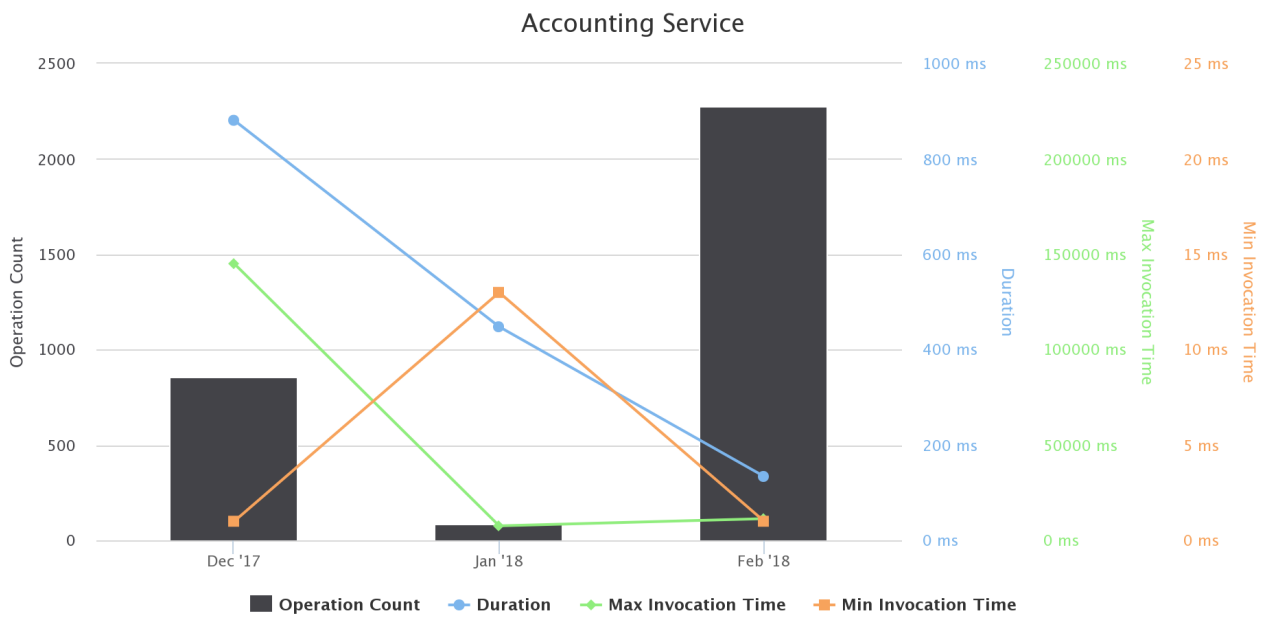

Figure 41. CWP Secretariat VRE / VLab Operations per Month

3.18 DRUMFISH

DRuMFISH is an EU Project aiming at advising on the status and management of data-poor stocks in mixed fisheries. The project reviews assessment and management approaches for data-poor stocks and identifies relevant approaches for application in the case studies and wider EU fisheries. The approaches should be compatible with the Common Fisheries Policy (CFP; EU 2013) in terms of (i) fishing mortality ranges compatible with Maximum Sustainable Yield (MSY), (ii) fish caught to be landed, and (iii) addressing uncertainty in significant components of the marine fish ecosystem. This VLab was designed to support the activities of the DRuMFISH Lorient meeting (21-23 March 2017) focussing on CMSY and its usage to produce Harvesting Control Rules and exploitation/profitability scenarios for fisheries.

The VLab is available at https://bluebridge.d4science.org/web/drumfish

This VLab has been in **operational** status since **February '17** and it is currently serving **27 users**. A screenshot of the VRE is in Figure 40. It shows the home page and the menu items for accessing the VLab facilities.

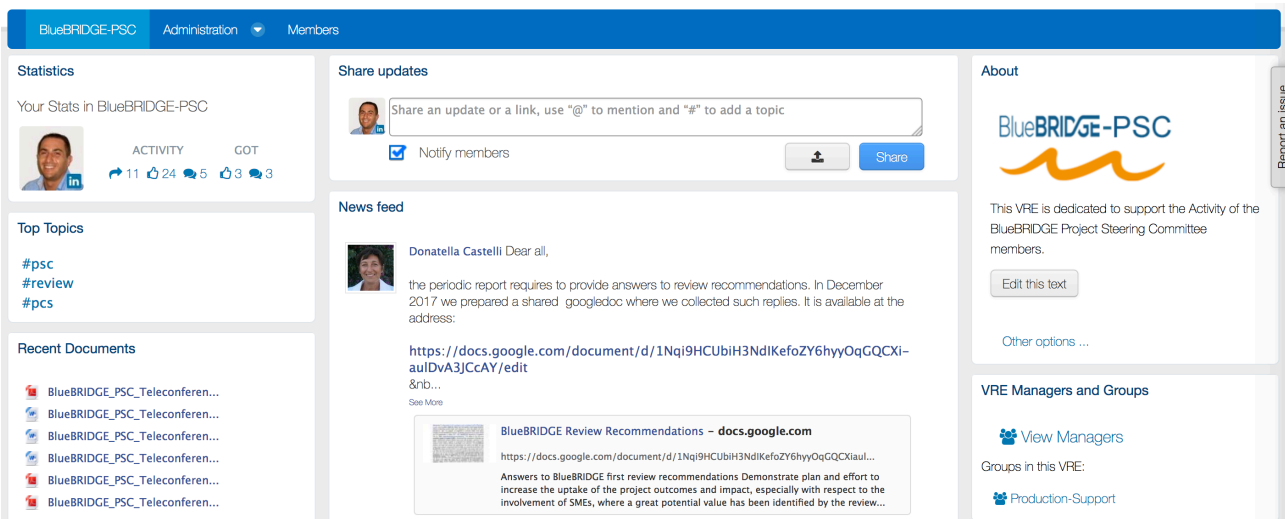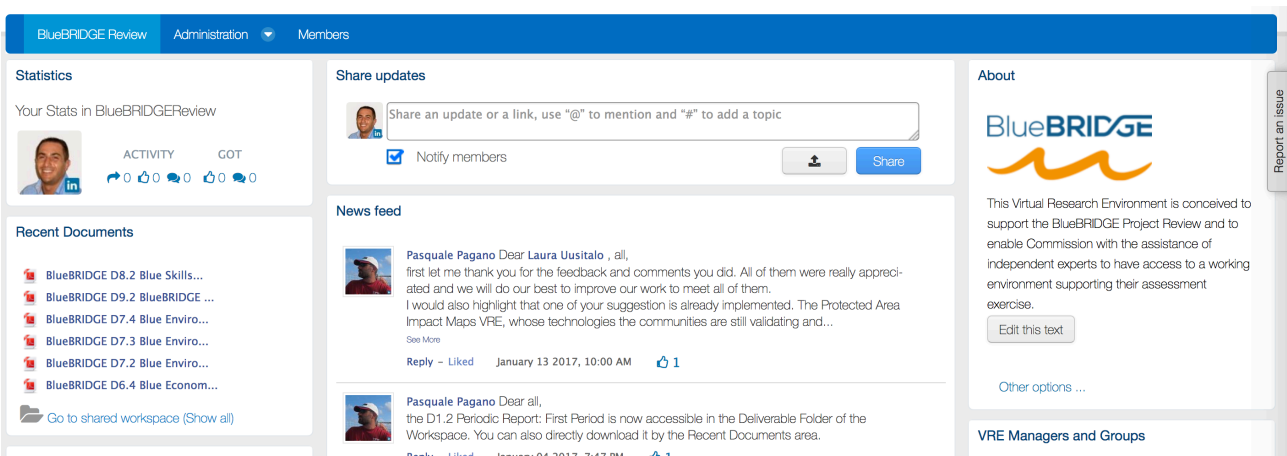**Figure 42. DRuMFISH VRE / VLab Home Page Screenshot**

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to **one algorithm** only, i.e. the CMSY method for data-limited stock assessment [11];

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps that have been generated and published. This facility relies on the GeoExplorer portlet, and makes it possible to effectively exploit the generated maps and to perform comparisons and analysis of the diverse distributions by enabling map overlay, transects production and values inspection;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 43 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
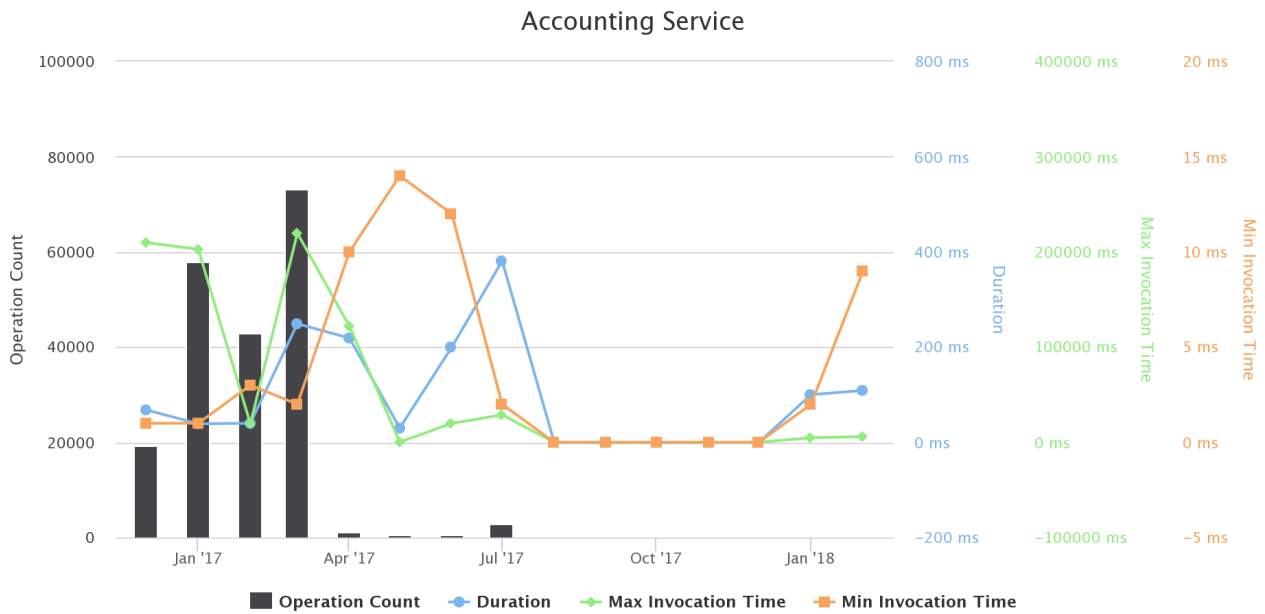
Figure 43. DRuMFISH VRE / VLab Operations per Month

3.19 ELLINIKA PSARIA VRE

This VRE was conceived to provide the Ellinika Psaria aquaculture company members with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis. Access to this working environment is restricted to Ellinika Psaria members only.

The Ellinika Psaria VRE is available at https://bluebridge.d4science.org/web/ellinikapsariavre

This VLab has been in *operational* status since *October '16* and it is currently serving *11 users*. A screenshot of the VRE is in Figure 44. It shows the home page and the menu items for accessing the VLab facilities.
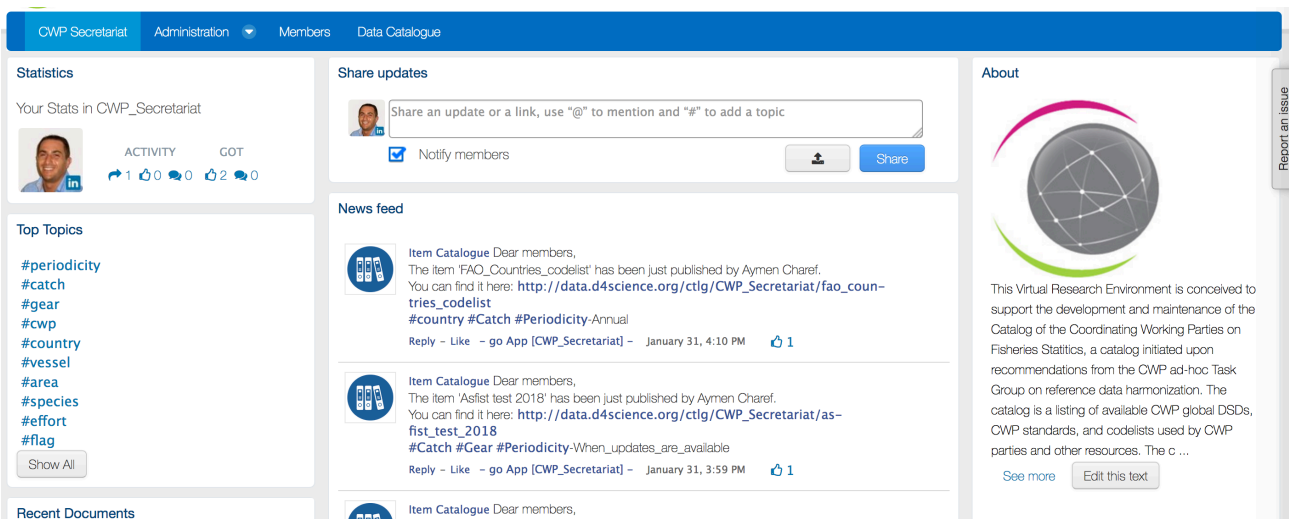

Figure 44. Ellinika Psaria VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the

broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 45 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
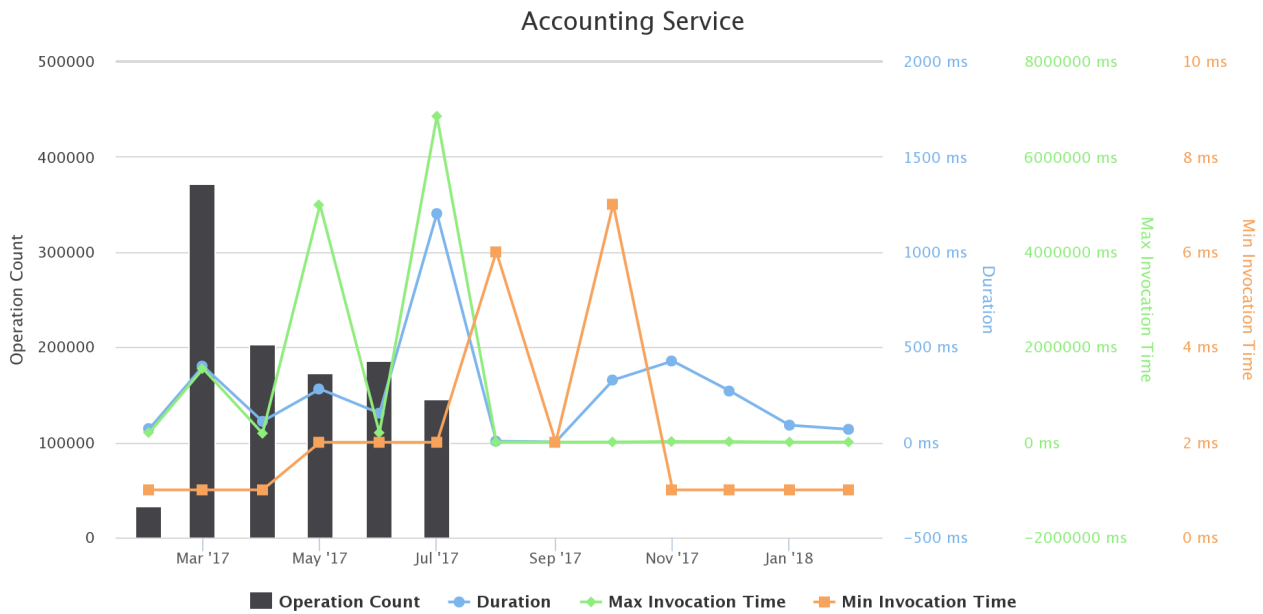

Figure 45. Ellinika Psaria VRE / VLab Operations by Month

3.20 FORKYS VRE

This VLab is conceived to provide the Forky's aquaculture company members with a set of aquafarming assessment tools enabling them to perform evaluation growth analysis and techno economic investment analysis. Access to this working environment is restricted to Forkys members only.

The Forkys VRE is available at https://bluebridge.d4science.org/web/forkysvre

This VLab has been in **operational** status since **October '16** and it is currently serving **11 users**. A screenshot of the VRE is in Figure 46. It shows the home page and the menu items for accessing the VLab facilities.
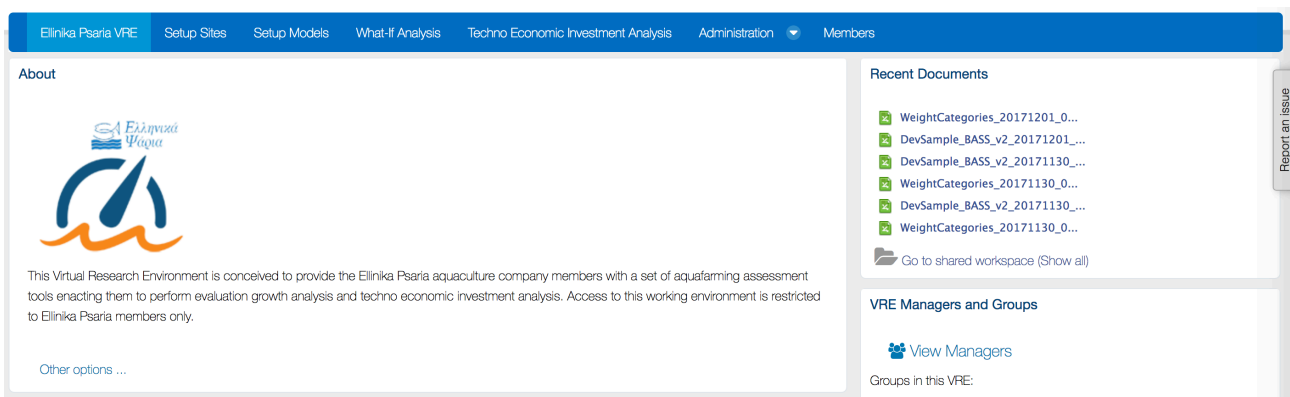
Figure 46. Forky's VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 47 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
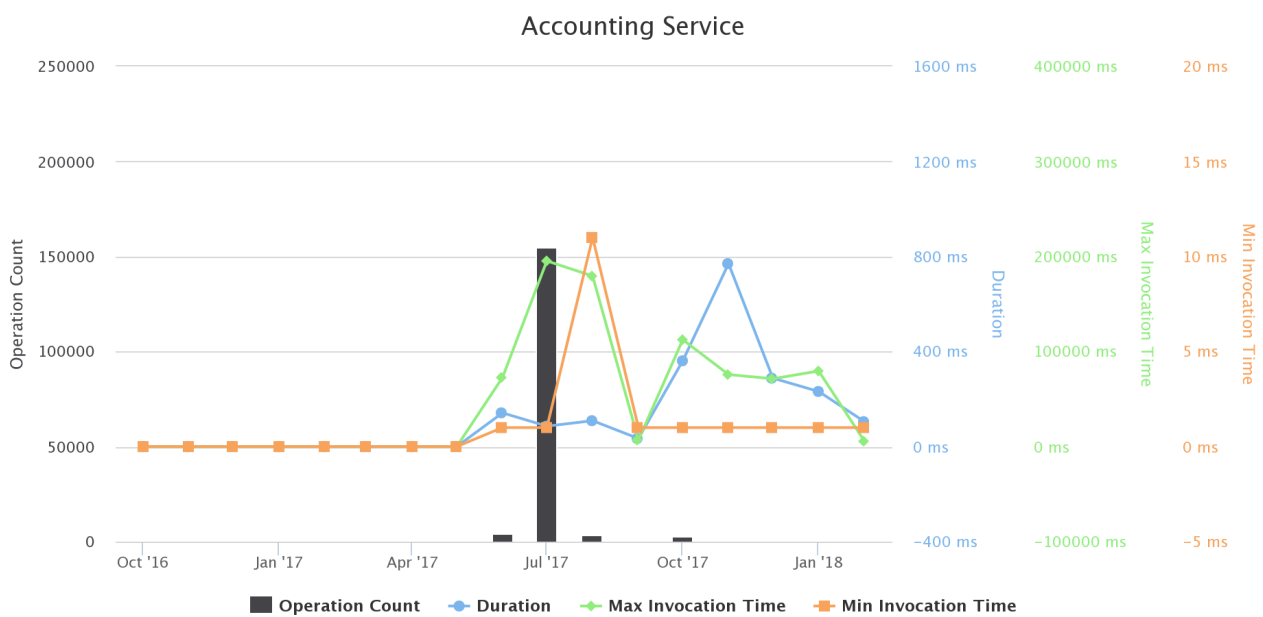
Figure 47. Forky's VRE / VLab Operations by Month

3.21 FRENCH TROPICAL TUNA ATLAS

The French Tropical Tuna Atlas VRE is a tool to handle public domain data from various (Tuna) Regional Fisheries Management Organizations (T-RFMOs). Data include catches, fishing efforts and size frequencies of the species managed by the five tuna RFMOs: CCSBT- Commission for the Conservation of Southern Bluefin Tuna, IATTC- Inter-American Tropical Tuna Commission, ICCAT- International Commission for the Conservation of Atlantic Tunas, IOTC- Indian Ocean Tuna Commission, WCPFC - Western and Central Pacific Fisheries Commission.

The French Tuna Atlas provides services to discover the available datasets at regional and global levels, extract them in several formats widely used by the scientific community (e.g. CSV, NetCDF, SDMX) and visualize them in an interactive web-viewer of indicators and maps. It also includes tools for the users to generate their own Tuna atlas by applying own processing (e.g. applying specific choices for scientific corrections) on the tuna RFMOs data. Target Users include: (i) Scientists willing to discover available public domain data on tuna fisheries, understand and reproduce the workflow that has been applied to generate a dataset (eventually modifying it using their own expertise), download the data in the format that they are used to work with, store newly produced datasets and share them to the community; (ii) Tuna Regional Fisheries Management Organizations willing to give more visibility to their data and more transparency to the processing steps driving to the datasets used as inputs for stocks assessments, and to provide tools to facilitate data extraction and visualization to anyone interested in tuna fisheries; (iii) Non Governmental Organizations, policy makers, general public willing to visualize tuna fisheries data at regional or global scale though interactive web-viewers.

The VLab is available at https://bluebridge.d4science.org/web/frenchtropicaltunaatlas

This VLab has been in *operational* status since *January '18* and it is currently serving *5 users*. A screenshot of the VRE is in Figure 48. It shows the home page and the menu items for accessing the VLab facilities.
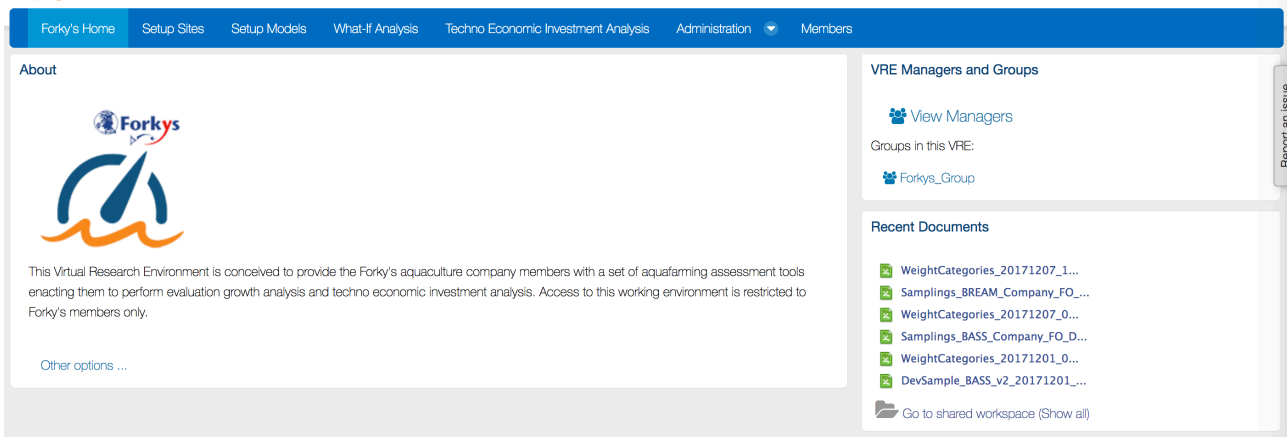
Figure 48. French Tropical Tuna Atlas VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Data Analytics at scale*: a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 the selection of algorithms to be enacted is still under discussion;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace;

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Geospatial Catalogue*: a facility enabling to search and browse geospatial datasets of interest for the specific VRE / VLab. As of February '18, this catalogue gives access to more than 200 items including more than 150 datasets, 60 services and 50 features;

- *Context Specific Catalogue*: a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18, this catalogue gives access to more than 200 items including more than 150 datasets, 60 services and 50 features;

- *ShareLaTeX:* a facility enabling users to access a fully-fledged ShareLaTeX® working environment directly from the VRE.

Figure 49 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
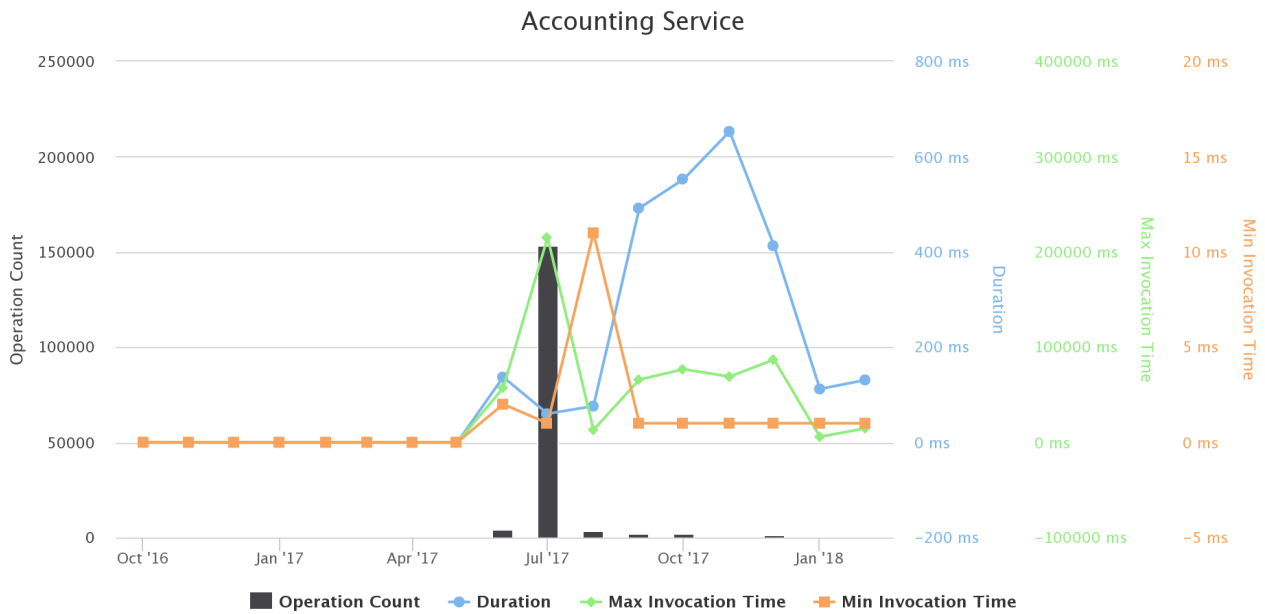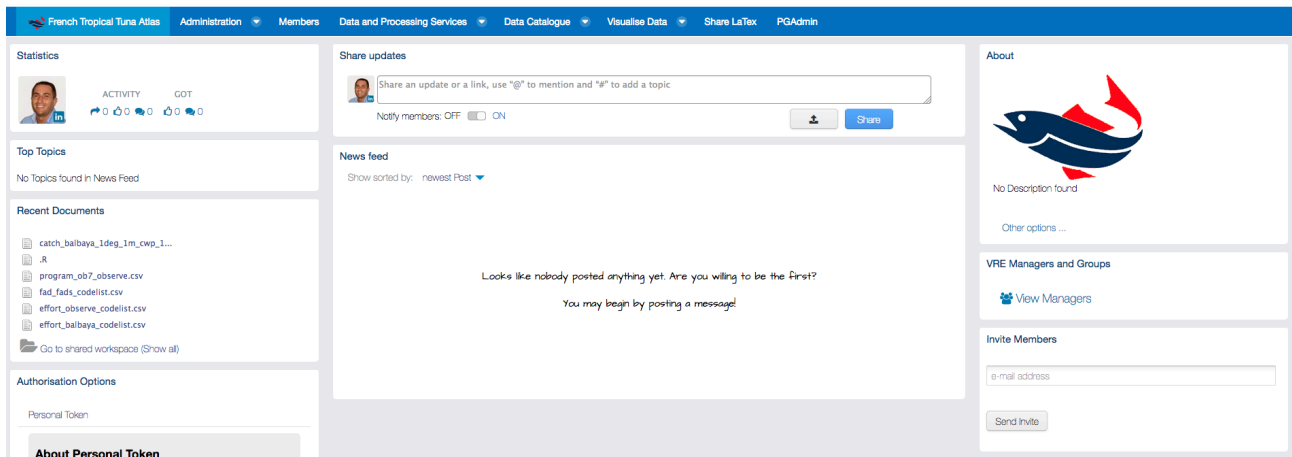
Figure 49. French Tropical Tuna Atlas VRE / VLab Operations per Month

3.22 GALAXIDI MARINE FARM

The GALAXIDI Marine Farm VLab supports the performance evaluation, benchmarking and decision making process of GALAXIDI aquaculture company to improve its profitability and minimise environmental impacts. It enables GALAXIDI company members to: (a) evaluate and optimise their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to GALAXIDI company members only.

The VLab is available at https://bluebridge.d4science.org/web/galaxidi

This VLab has been in *operational* status since *September '17* and it is currently serving *4 users*. A screenshot of the VRE is in Figure 50. It shows the home page and the menu items for accessing the VLab facilities.

Figure 50. Galaxidi Marine Farm VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 51 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
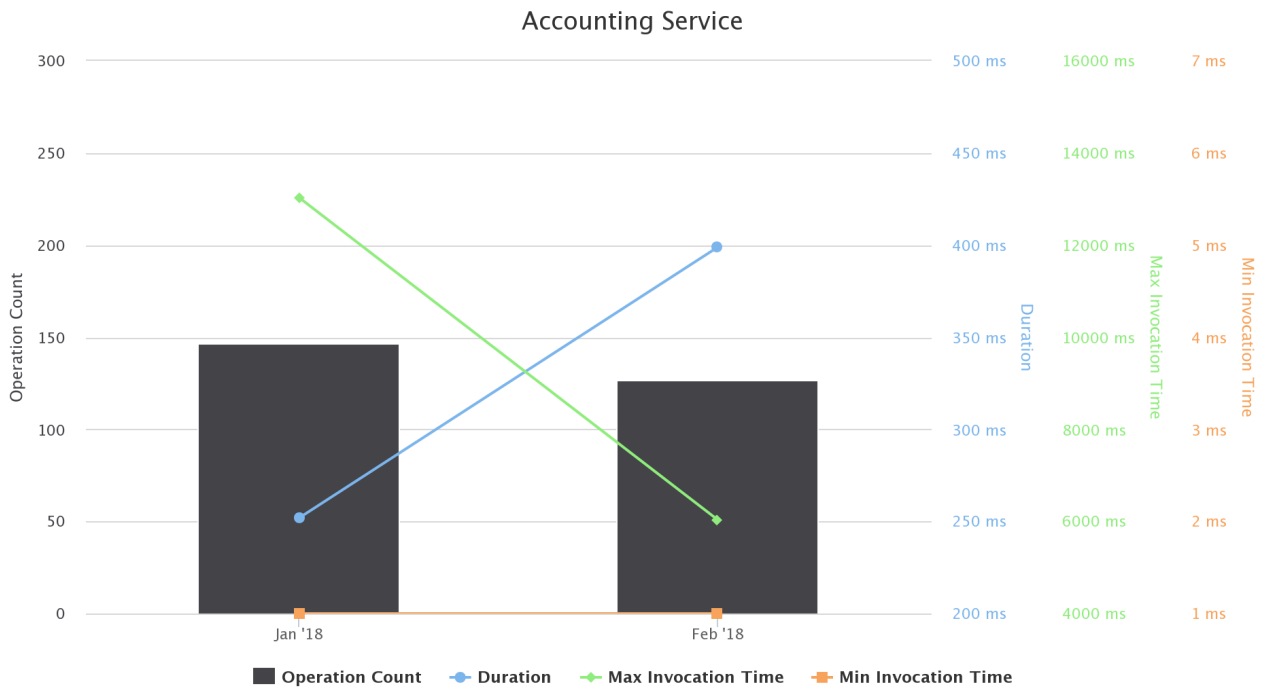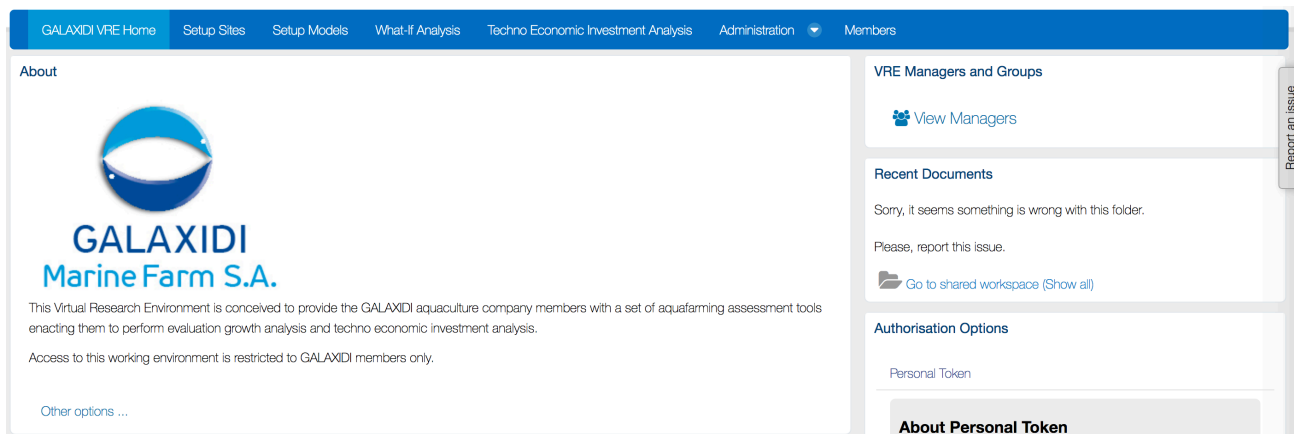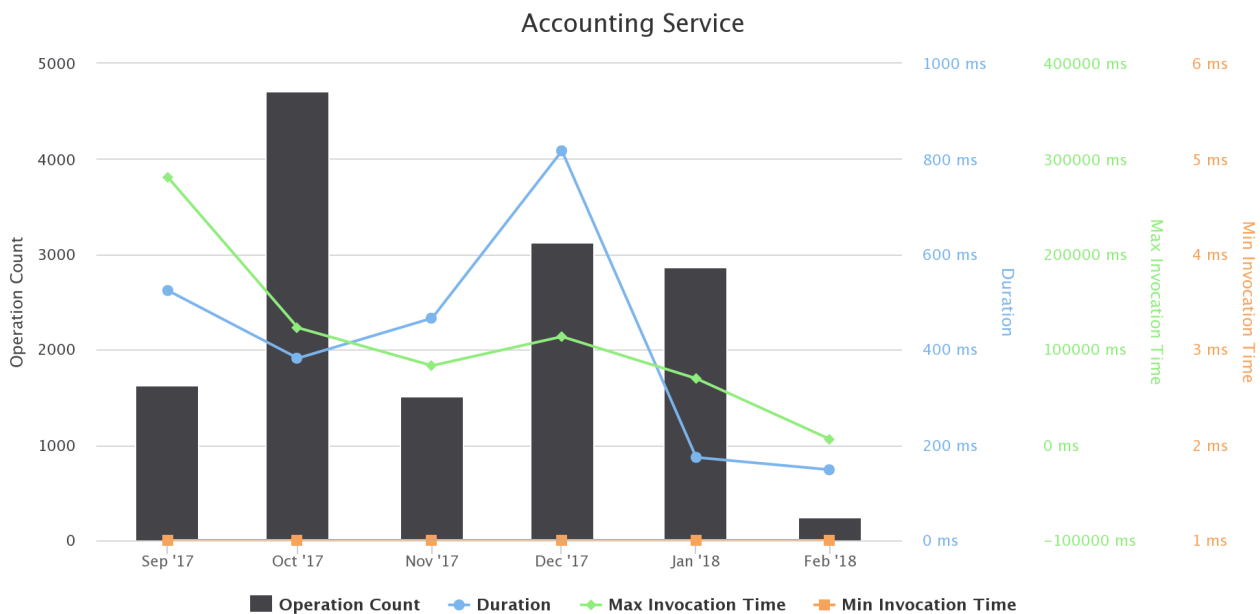

Figure 51. Galaxidi Marine Farm VRE / VLab Operations per Month

3.23 GLOBAL RECORD OF STOCKS AND FISHERIES (GRSF)

The main purpose of this VLab is to provide scientists with an environment and tools for *accessing stocks and fisheries information* in an integrated and uniform way. To this end, an innovative and unifying registry containing such information is made available: the **Global Registry of Stocks and Fisheries**. It integrates data about stocks, fisheries and their corresponding details, coming from different sources (including FIRMS

http://firms.fao.org/firms/en - RAM Legacy Stock Assessment Database http://ramlegacy.org - FishSource http://www.fishsource.com) and offers authoritative records about them, i.e., the GRSF records. The GRSF records made available by this VLab are produced by relying on the GRSF Admin VLab (cf. Sec. 3.24).

The VLab is available at https://bluebridge.d4science.org/web/grsf

This VLab has been in **operational** status since **October '16** and it is currently serving **13 users**.[9] A screenshot of the VRE is in Figure 52. It shows the home page and the menu items for accessing the VLab facilities.

Figure 52. GRSF VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *GRSF Catalogue*: a facility enabling users to have access (via search and browse) to the current version of the catalogue of records on stocks and fisheries resulting from the integration of data coming from different sources (including FIRMS http://firms.fao.org/firms/en - RAM Legacy Stock Assessment Database http://ramlegacy.org - FishSource http://www.fishsource.com);

Figure 53 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 53. GRSF VRE / VLab Operations per Month

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[9] This VRE / VLab is expected to be released once the assessment activity performed in the GRSF Admin VRE / VLab is complete, i.e. the catalogue is officially approved by the GRSF management and development boards.

3.24 GRSF ADMIN

The main purpose of this VLab is to provide scientists and practitioners with an environment and the tools for building an integrated catalogue on *stocks and fisheries information*, i.e. for defining the authoritative version of the stocks and fisheries records made available by the GRSF VLab (cf. Sec. 3.23). To this end, it is mainly equipped with a registry containing the "under development version" of such information to be disseminated by the GRSF VRE when ready (cf. Sec. 3.23) and an approve / reject facility enabling experts to assess the candidate records to decide whether they are suitable for publication or not.

The GRSF Admin VLab is available at https://bluebridge.d4science.org/web/grsf_admin

This VLab has been in *operational* status since *November '16* and it is currently serving *32 users*. A screenshot of the VRE is in Figure 54. It shows the home page and the menu items for accessing the VLab facilities.
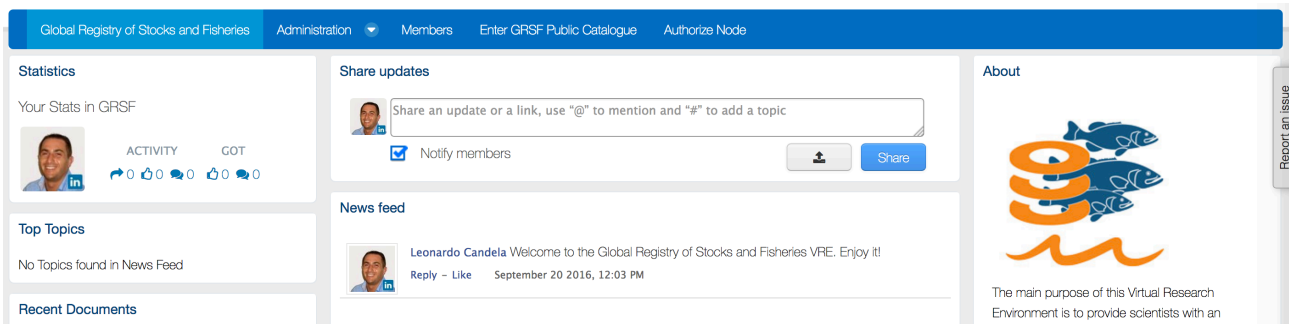

Figure 54. GRSF Admin VRE / VLab Home Page Screenshot

In addition to the basic facilities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *GRSF Catalogue (development version)*: a facility enabling users to have access (by search and browse) to the current version of the catalogue records on stocks and fisheries (i.e. candidate records) resulting from the integration of data coming from different sources (including FIRMS http://firms.fao.org/firms/en - RAM Legacy Stock Assessment Database http://ramlegacy.org - FishSource http://www.fishsource.com). Users are allowed to annotate every single record by either approving or rejecting them. As of February '18 this catalogue gives access to **more than 18,000 records**;

- *GRSF Competency Queries*: a facility giving access to a set of predefined queries that have been formulated based on the requirements that have been collected from the corresponding communities. These queries are formulated in such a way that they return information that is useful for the communities, and in the case of the GRSF competency question they return results that exploit the integrated data warehouse and in certain cases return results that could not be answered from the individual sources;

- *Data Analytics at scale:* a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 the facility gives access to *3 specific algorithms* calculating spatial interest / overlap / adjacency indicators given list of pairs of bounding boxes;

- *Algorithm Importer:* a facility enabling users to transform user defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code, thus making it possible for Data Miner to properly executing it;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 55 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
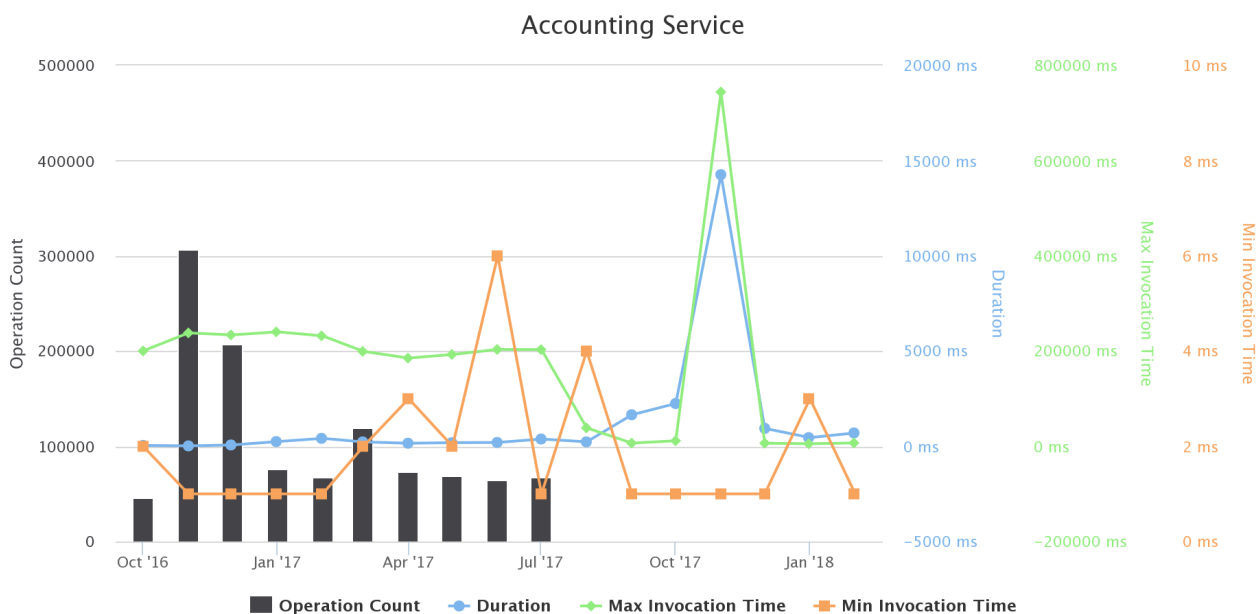

Figure 55. GRSF Admin VRE / VLab Operations per Month

3.25 ICCAT BFT-E

ICCAT BFT-E is the stock assessment VLab dedicated to the International Commission for the Conservation of Atlantic Tunas. This VRE has been exploited to support and showcase BlueBRIDGE offerings in the context of several ICCAT events [2].

The ICCAT BFT-E VLab is available at https://bluebridge.d4science.org/web/iccat_bft-e

This VLab stems from the Blue Assessment VREs [5] and has been largely exploited by Blue Skills [2]. It has been in "*operational*" status since *August '16,* and it is currently serving *38 users*. A screenshot of the VLab is provided in Figure 56. It shows the home page and the menu items for accessing the VLab facilities.
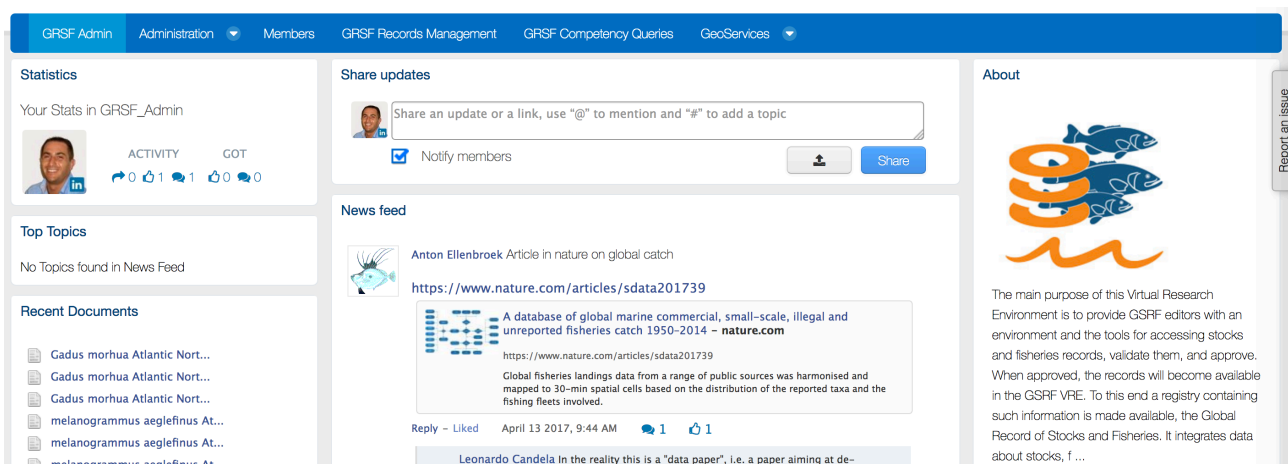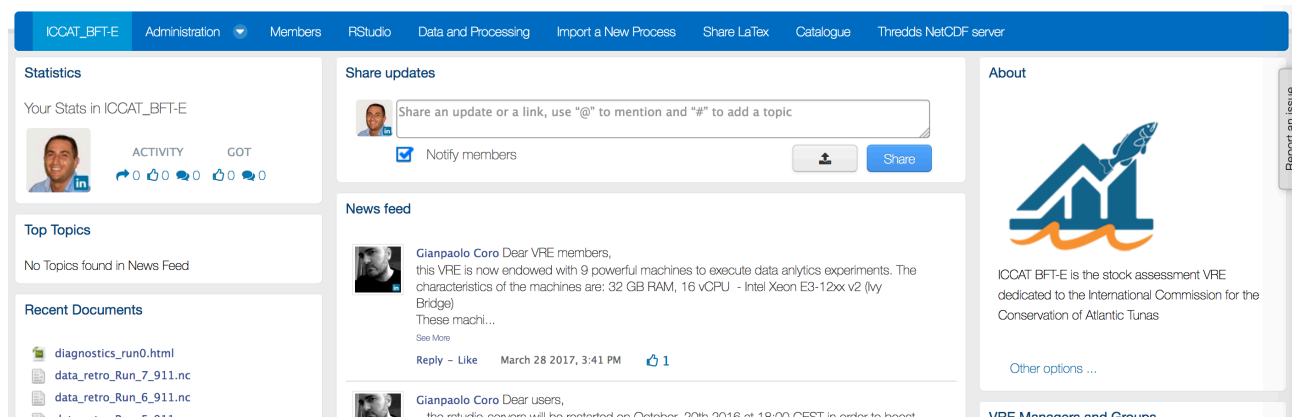

Figure 56. ICCAT BFT-E VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. These algorithms include the various steps of stock assessment workflow based on Virtual Population Analysis (VPA). As of February '16, this environment has been configured to give access to **6 VPA algorithms** [5][12]: Step 1 VPA ICCAT BFT-E Retros, Step 1 VPA ICCAT BFT-E Retros Parallelized, Step 2 VPA ICCAT BFT-E Visualisation, Step 3 VPA ICCAT BFT-E Projection, Step 4 VPA ICCAT BFT-E Report, Whole VPA ICCAT BFT-E;

- *Algorithm Importer*: a facility enabling users to transform user-defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code, thus making it possible for Data Miner to properly executing it;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace;

- *ShareLaTeX:* a facility enabling users to access a fully-fledged ShareLaTeX® working environment directly from the VRE;

- Context Specific Catalogue: a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab.

Figure 57 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
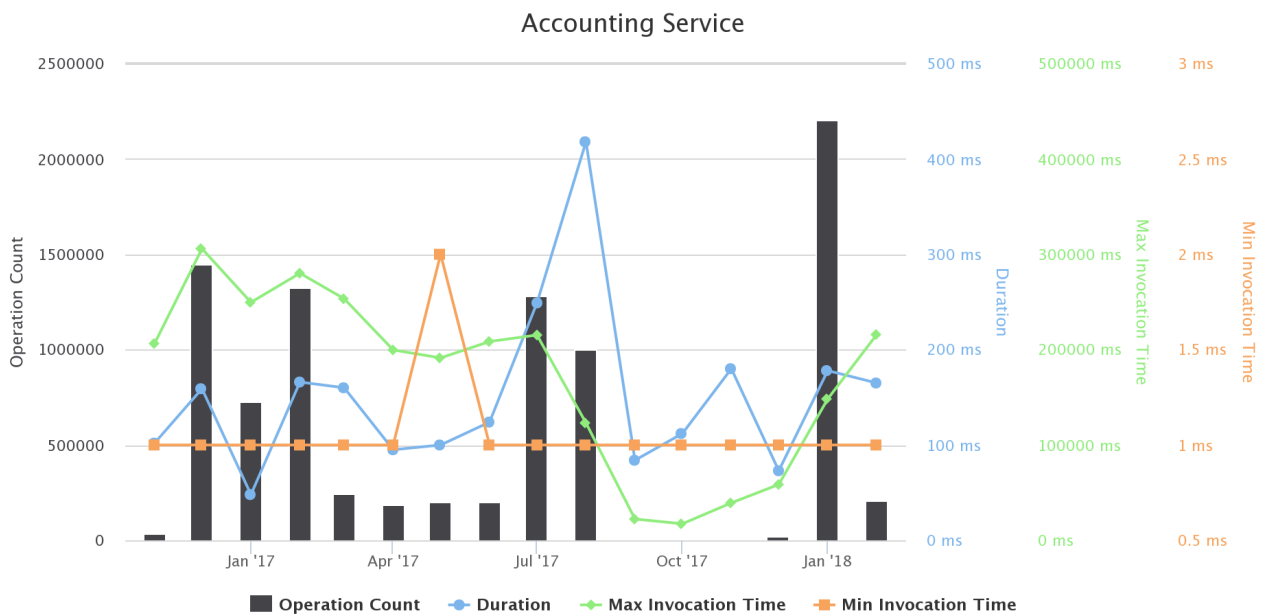

Figure 57. ICCAT BFT-E VRE / VLab Operations per Month

3.26 ICES BAYESIAN NETWORK ANALYSIS

This VLab has been designed to support the ICES training course on Bayesian Network analysis including the socio-cultural dimension (27 November–1 December, ICES, Copenhagen, Denmark) [2]. This ICES course introduced the basics of Bayesian Network modelling and discuss how the method can be used to address questions related to social-ecological systems. The instructors (Laura Uusitalo, Finnish Environment Institute, Marine Research Centre, and Päivi Haapasaari, Fisheries and Environmental Management Group, University of Helsinki) exploited it for sharing material of interest and for interacting with the course participants.

The VLab is available at https://bluebridge.d4science.org/web/ices_bnetworkanalysis

This VLab stems from the Blue Skills needs [2]. It has been in **operational** status since **October '17** and it is currently serving **21 users**. A screenshot of the VRE is in Figure 58. It shows the home page and the menu items for accessing the VLab facilities.

Figure 58. ICES Bayesian Network Analysis VRE / VLab Home Page Screenshot

This VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 59 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
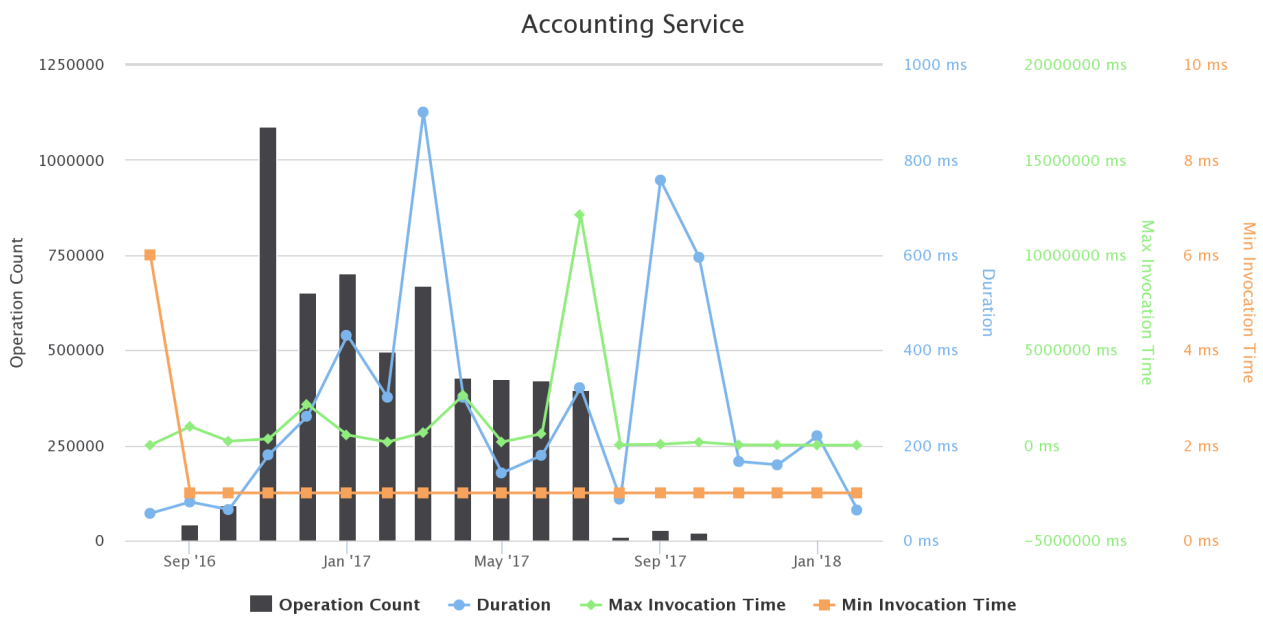

Figure 59. ICES Bayesian Network Analysis VRE / VLab Operations per Month

3.27 ICES DALSA: ICES TRAINING COURSE ON DATA LIMITED STOCK ASSESSMENT

This VLab was conceived and used to support the ICES training course on Data Limited Stock Assessment, Date: 12 - 16 September, Location: Reykjavik, Iceland.

This course was intended to enable participants to identify data information content and how they interact in a variety of assessment settings – from data-limited to data-rich. Students were also taught to recognize a diverse range of data-limited assessment methodologies and the data needs for each. In addition, they were able to understand each method's assumptions, benefits, limitations, and prior applications and performances.

The ICES DALSA VLab is available at https://bluebridge.d4science.org/web/ices_dalsa

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since **August '16,** and it is currently serving **27 users**. A screenshot of the VLab is provided in Figure 60. It shows the home page and the menu items for accessing the VLab facilities.

Figure 60. ICES DALSA VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 61 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
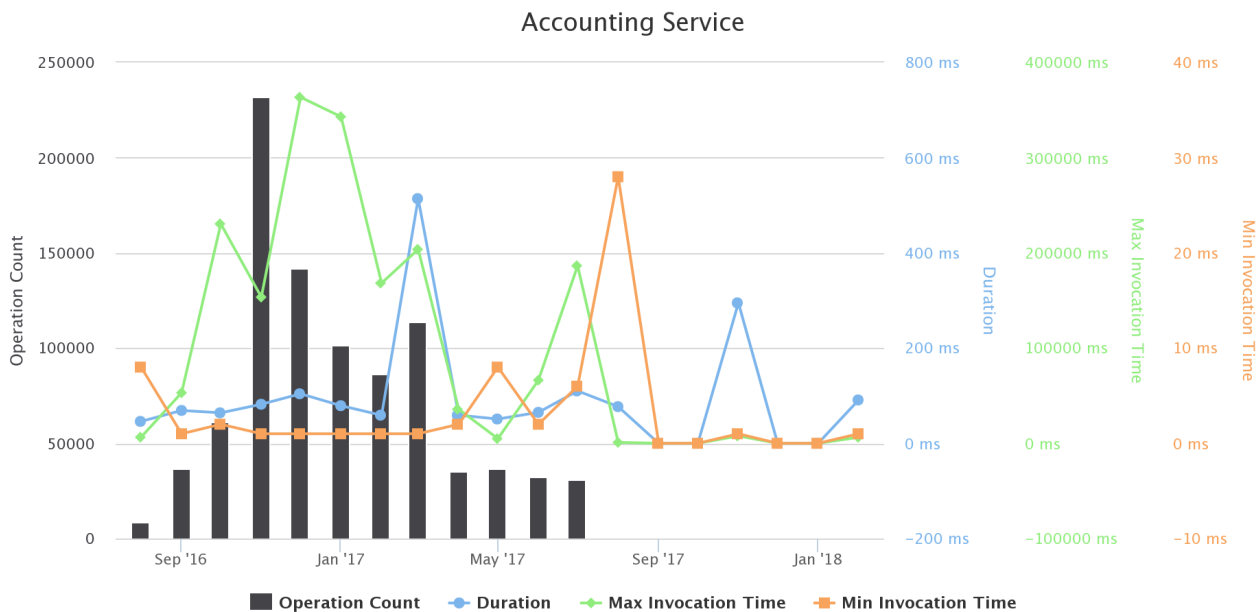
Figure 61. ICES DALSA VRE / VLab Operations by Month

3.28 ICES DASC: ICES TRAINING COURSE ON DESIGN AND ANALYSIS OF STATISTICALLY SOUND CATCH SAMPLING PROGRAMMES

This VLab was conceived and used to support the ICES training course on Design and analysis of statistically sound catch sampling programmes, 12–16 September 2016, ICES, Copenhagen. Instructors: Denmark Jon Helge Vølstad, Institute of Marine Research, Norway Mary Christman, Courtesy Professor of the University of Florida, USA.

The ICES_DASC VRE is available at https://bluebridge.d4science.org/web/ices_dasc

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *August '16,* and it is currently serving *17 users*. A screenshot of the VLab is provided in Figure 62. It shows the home page and the menu items for accessing the VLab facilities.
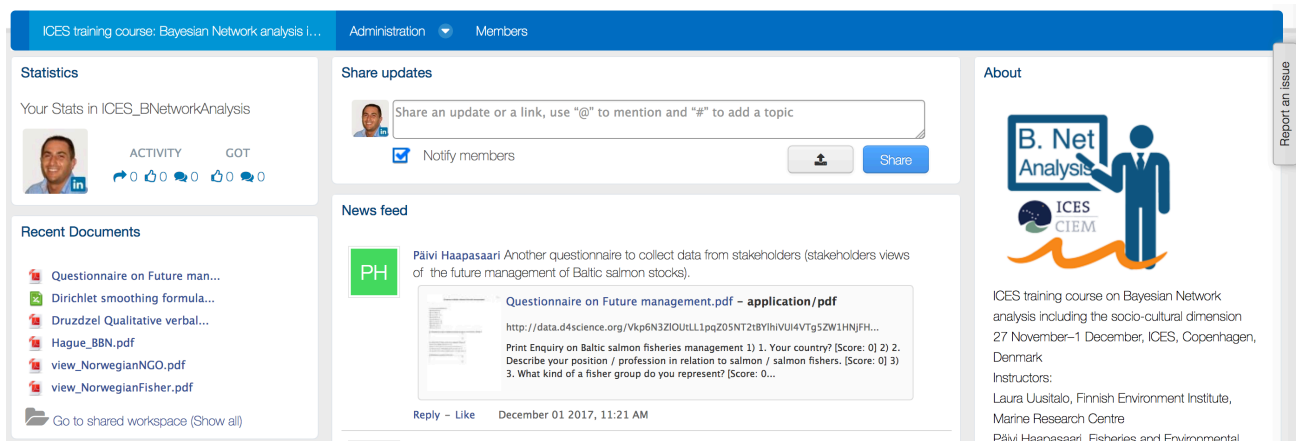

Figure 62. ICES DASC VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 63 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
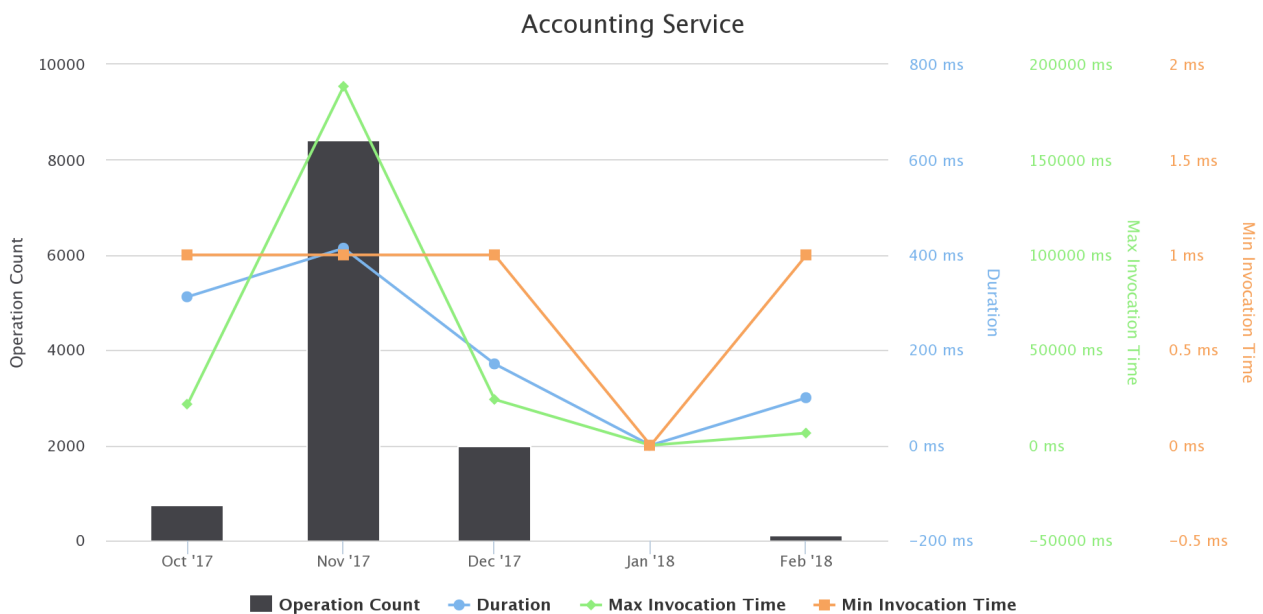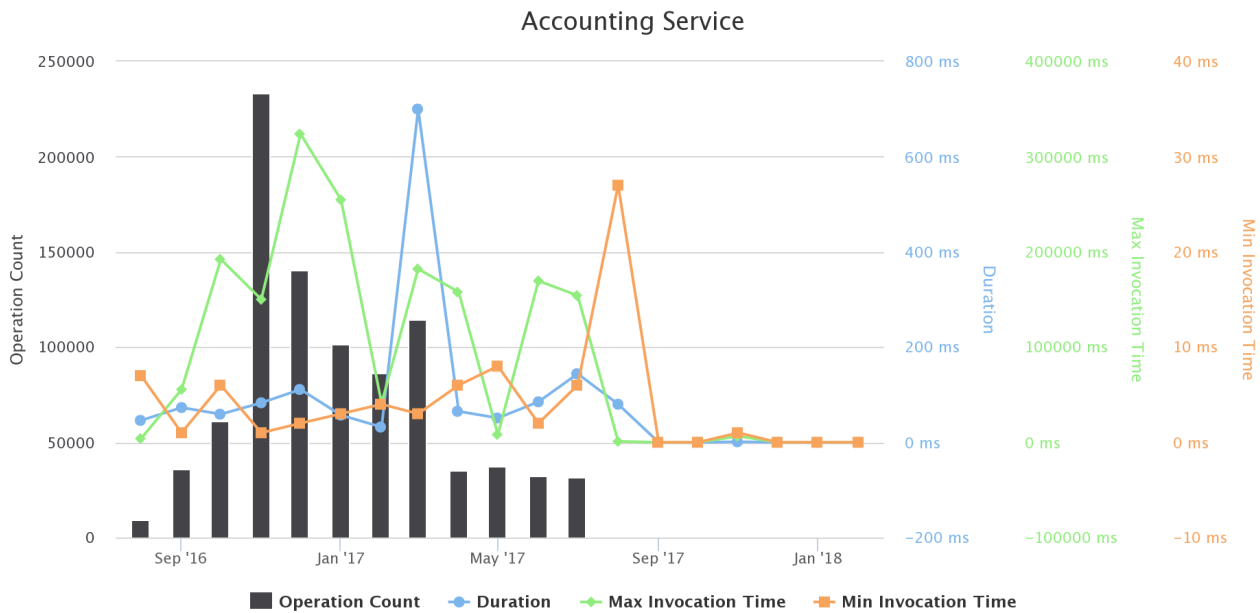

Figure 63. ICES DASC VRE / VLab Operations per Month

3.29 ICES FIACO: ICES TRAINING COURSE ON PRINCIPLES AND METHODS OF BROADBAND/WIDEBAND TECHNOLOGIES: APPLICATION TO FISHERIES ACOUSTICS

This VLab was conceived and used to support the ICES training course "Principles and methods of broadband/wideband technologies: application to fisheries acoustics", 8 – 12 December 2016, Bergen, Norway. Course instructors: Dezhang Chu, Northwest Fisheries Science Center (NWFSC), NOAA/NMFS, USA; Lars N. Andersen, Simrad-Kongsberg Maritime, Norway; Gavin J. Macaulay, Institute of Marine Research (IMR), Norway; Egil Ona, Institute of Marine Research (IMR), Norway Rolf J. Korneliussen, Institute of Marine Research (IMR), Norway. Support: Anna Davies, conference and training coordinator, Lise Cronne, Science Programme Assisting Secretary.

The ICES_FIACO VLab is available at https://bluebridge.d4science.org/web/ices_fiaco

This VLab stems from the Blue Skills needs [2]. It has been in "***operational***" status since **October '16,** and it is currently serving **28 users**. A screenshot of the VLab is provided in Figure 64. It shows the home page and the menu items for accessing the VLab facilities.
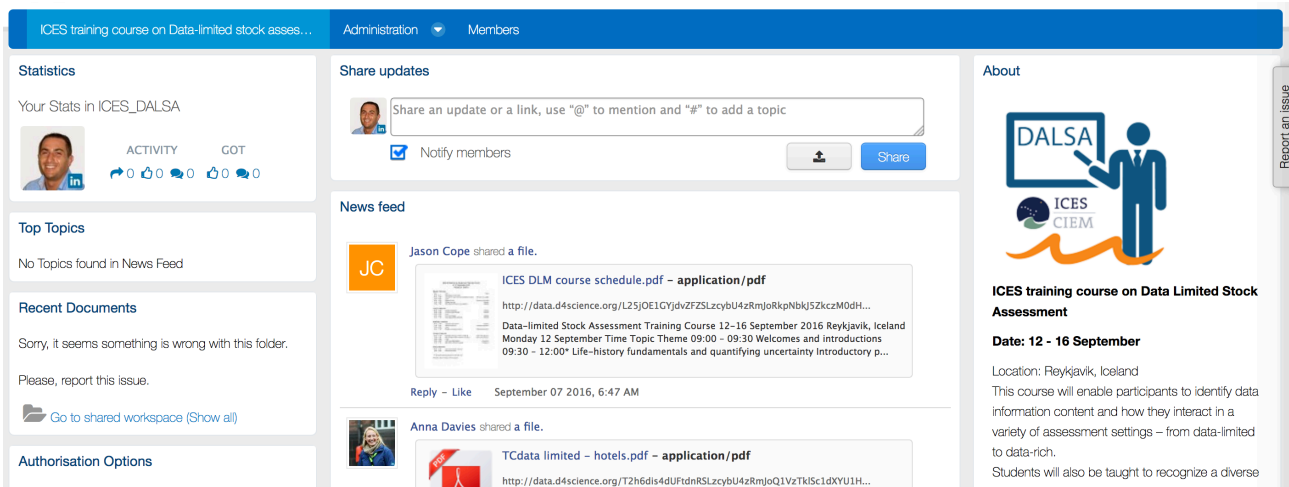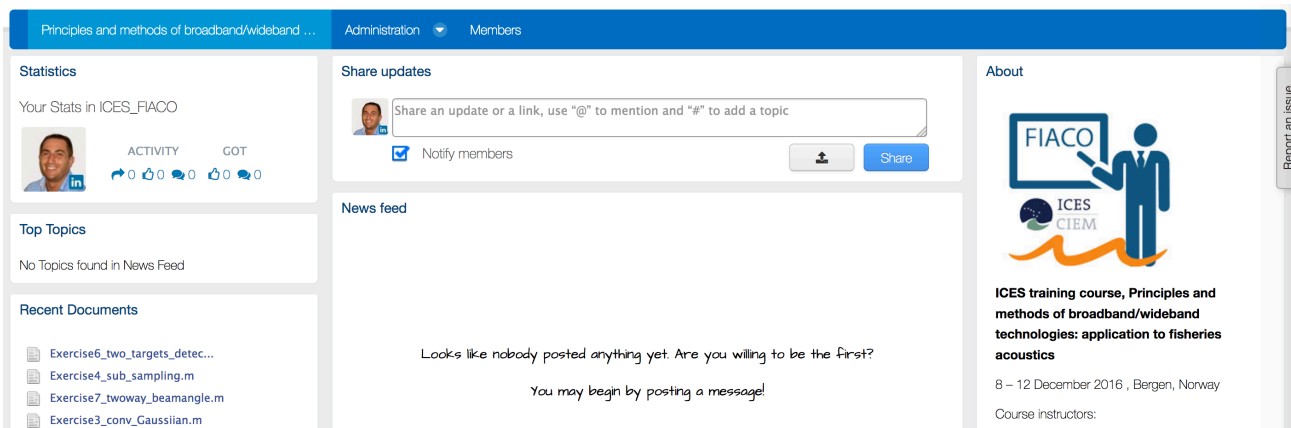

Figure 64. ICES FIACO VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 65 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
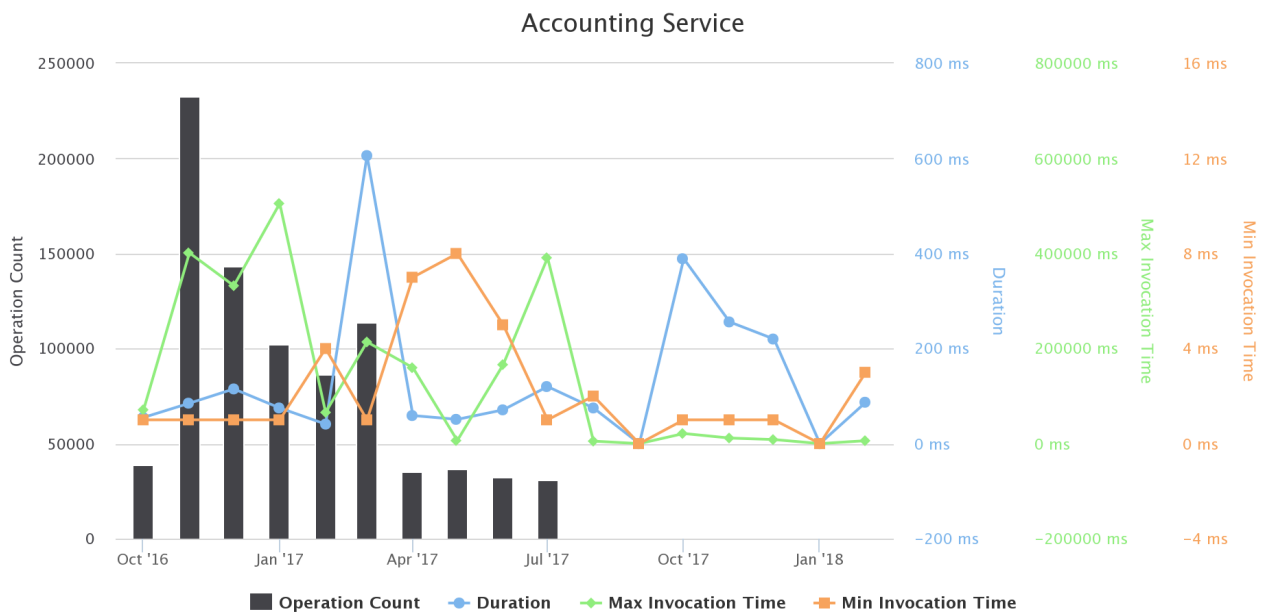

Figure 65. ICES FIACO VRE / VLab Operations per Month

3.30 ICES FIACO 2017: ICES TRAINING COURSE ON PRINCIPLES AND METHODS OF BROADBAND/WIDEBAND TECHNOLOGIES: APPLICATION TO FISHERIES ACOUSTICS

This VLab was conceived and used to support the ICES training course on Principles and methods of broadband/wideband technologies: application to fisheries acoustics 8 – 12 December 2017, Bergen, Norway. Course instructors: Dezhang Chu (Northwest Fisheries Science Center (NWFSC), NOAA/NMFS, USA), Lars N. Andersen (Simrad-Kongsberg Maritime, Norway), Gavin J. Macaulay (Institute of Marine Research (IMR)), Norway Egil Ona (Institute of Marine Research (IMR), Norway), Rolf J. Korneliussen (Institute of Marine Research (IMR), Norway).

The VLab is available at https://bluebridge.d4science.org/web/ices_fiaco2017

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *October '17,* and it is currently serving *27 users*. A screenshot of the VLab is provided in Figure 66. It shows the home page and the menu items for accessing the VLab facilities.
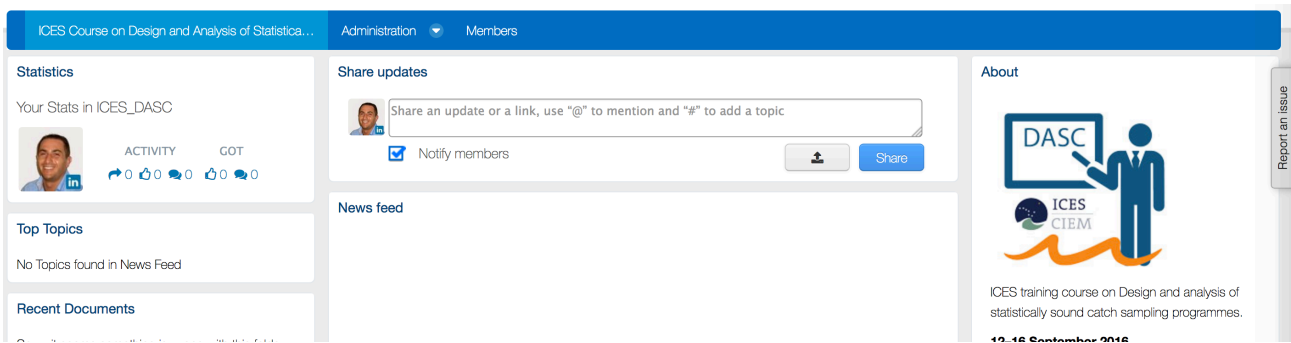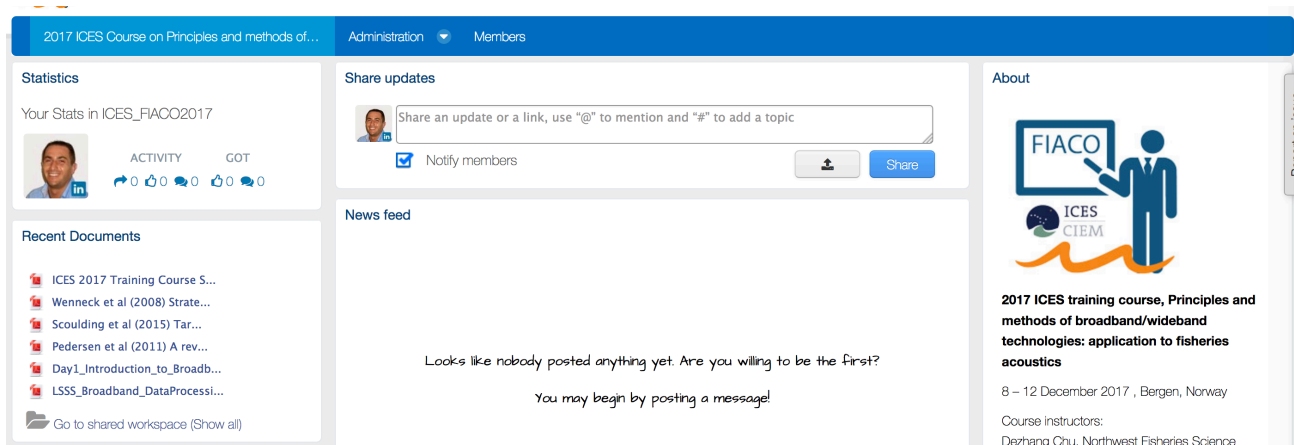

Figure 66. ICES FIACO 2017 VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 67 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 67. ICES FIACO 2017 VRE / VLab Operations per Month

3.31 ICES INTRODUCTION TO ABUNDANCE ESTIMATION FROM FISHERIES ACOUSTIC SURVEYS

This VLab was conceived and used to support the ICES training course on ICES training course: Introduction to abundance estimation from fisheries acoustic surveys (Date: 12 June - 16 June 2017, Location: Copenhagen, Denmark).

The VLab is available at https://bluebridge.d4science.org/web/ices_abundanceestimationfromacoustic

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *May '17,* and it is currently serving *36 users*. A screenshot of the VLab is provided in Figure 68. It shows the home page and the menu items for accessing the VLab facilities.
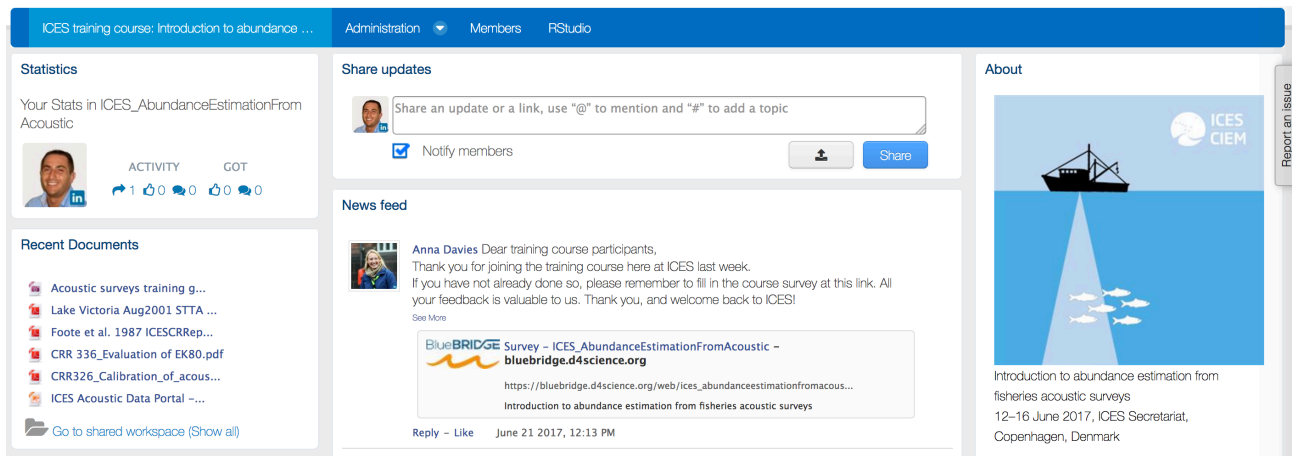
Figure 68. ICES Introduction to abundance estimation from fisheries acoustic surveys VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 69 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
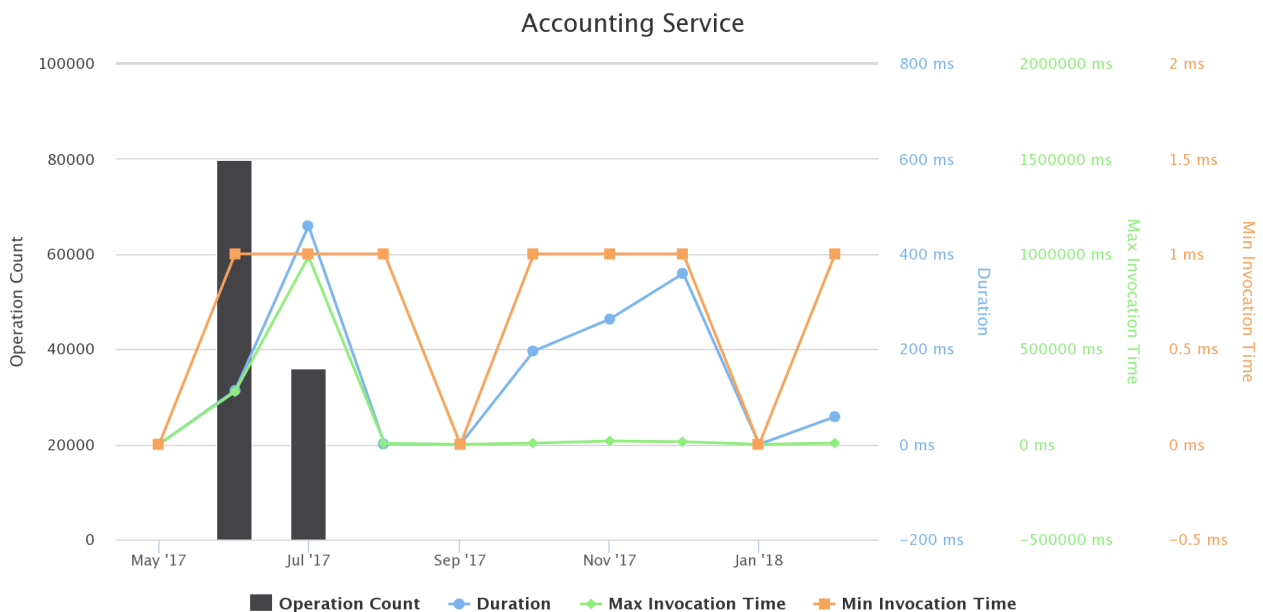

Figure 69. ICES Introduction to abundance estimation from fisheries acoustic surveys VRE / VLab Operations per Month

3.32 ICES INTRODUCTION TO STOCK ASSESSMENT

This VLab was conceived and used to support the ICES training course on Introduction to Stock Assessment (Date: 5 June - 9 June 2017, Location: Copenhagen, Denmark).

The VLab is available at https://bluebridge.d4science.org/web/ices_introstockassessment

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *April '17,* and it is currently serving *34 users*. A screenshot of the VLab is provided in Figure 70. It shows the home page and the menu items for accessing the VLab facilities.
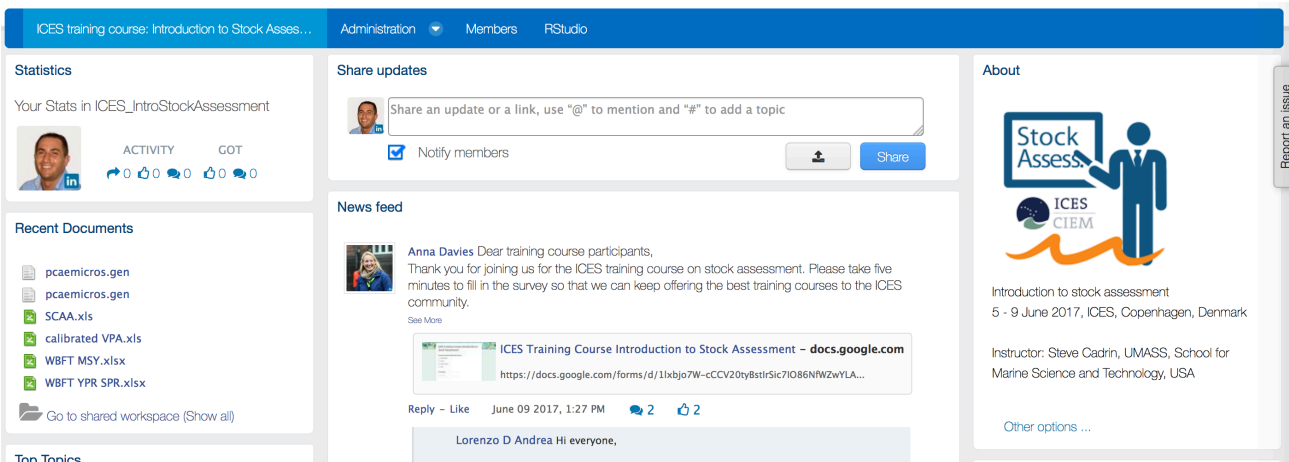

Figure 70. ICES Introduction to Stock Assessment VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 71 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
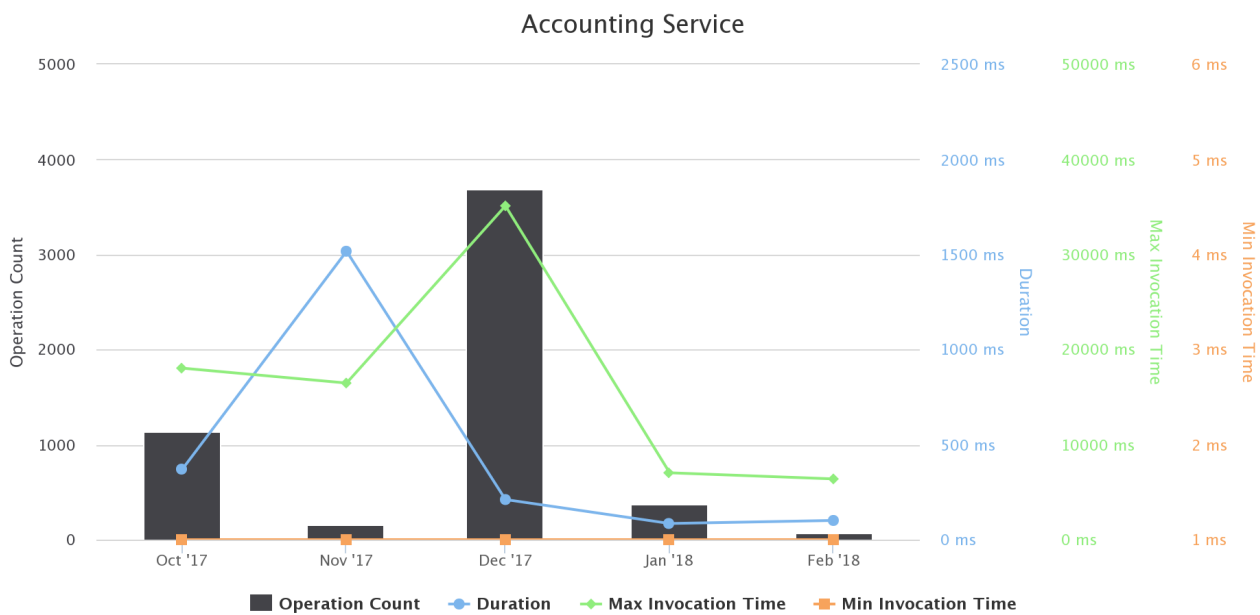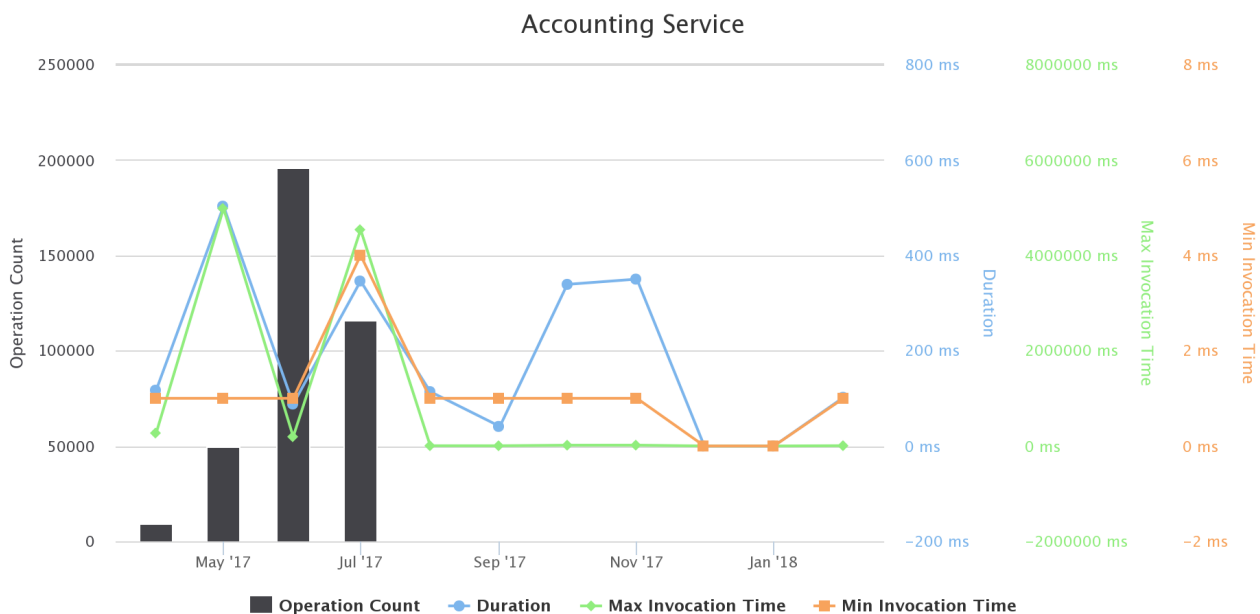

Figure 71. ICES Introduction to Stock Assessment VRE / VLab Operations per Month

3.33 ICES INTRODUCTION TO THE R ENVIRONMENT 2017

This VLab was conceived and used to support the ICES training course on Introduction to the R Environment (Date: 21 August - 25 August 2017, Location: Copenhagen, Denmark).

The VLab is available at https://bluebridge.d4science.org/web/ices_introtorenv

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *July '17,* and it is currently serving *31 users*. A screenshot of the VLab is provided in Figure 72. It shows the home page and the menu items for accessing the VLab facilities.


Figure 72. ICES Introduction to the R Environment 2017 VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 73 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.


Figure 73. ICES Introduction to the R Environment 2017 VRE / VLab Operations per Month

3.34 ICES LOOGBOOK DATA: ICES TRAINING COURSE ON WMS AND EU LOGBOOK DATA

This VLab is conceived to support the ICES training course on VMS and EU logbook data (Date: 23-27 October 2017, Location: Copenhagen, Danmark).

The VLab is available at https://bluebridge.d4science.org/web/ices_logbookdata

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *October '17,* and it is currently serving *25 users*. A screenshot of the VLab is provided in Figure 74. It shows the home page and the menu items for accessing the VLab facilities.

Figure 74. ICES Logbook Data VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 75 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.


Figure 75. ICES Logbook Data VRE / VLab Operations per Month

3.35 ICES MSE: ICES TRAINING COURSE ON MANAGEMENT STRATEGY EVALUATION

This VLab has been deployed to support the ICES training course Introduction to Management Strategy Evaluation, 28 August–1 September 2017 ICES, Copenhagen, Denmark [2].

The VLab is available at https://bluebridge.d4science.org/web/ices_mse

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *July '17,* and it is currently serving *27 users*. A screenshot of the VLab is provided in Figure 76. It shows the home page and the menu items for accessing the VLab facilities.
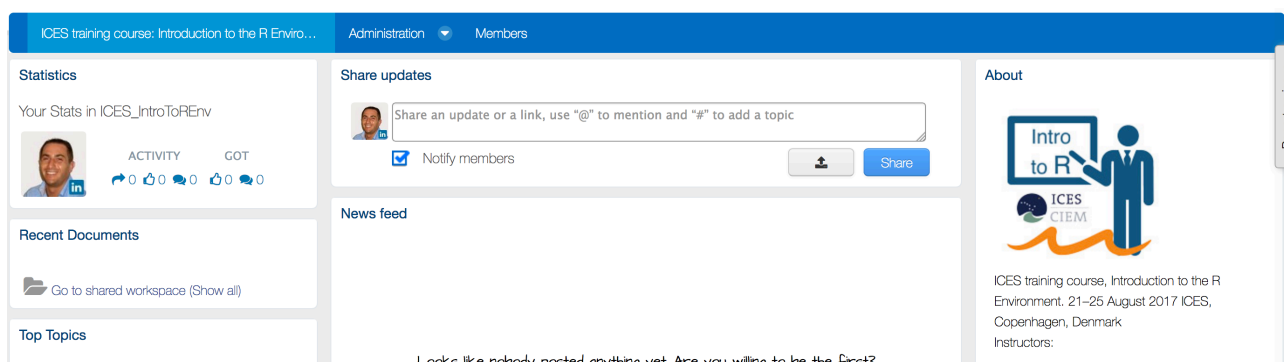
Figure 76. ICES MSE VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 77 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
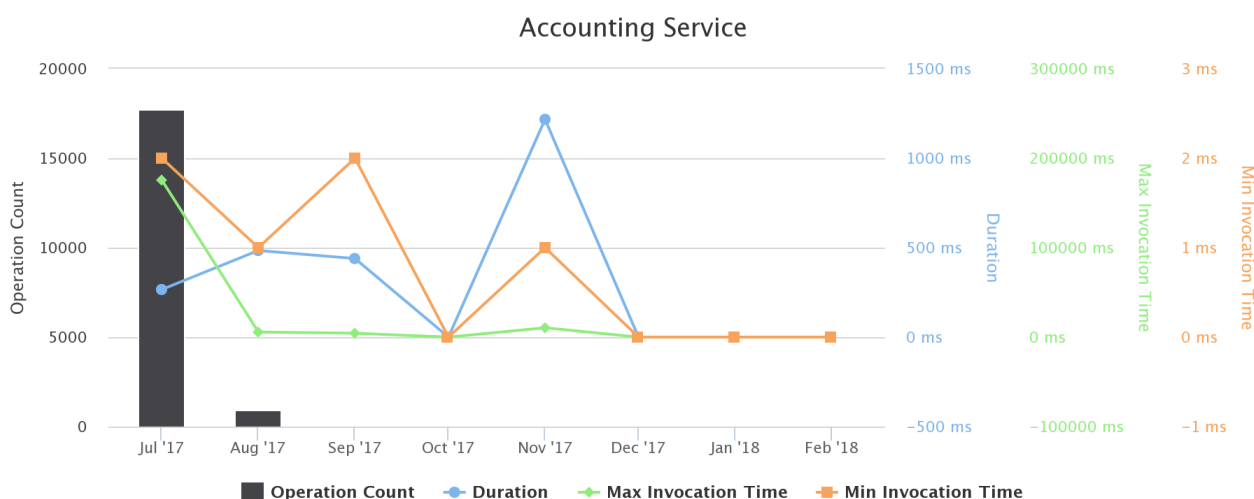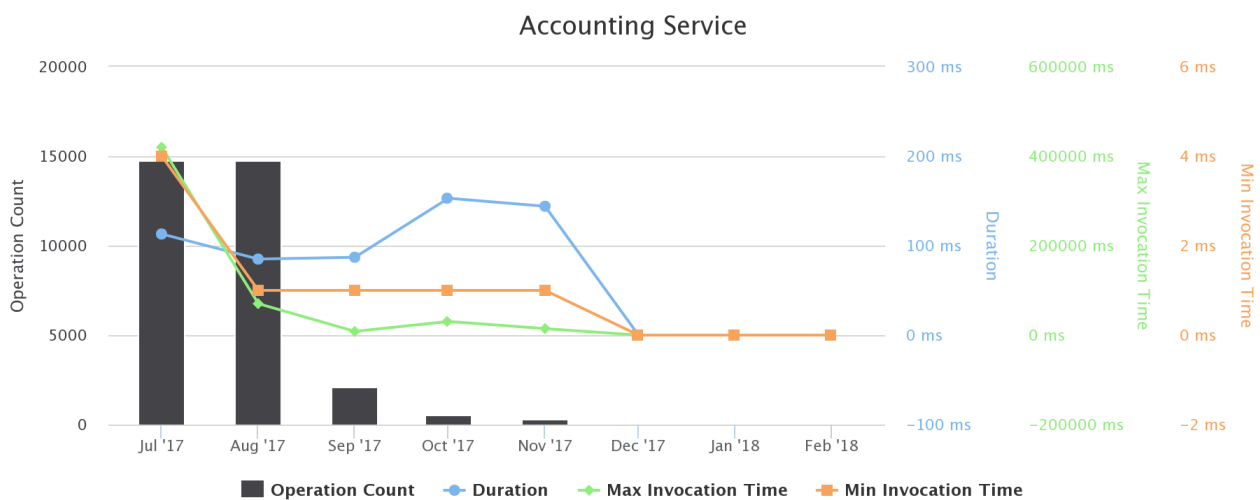

Figure 77. ICES MSE VRE / VLab Operations per Month

3.36 ICES MSY: ICES TRAINING COURSE ON METHODS FOR SETTING PROXY MAXIMUM SUSTAINABLE YELD REFERENCE POINTS

This VLab is conceived to support the ICES training course on methods for setting proxy Maximum Sustainable Yeld (MSY) reference points (Date: 25-26 January 2017, Location: Copenhagen, Danmark).

The VLab is available at https://bluebridge.d4science.org/web/ices_msy

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *December '16,* and it is currently serving *84 users*. A screenshot of the VLab is provided in Figure 78. It shows the home page and the menu items for accessing the VLab facilities.
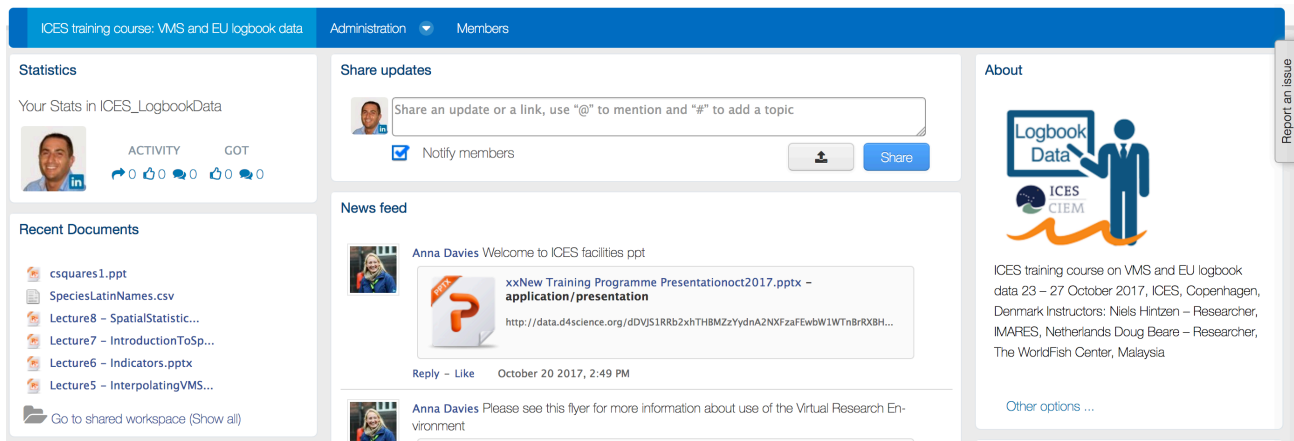
Figure 78. ICES MSY VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.

Figure 79 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
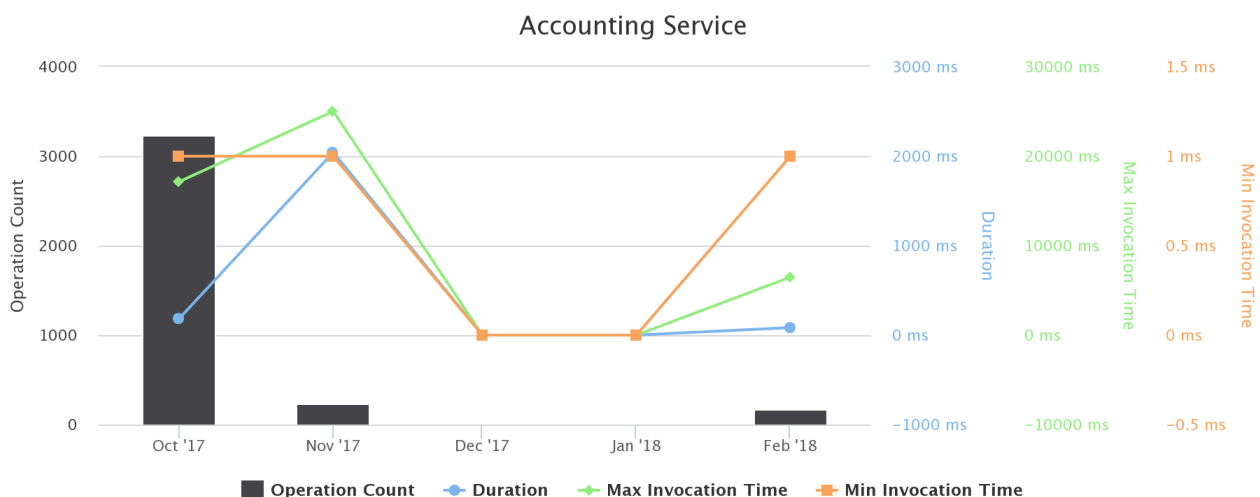

Figure 79. ICES MSY VRE / VLab Operations per Month

3.37 ICES ONLINE OCEANOGRAPHY

This VLab was conceived and used to support the ICES online training course on oceanography made in collaboration with the Technical University of Denmark.

The VLab is available at https://bluebridge.d4science.org/web/onlineoceanography

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *February '18,* and it is currently serving *11 users*. A screenshot of the VLab is provided in Figure 60. It shows the home page and the menu items for accessing the VLab facilities.
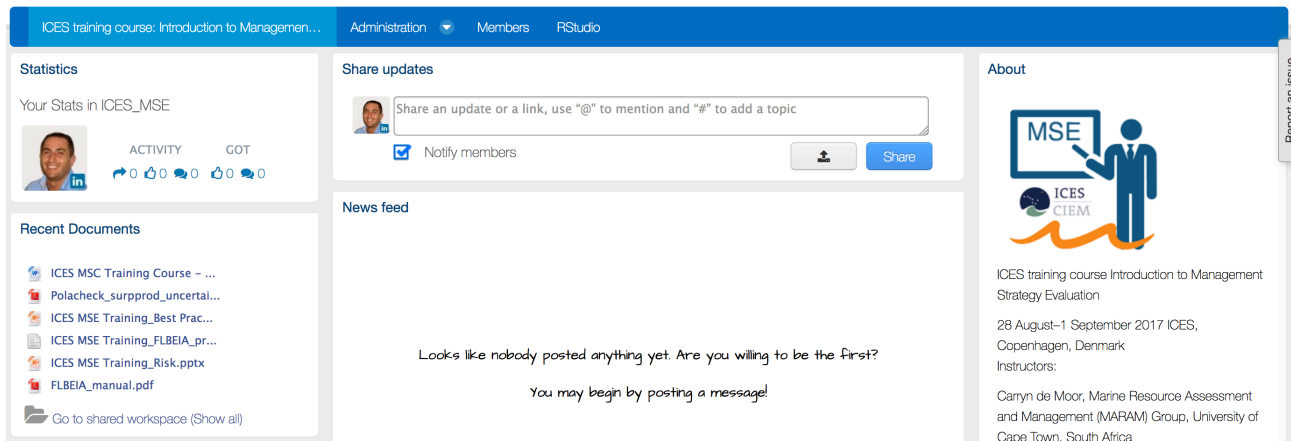
Figure 80. ICES Online Oceanography VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *the Online Training Application* [2]: a facility supporting both instructors and students in sharing and accessing learning materials (PDF, PowerPoints, Videos) by creating simple and understandable learning paths. Students have the opportunity to download files, or watch the video-contents, prepared by trainers without having to leave the site and thereby remain in the online learning environment.

Figure 81 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.


Figure 81. ICES Online Oceanography VRE / VLab Operations per Month

3.38 ICES SA: ICES TRAINING COURSE ON STOCK ASSESSMENT ADVANCED

This VLab was conceived and used to support the ICES training course on Stock Assessment Advanced, 28 November – 2 December, ICES HQ, Copenhagen, Denmark. Course instructors: Jan Jaap Poos, Wageningen IMARES (The Netherlands) and Richard Hillary, CSIRO Marine and Atmospheric Research (Australia).

The ICES SA VRE is available at https://bluebridge.d4science.org/web/ices_sa

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since **October '16,** and it is currently serving **26 users**. A screenshot of the VLab is provided in Figure 82. It shows the home page and the menu items for accessing the VLab facilities.
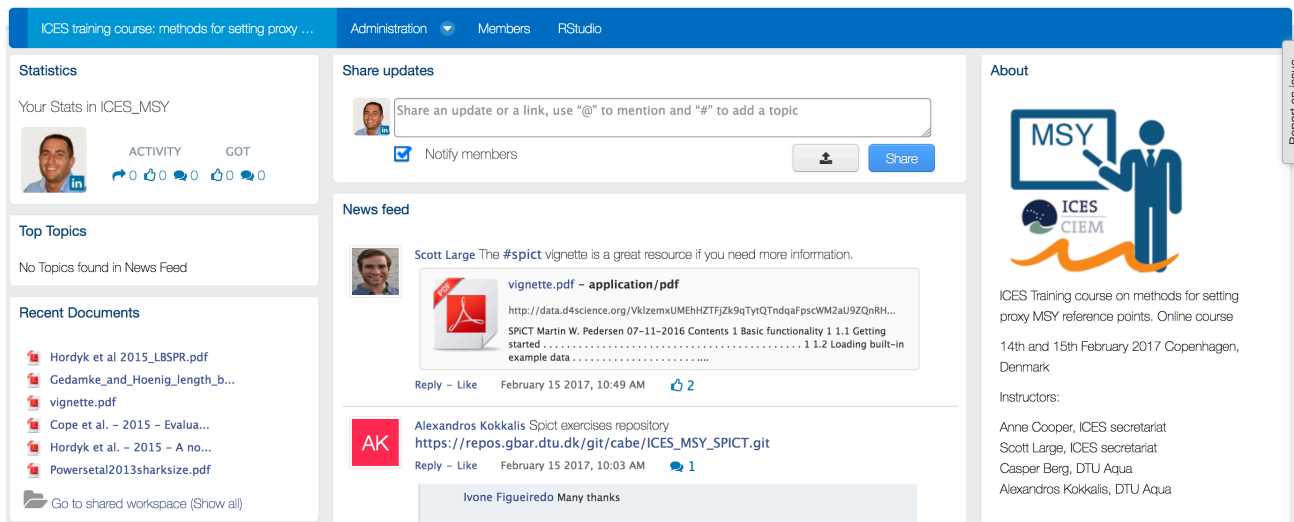

Figure 82. ICES SA VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace.

Figure 83 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
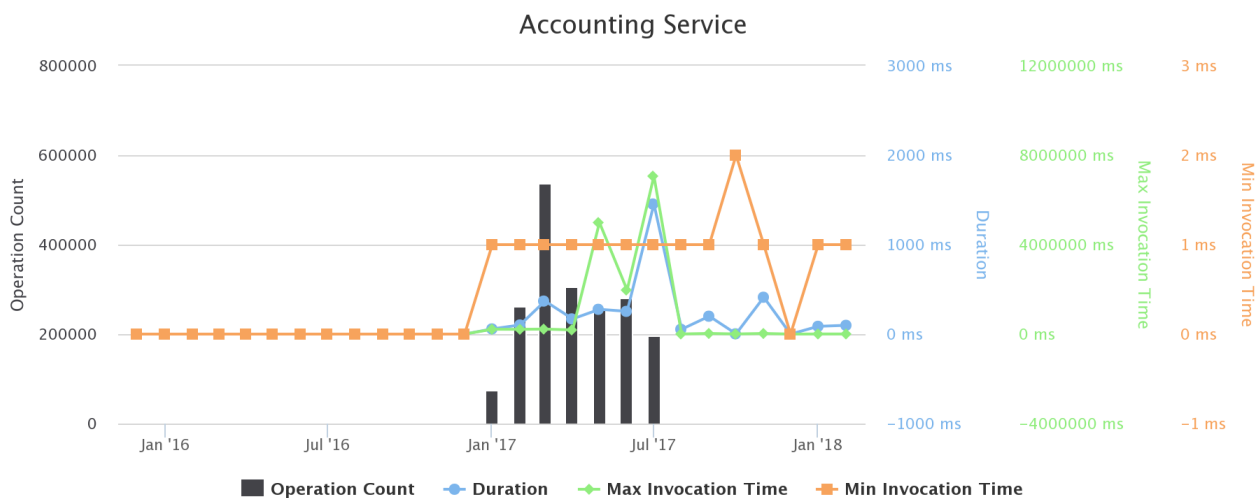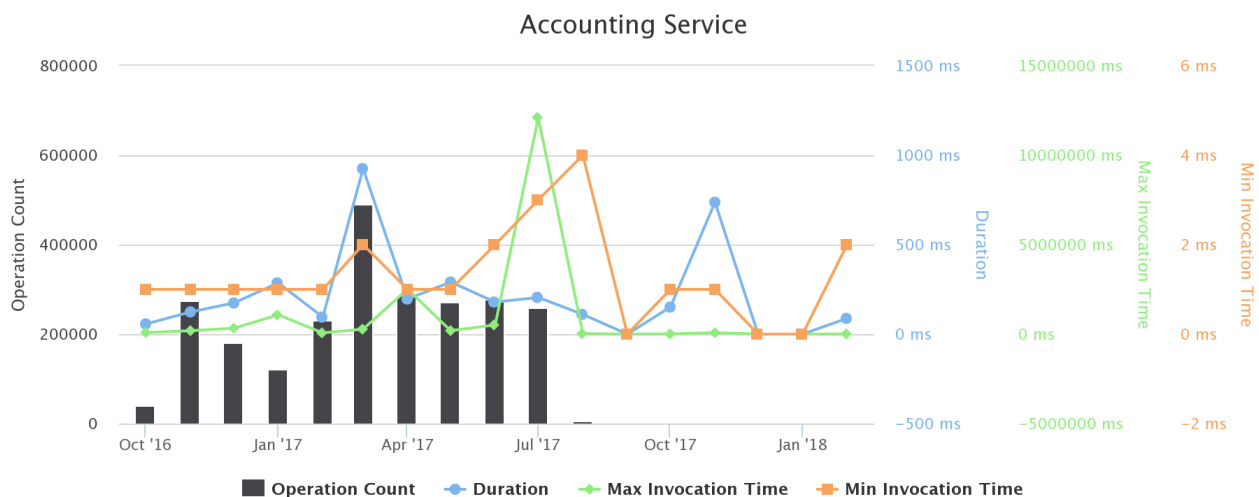

Figure 83. ICES SA VRE / VLab Operations per Month

3.39 ICES TCRE: ICES TRAINING COURSE IN THE R ENVIRONMENT

A VLab that supported the ICES Training Course in the R Environment (TCRENV), ICES HQ, Denmark, 29 February - 4 March 2016, Instructors: Einar Hjorleifsson, Iceland and Bjarki Thor Elvarsson, Iceland. Training Coordinator: Anna Davies and Support Secretary: Lise Cronne. Course started on Monday 29 February at 9:00 and ended on Friday 4 March at 16:00.

The objective of the course was to provide participants with a solid foundation in efficient use of the R environment using various typical and familiar fisheries data sets (landings data, catch data, survey data and tagging data) as case examples. Emphasis was put on data munging and literate programming starting with 'raw' data (individual stations, individual fish measurements) and culminating with deliverance of publishable output produced from a single coded document file.

The ICES TCRE VRE is available at https://bluebridge.d4science.org/web/ices_tcre

This VLab stems from the Blue Skills needs [2]. It has been in "**operational**" status since **December '15,** and it is currently serving **37 users**. A screenshot of the VLab is provided in Figure 84. It shows the home page and the menu items for accessing the VLab facilities.
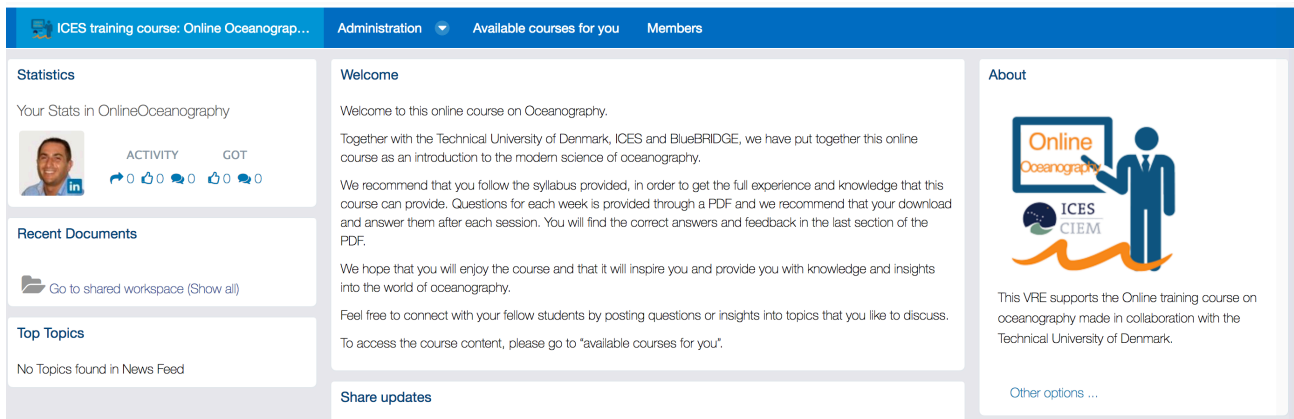

Figure 84. ICES TCRE VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 85 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
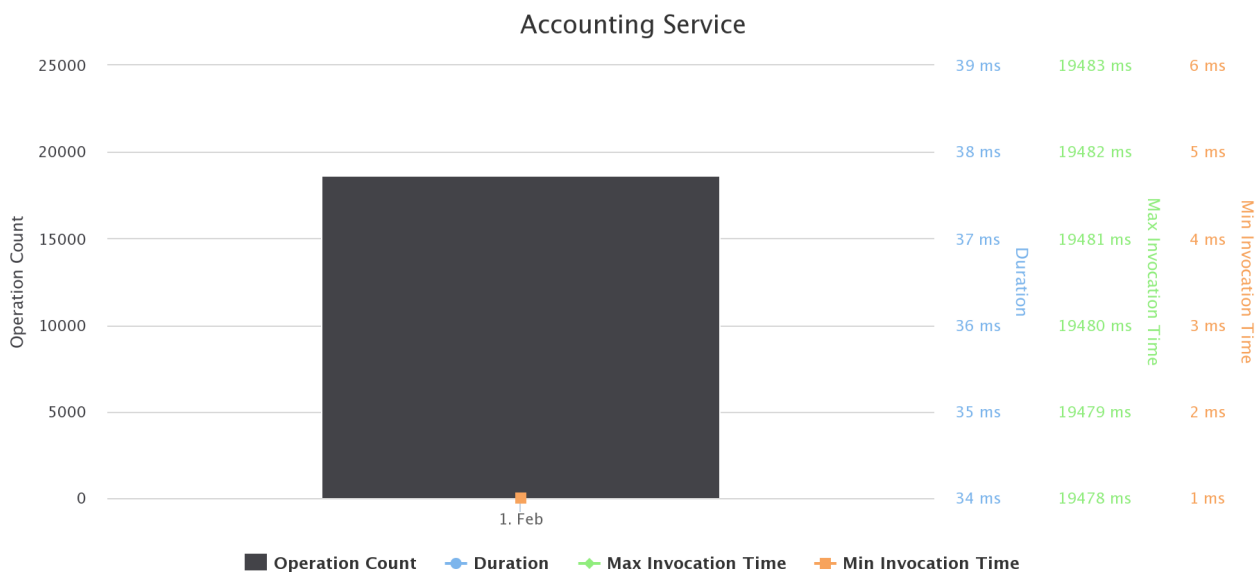

Figure 85. ICES TCRE VRE / VLab Operations per Month

3.40 ICES TCSSM: ICES TRAINING COURSE ON SOCIAL SCIENCE METHODS FOR NATURAL SCIENTISTS

This VLab was conceived and used to support the ICES training course on Social Science Methods for Natural Scientists, 26-28 May 2016, Faculté Victor Segalen, Brest, France. Instructors: Marloes Kraan and Maiken Bjørkan. Training coordinator: Anna Davies. Supporting secretary: Lise Cronne.

Course objective: Through gaining new skills, participants were better able to work effectively with stakeholders in (cooperative) research projects, as well as having a better appreciation of the strengths and application of the social sciences in fisheries research.

The ICES TCSSM VLab is available at https://bluebridge.d4science.org/web/ices_tcssm

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *April '16,* and it is currently serving *29 users*. A screenshot of the VLab is provided in Figure 60. It shows the home page and the menu items for accessing the VLab facilities.
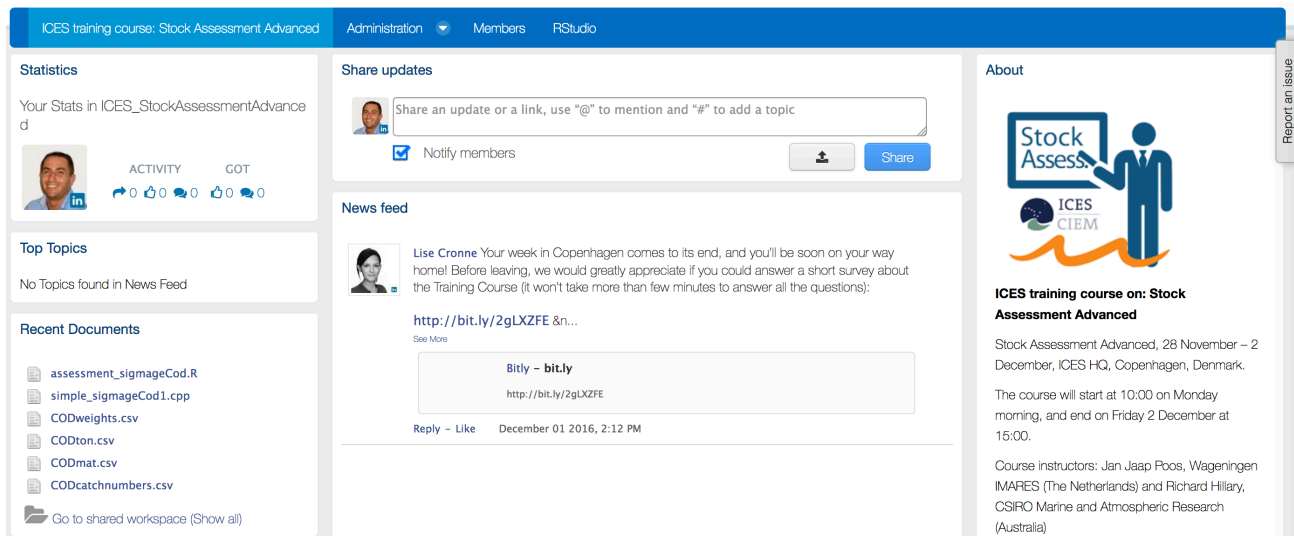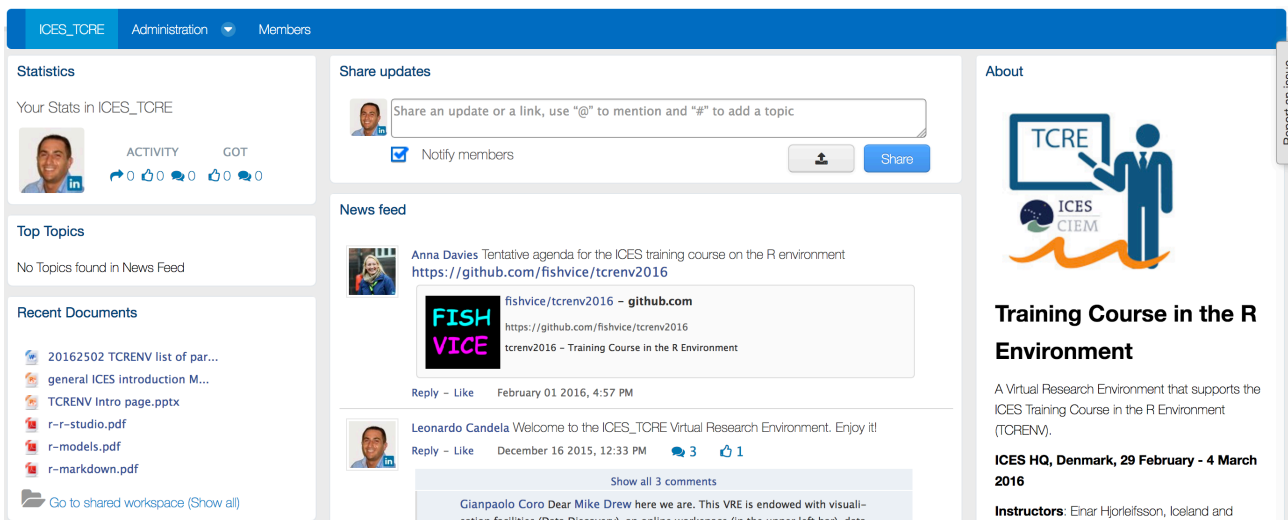

Figure 86. ICES TCSSM VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. These algorithms range from data clustering and anomalies detection methods (e.g. DBScan and KMeans) to algorithms for manipulating datasets from the geospatial perspective (e.g. transform FAO Area Code in latitude and longitude). As of February '18, this environment has been configured to give access to *more than 110 diverse algorithms*;

- *Species Data Discovery*: a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a) GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, ITIS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps, Sea Surface Temperature, that have been generated and/or published. This facility relies on the GeoExplorer portlet and makes it possible to effectively exploit the generated maps and perform comparisons and analysis of the diverse distributions by enabling maps overlay, transects production and values inspection.

Figure 87 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
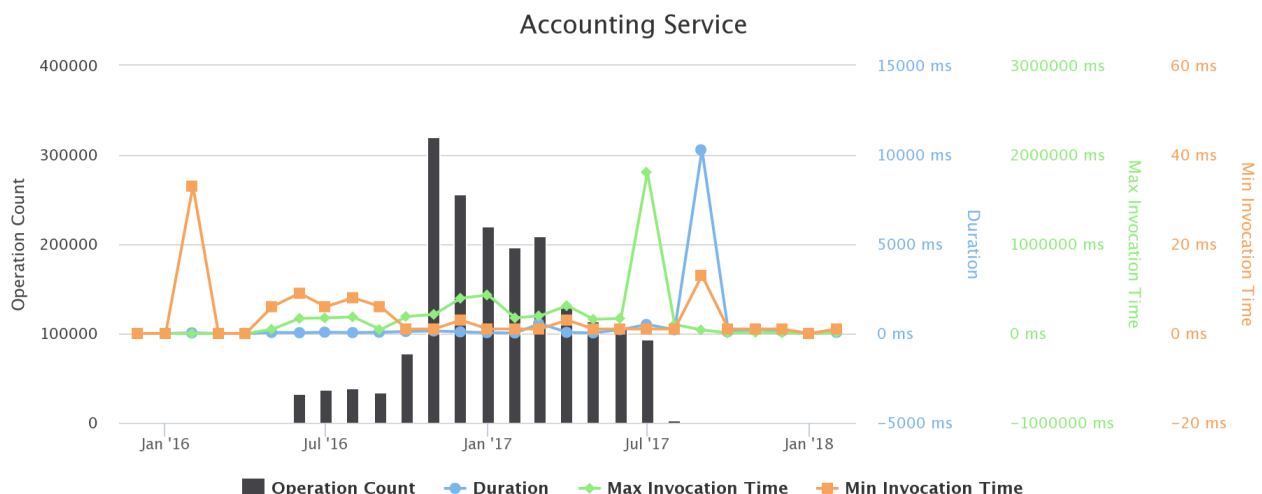

Figure 87. ICES TCSSM VRE / VLab Operations per Month

3.41 ILKNAK AQUACULTURE

The iLKNAK Aquaculture VLab supports the performance evaluation, benchmarking and decision making process of iLKNAK Aquaculture company to improve its profitability and minimise environmental impacts. It enables iLKNAK Aquaculture company members to: (a) evaluate and optimise their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to iLKNAK Aquaculture company members only.

The VLab is available at https://bluebridge.d4science.org/web/ilknak_aquaculture

This VLab stems from the Blue Economy needs [9]. It has been in "***operational***" status since ***September '17,*** and it is currently serving ***6 users***. A screenshot of the VLab is provided in Figure 88. It shows the home page and the menu items for accessing the VLab facilities.
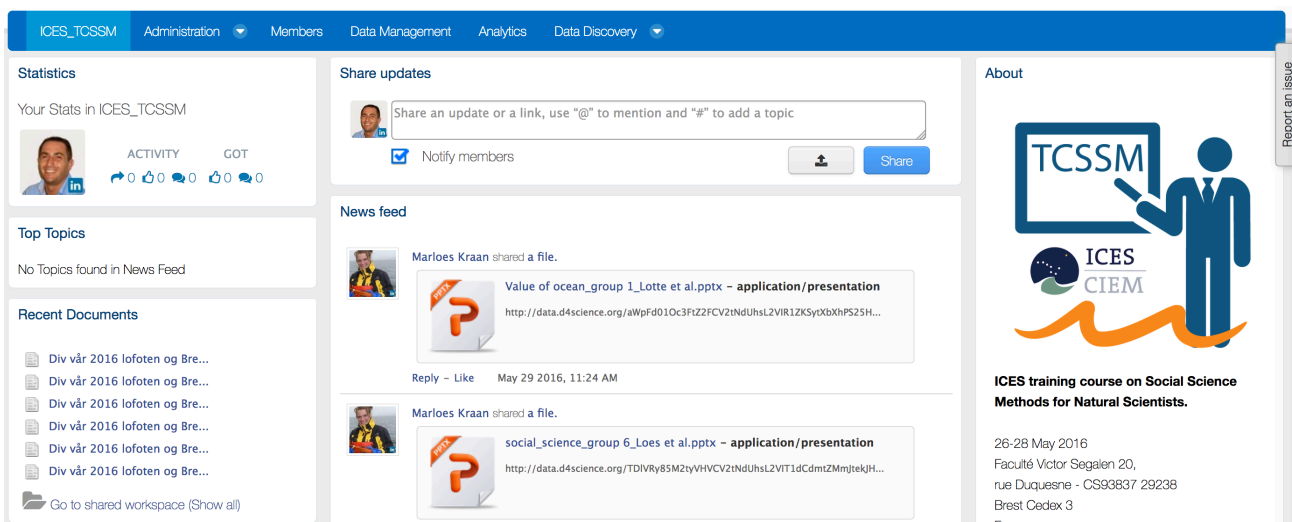
Figure 88. iLKNAK Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 89 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
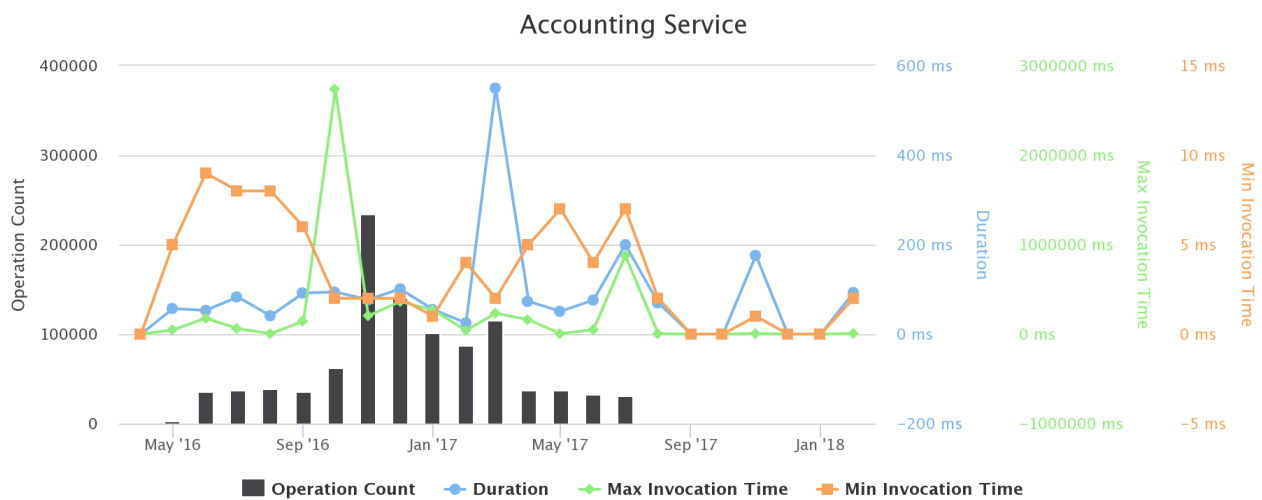
Figure 89. iLKNAK Aquaculture VRE / VLab Operations per Month

3.42 INFRATRAINING

The InfraTraining VLab is conceived to provide its users with the basic functionalities offered by the underlying infrastructure and the BlueBRIDGE gateway, including shared workspace, social and collaboration facilities and a set of dynamically deployed services offering search facilities, bench-marking and more.

The VLab is available at https://bluebridge.d4science.org/web/infratraining

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *March '17,* and it is currently serving *10 users*. A screenshot of the VLab is provided in Figure 90. It shows the home page and the menu items for accessing the VLab facilities.
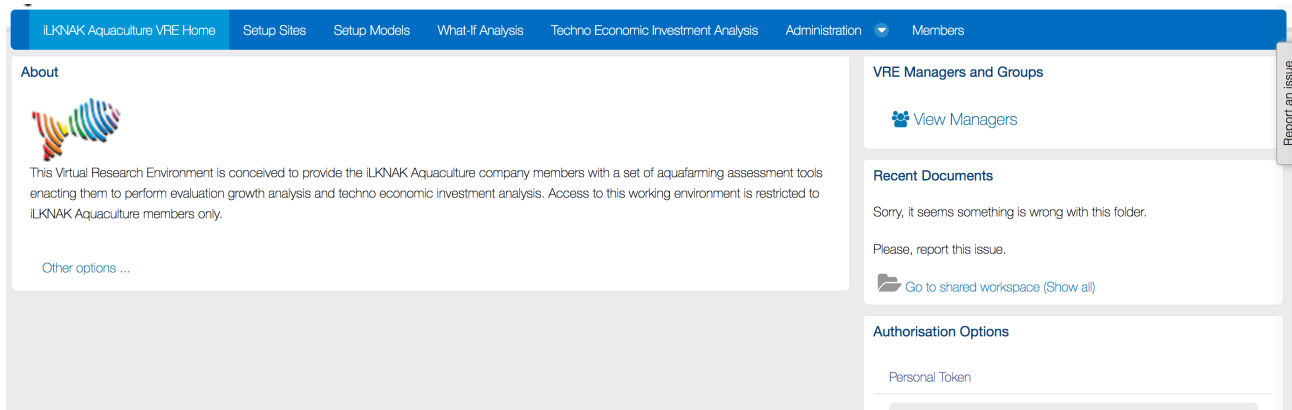

Figure 90. InfraTraining VRE / VLab Home Page Screenshot

This VRE / VLab is equipped with VRE basic facilities: a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 90 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
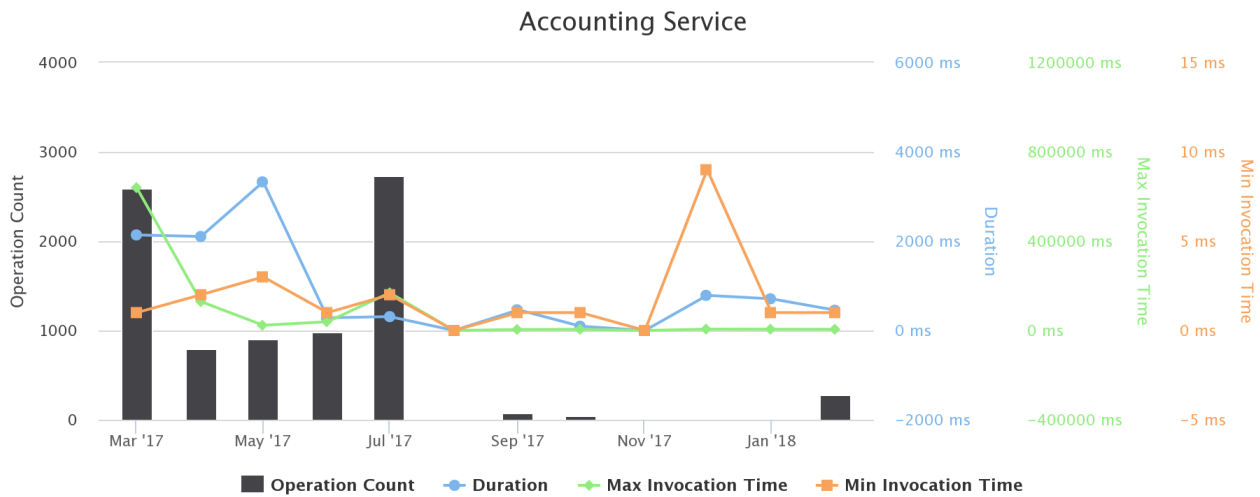
Figure 91. InfraTraining VRE / VLab Operations per Month

3.43 IOTC SS3

The SS3 VLab is a tool that hosts codes necessary to run the Stock Synthesis version 3 (SS3) stock assessment model (a widely-used statistical catch-at-age model), parallelize, visualize and store the standardized data outputs. Stock assessment software are complex and advanced technical skills are required to develop the models. Producing output becomes time-intensive and even more complex as thousands of simulations must be run on large scale computing facilities in order to include the multiple sources of uncertainty in assessment results. As few stock assessment participants have the specific technical skills required to reproduce these outputs, this VLab was developed to facilitate the use of SS3 to users with varying levels of expertise.

The VLab is available at https://bluebridge.d4science.org/web/iotc_ss3

This VLab stems from the Blue Assessment needs [5]. It has been exploited for supporting Blue Skills needs [2]. It has been in "*operational*" status since *September '17,* and it is currently serving *38 users*. A screenshot of the VLab is provided in Figure 92. It shows the home page and the menu items for accessing the VLab facilities.

Figure 92. IOTC SS3 VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Data Analytics at scale:* a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 the VLab gives access to **4 specific algorithms** all related with SS3;

- *Algorithm Importer:* a facility enabling users to transform user defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code, thus making it possible for Data Miner to properly executing it*;*

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace;

- *Context Specific Catalogue*: a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **7 datasets**, all resulting from IOTC events [2];

- *Geospatial Data Catalogue*: a facility enabling to search and browse geospatial datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **7 datasets**, all resulting from IOTC events [2];

- *Shiny Apps*: a set of domain specific Shiny Apps including the LBI Application (enacting to calculate a set of length based indicators), the BFT-E App (retrospective analysis outputs of the Bluefin tuna east stock assessment), the ICCAT App (East/Med Bluefin tuna stock assessment), and the SS3 Diagnostic App (produce diagnostic plots).

Figure 93 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
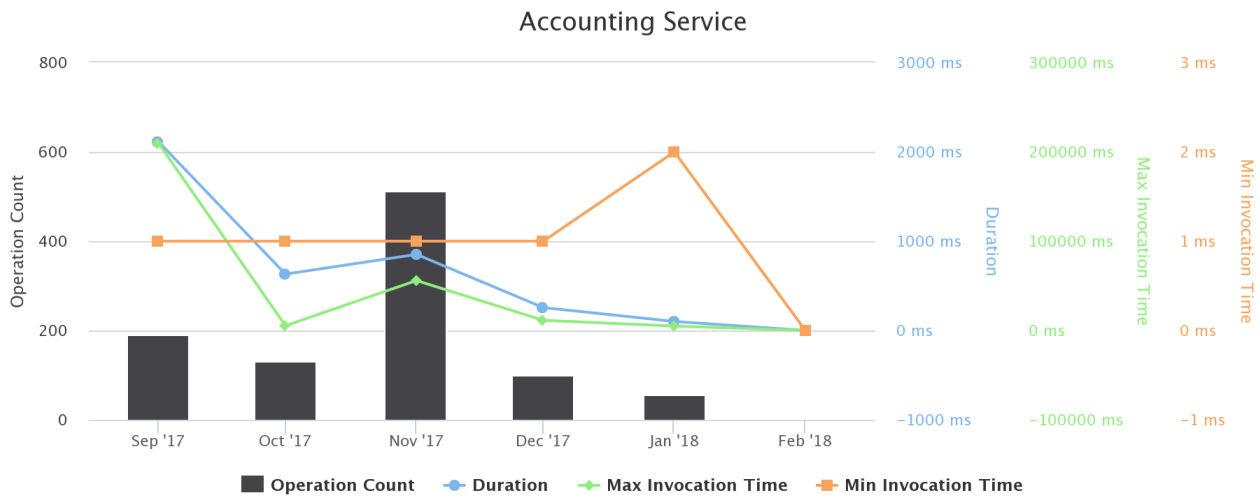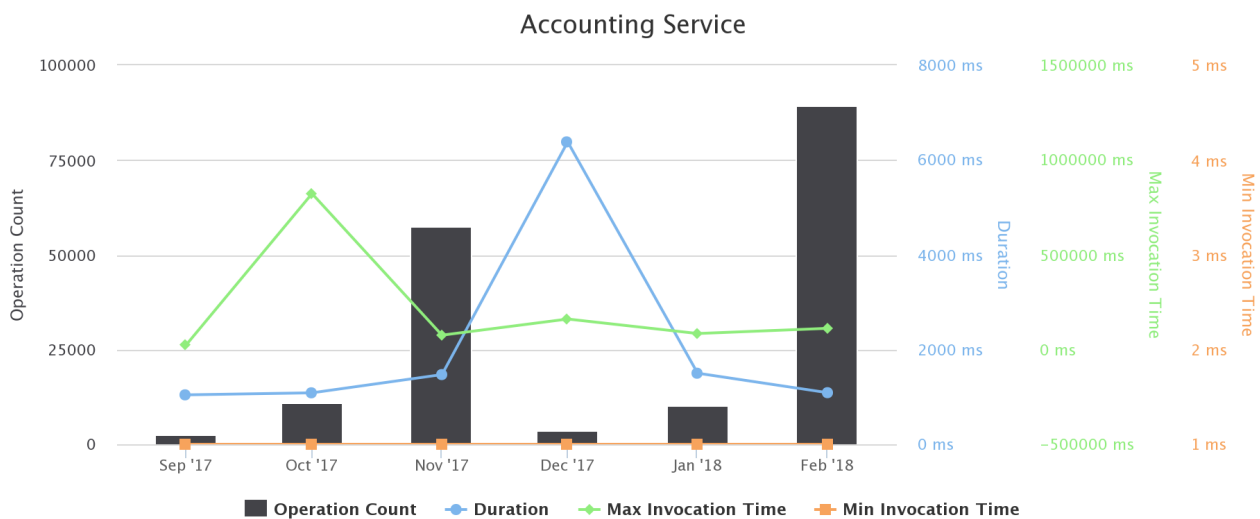

Figure 93. IOTC SS3 VRE / VLab Operations per Month

3.44 ISEARCH

The iSearch Virtual Research Environment (actually a VLab) is for providing its users with an environment dedicated to showcase the data discovery facilities, in particular the IR and semantic based ones.

The iSearch VLab is available at https://i-marine.d4science.org/web/isearch

This VLab was inherited by iMarine, and thus it has been **operational** status since **September 2015,** from the perspective of BlueBRIDGE. It is currently serving **59 users**. A screenshot of the VLab is provided in Figure 94. It shows the home page and the menu items for accessing the VLab facilities.
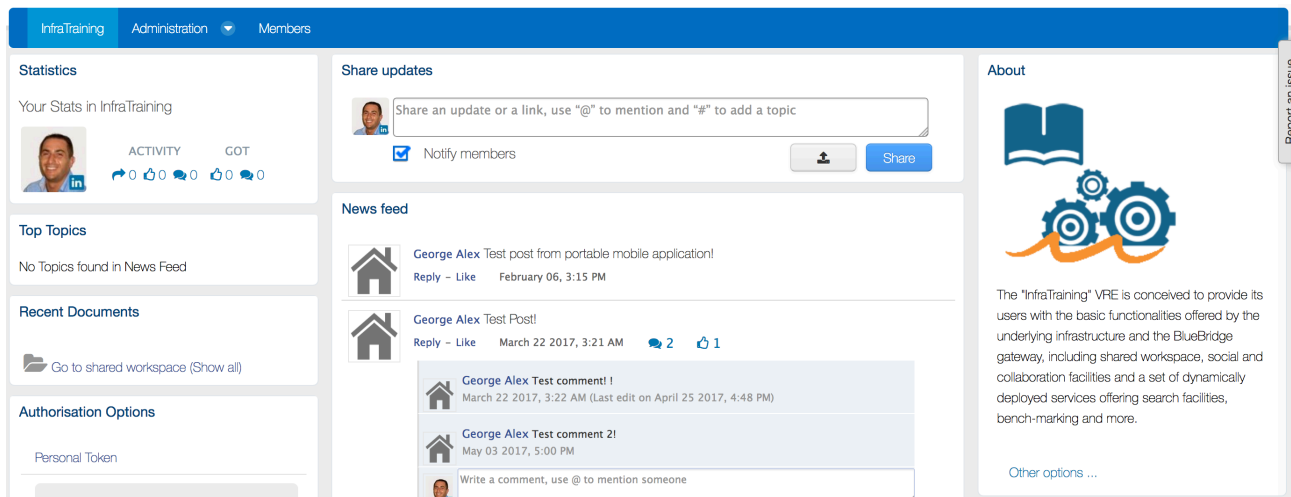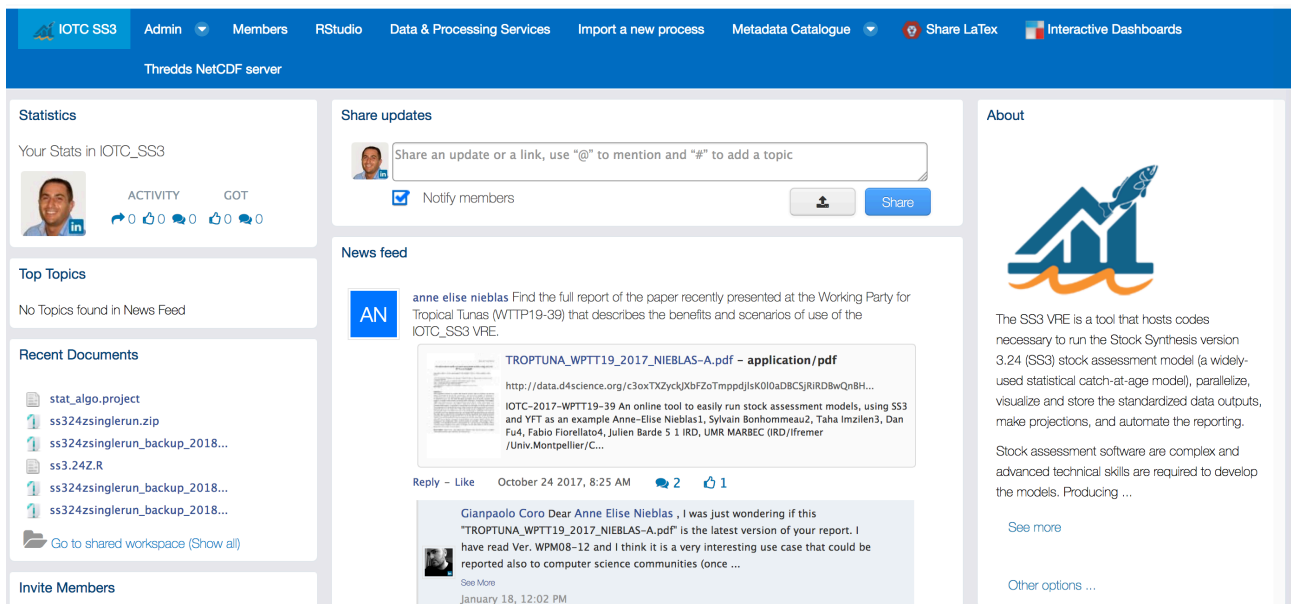

Figure 94. iSearch VRE / Vlab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VLab is specifically equipped with the following capabilities:

- *Keyword-based data discovery*[10]: a facility enabling users to specify their Google-like queries, search for objects in the VRE information space and visualise the resulting objects;

- *Data Ingestion Console*[11]: a facility enabling authorized users to populate the VRE information space by harvesting objects from repositories compliant with OAI-PMH protocol;

- *Semantic-based data discovery*: a facility enabling users to search and browse the MarineTLO Data Warehouse.

The major changes occurred in this VLab with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. In particular, the VLab is now exploiting the new version of the keyword-based data discovery and the data ingestion console.

Figure 95 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

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[10] This is a facility that has been re-engineered in the context of BlueBRIDGE.

[11] This is a facility that has been re-engineered in the context of BlueBRIDGE.
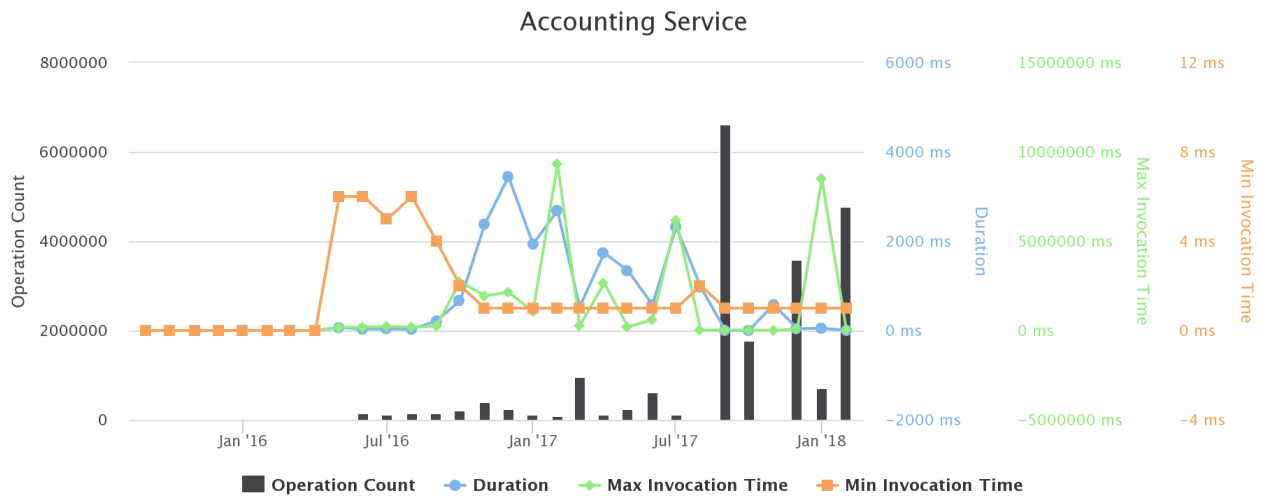
Figure 95. iSearch VRE / VLab Operations per Month

3.45 KIMAGRO FISHFARMING

KIMAGRO Fishfarming VRE supports the performance evaluation, benchmarking and decision making process of KIMAGRO Fishfarming LTD, an aquafarming company, to improve its profitability and minimise environmental impacts. The VRE enables KIMAGRO aquafarmers to: (a) evaluate and optimize their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to KIMAGRO aquafarmers only.

The Vlab is available at https://bluebridge.d4science.org/web/kimagro_fishfarming

This VLab stems from the Blue Economy needs [9]. It has been in "**operational**" status since **October '17,** and it is currently serving **3 users**. A screenshot of the VLab is provided in Figure 96. It shows the home page and the menu items for accessing the VLab facilities.
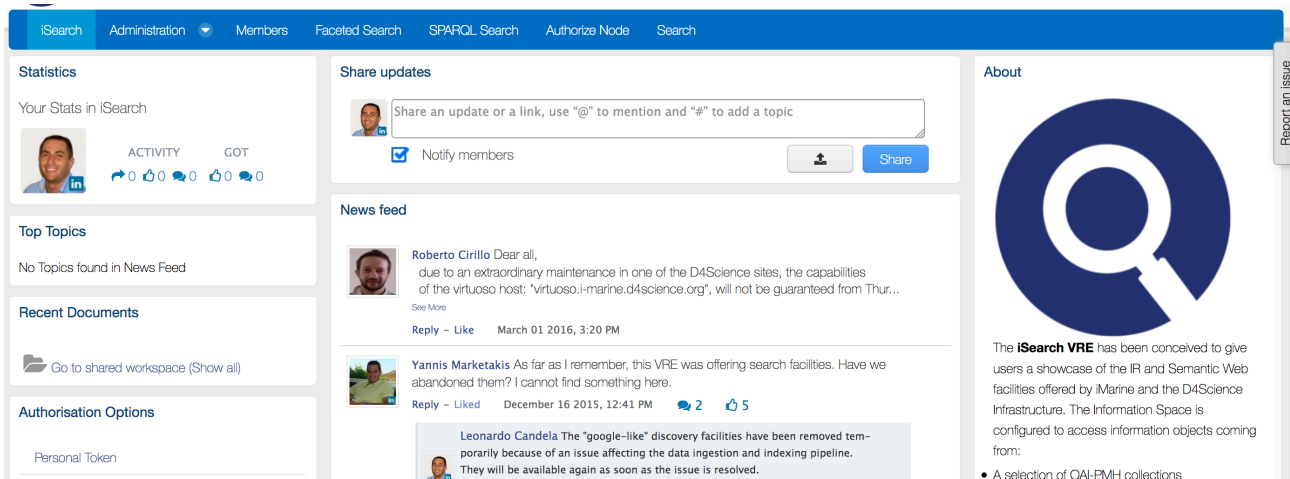

Figure 96. KIMAGRO Fishfarming VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 97 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 97. KIMAGRO Fishfarming VRE / VLab Operations per Month

3.46 KNOWLEDGE BRIDGING

This VRE was created to support the discussions and activity of the Blue Skills pillar, in particular it supports project members in planning courses, discussing experiences resulting from courses, sharing material prepared for supporting courses, exploiting current tools and facilities to assess the fitness for purpose with respect to a planned course.

The Knowledge Bridging VRE is available at https://bluebridge.d4science.org/web/knowledgebridging

This VLab stems from the Blue Skills needs [2]. It has been in "*operational*" status since *September '15,* and it is currently serving *26 users*. A screenshot of the VRE is provided in Figure 98. It shows the home page users are presented with including the menu items for accessing the VRE facilities.
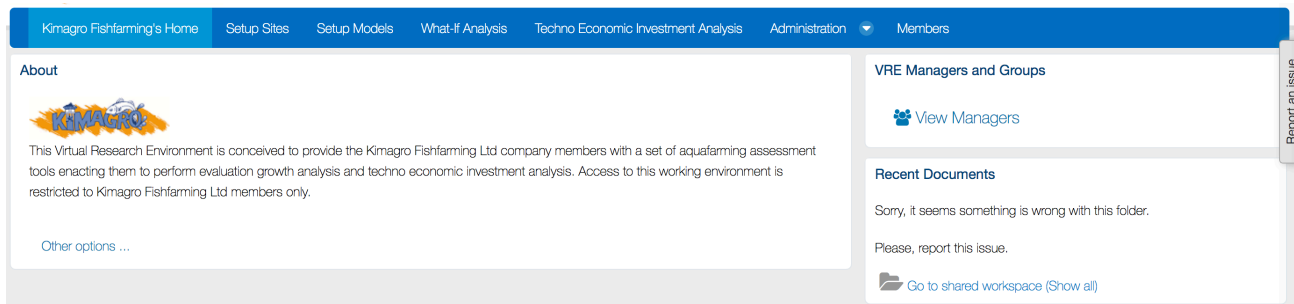
Figure 98. Knowledge Bridging VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities being prototypical examples of facilities to use in courses:

- *Species Data Discovery*: a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a) GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, ITIS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. These algorithms range from data clustering and anomalies detection methods (e.g. DBScan and KMeans) to algorithms for manipulating datasets from the geospatial perspective (e.g. transform FAO Area Code in latitude and longitude). As of November '16, this environment has been configured to give access to more than ***20 diverse algorithms***;

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps, Sea Surface Temperature, that have been generated and/or published. This facility relies on the GeoExplorer portlet and makes it possible to effectively exploit the generated maps and perform comparisons and analysis of the diverse distributions by enabling maps overlay, transects production and values inspection.

Figure 99 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
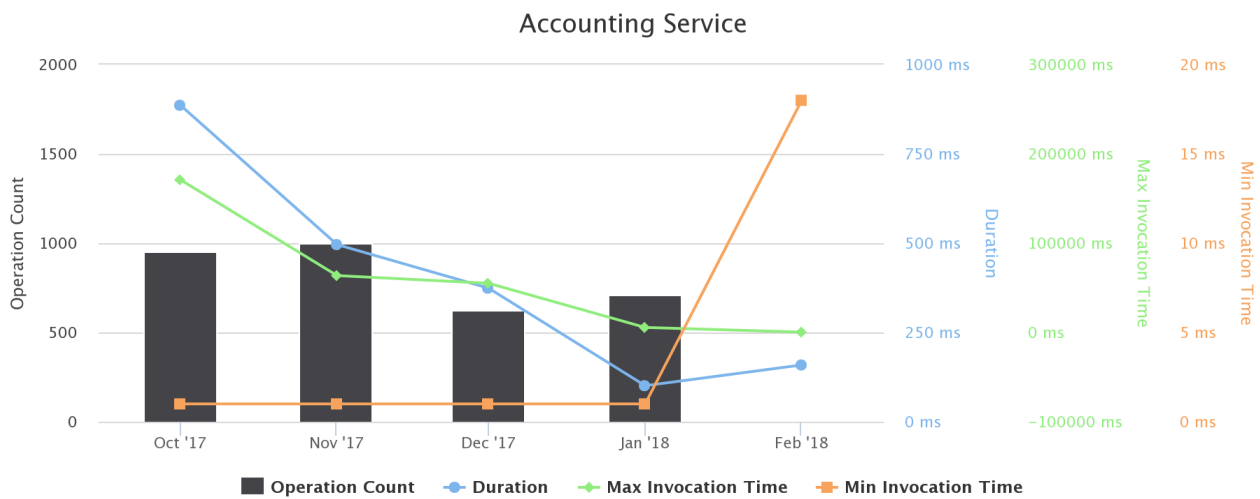
Figure 99. Knowledge Bridging VRE / VLab Operations per Month

3.47 MARKELLOS AQUACULTURE

MARKELLOS Aquaculture VRE supports the performance evaluation, benchmarking and decision making process of MARKELLOS Marine Farm S.A, a Greek aquafarming company, to improve its profitability and minimise environmental impacts. The VRE enables Markellos Marine Farm aquafarmers to: (a) evaluate and optimize their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to MARKELLOS company members only.

The VLab is available at https://bluebridge.d4science.org/web/markellos_aquaculture

This VLab stems from the Blue Economy needs [9]. It has been in "*operational*" status since *June '17,* and it is currently serving *6 users*. A screenshot of the VLab is provided in Figure 100. It shows the home page and the menu items for accessing the VLab facilities.

Figure 100. MARKELLOS Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate

(MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstock is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 101 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
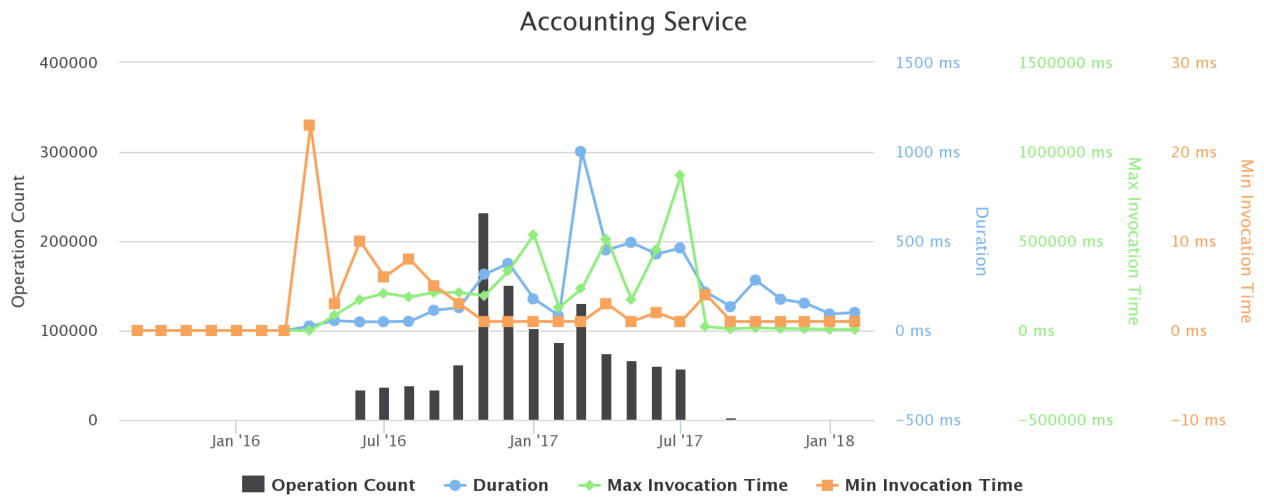

Figure 101. MARKELLOS Aquaculture VRE / VLab Operations per Month

3.48 NHREUS AQUACULTURE

The NHREUS Aquaculture VLab supports the performance evaluation, benchmarking and decision making process of NHREUS aquaculture company to improve its profitability and minimise environmental impacts. It enables NHREUS company members to: (a) evaluate and optimise their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to NHREUS company members only.

The VLab is available at https://bluebridge.d4science.org/web/nhreus_aquaculture

This VLab has been in *operational* status since *July '17* and it is currently serving *4 users*. A screenshot of the VRE is in Figure 102. It shows the home page and the menu items for accessing the VLab facilities.
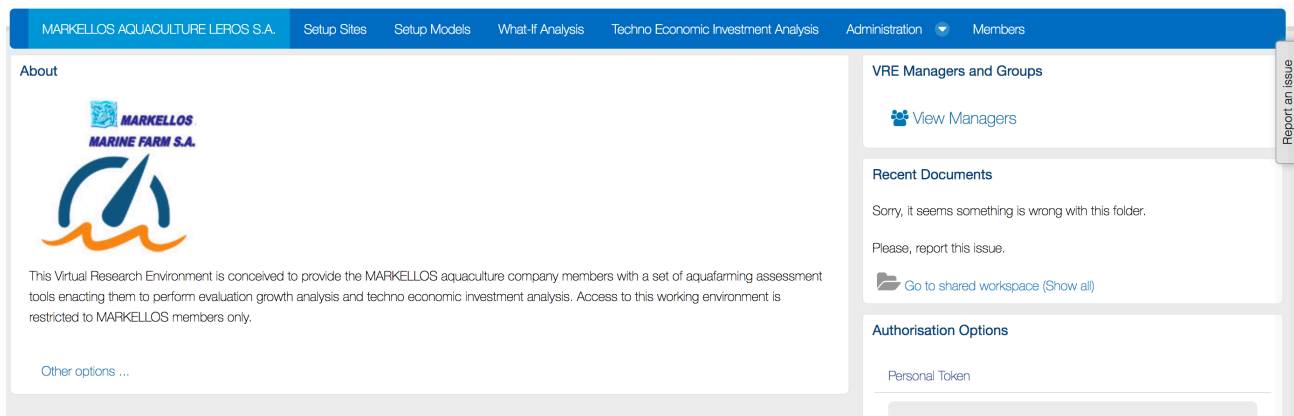
Figure 102. NHREUS Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstock is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 103 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
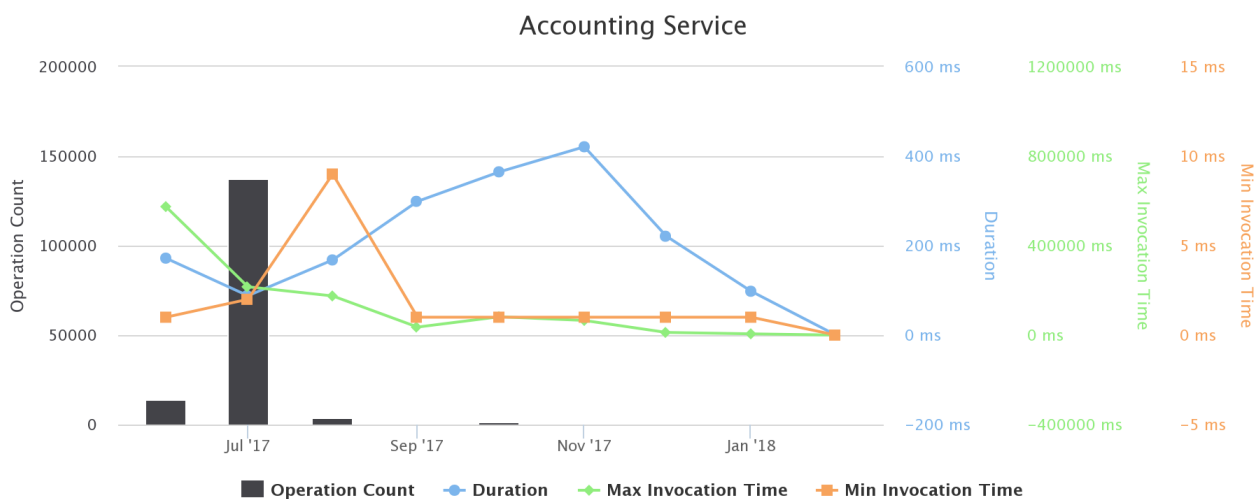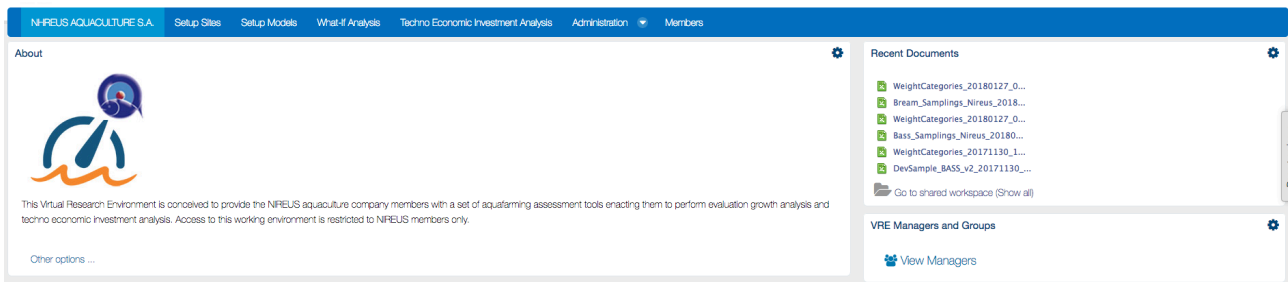
Figure 103. NHREUS Aquaculture VRE / VLab Operations per Month

3.49 PERFORMANCE EVALUATION IN AQUACULTURE

This VRE is created to capture and confront the dual challenge of understanding the performance of an aqua-farming operation, allowing investors and entrepreneurs to conform to environmental rules and optimize the use of resources (monetary and non-monetary ones) and the monetary and environmental pressure produced by such operations, so that scientists and policy makers can craft guidelines or even regulations, taking into account the economic interest of those operations.

The Performance Evaluation in Aquaculture VRE is available at https://bluebridge.d4science.org/web/performanceevaluationinaquaculture

This VLab stems from the Blue Economy needs [9]. It has been in "**operational**" status since **September '15,** and it is currently serving **27 users**. A screenshot of the VLab is provided in Figure 104. It shows the home page users are presented with including the menu items for accessing the VLab facilities.

Figure 104. Performance Evaluation in Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Resource Catalogue:* a facility enabling VRE members to access the BlueBRIDGE products catalogue. As of February 2018, this catalogue give access to more than 70,000 items including datasets, virtual research environments, services, and "research objects".

Figure 105 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
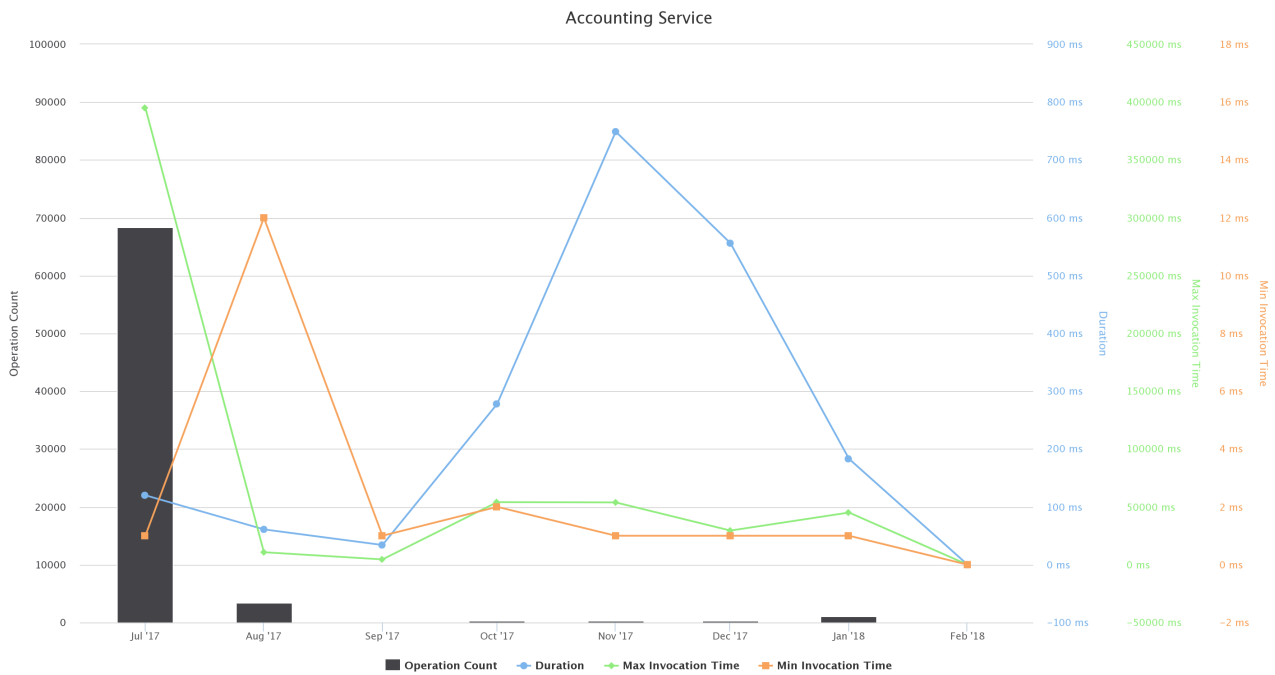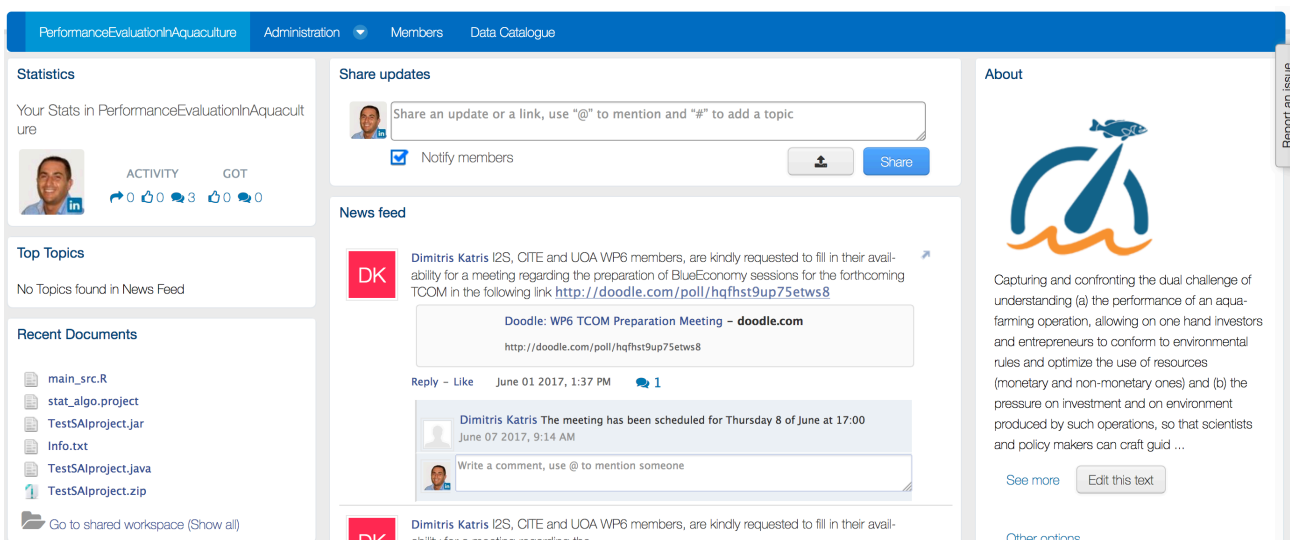

Figure 105. Performance Evaluation in Aquaculture VRE / VLab Operations per Month

3.50 PROTECTED AREA IMPACT MAPS

The Protected Area Impact Maps Virtual Research Environment provides the user with tools to visualize, analyze and report on a range of ecologically important seafloor features within marine protected areas - a key component of Maritime Spatial Planning (MSP). The interface is built around an interactive map viewer that provides visualization of a range seafloor features. The interface utilizes cloud computing to analyse the representation of seafloor features within marine protected areas for a selected exclusive economic zone or marine ecoregion. Finally, the interface presents the results of this analysis in an interactive report, with options to download the report or the results of the analysis. The interface will assist users in understanding which seafloor features occur in an area and how these are currently represented in marine protected areas. This information can be used to prioritize future planning of protected areas to include seafloor features which are poorly represented. The interface allows the user, for a selected reporting region, to report on a range of seafloor features within managed areas: (i) Reporting regions: Exclusive Economic Zones (EEZs) and Marine Ecoregions, (ii) Managed areas: Marine Protected Areas (MPAs), (iii) Seafloor Features: Seafloor Geomorphology and Seagrass, Mangroves and Coral Reefs.

The Protected Area Impact Maps VLab[12] is available at https://bluebridge.d4science.org/web/protectedareaimpactmaps

This VLab stems from the Blue Environment VRE [13]. It has been in "***operational***" state since ***September '15,*** and is currently serving ***71 users***. A screenshot of the VLab is in Figure 106; it shows the home page and the menu items for accessing the VLab facilities.

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[12] This started as a VRE for supporting Blue Environment tasks and then released to the community in the second part of the project.

Figure 106. Protected Area Impact Maps VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *The MPA Reporting*: a facility offering three main functions on MPA (Visualising, Analyzing and Reporting). In particular, the MPA Reporting interface allows users to view marine data layers such as seafloor geomorphology (seamounts, canyons, etc.), seagrass, coral reefs and mangroves in a simple web map. At a glance, users can get a quick overview of the spatial distribution of different features within an area. The map interface allows users to pan around the map and zoom in on an area of interest. Two different base maps are available. The MPA Reporting interface allows users to analyze the seafloor features represented in marine protected areas within a selected target area, either an exclusive economic zones (EEZs) or a marine ecoregion. Behind the interface, a powerful algorithm, developed in R, computes feature representation within the target region. The analysis provides detailed statistical information to the representation of seafloor features inside the protected areas for the target region. Finally, the MPA Reporting interface provides powerful tools to explore the analysis results. The reporting interface consists of separate results and report pages. The results page provides interactive tables and charts to explore the results split by seafloor feature and protected area name. The report page provides an overview, by protected area for each of the features, including an interactive map display and contextual information on the protected areas and features. The user can download a PDF report of the analysis and the data in a CSV format.
- *Data Analytics at scale* (for VRE Managers only): a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 the VLab gives access to **5 specific algorithms** underlying the MPA Reporting facility;
- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace.
- *Context Specific Catalogue:* a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **23 datasets** including global distributions of mangrove forests, seagrasses, coral reefs.

Figure 107 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
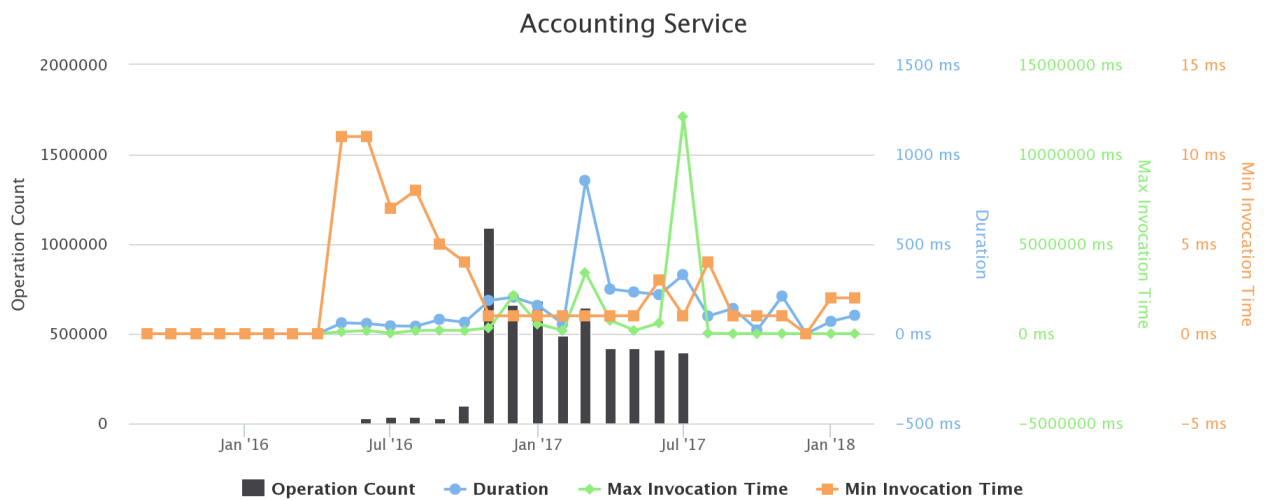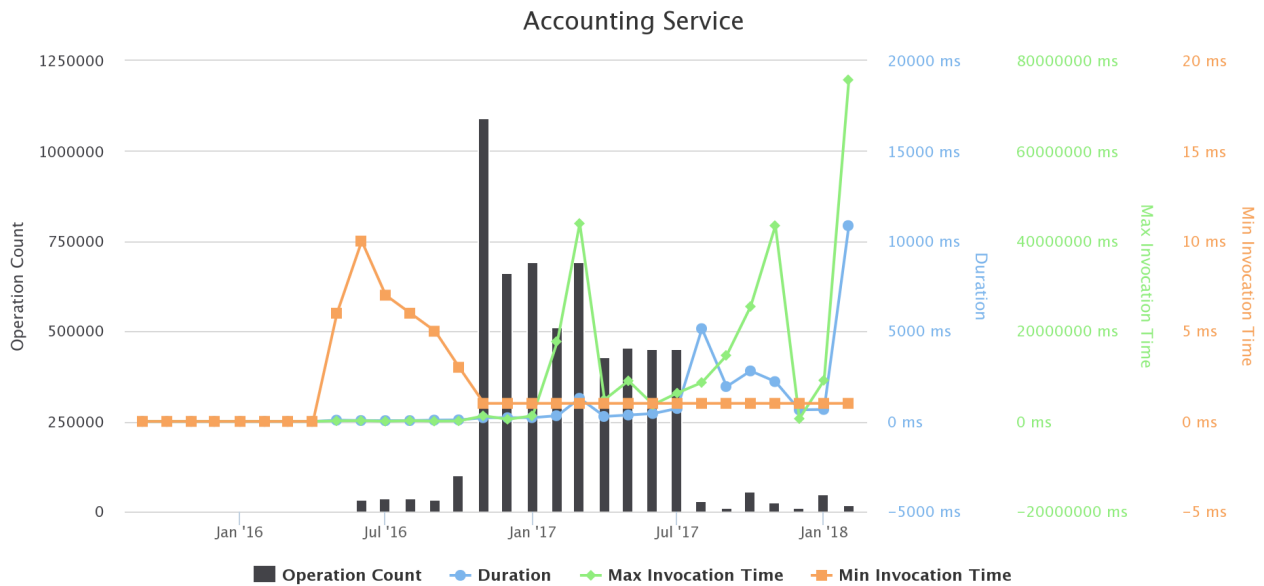
Figure 107. Protected Area Impact Maps MRE / VLab Operations per Month

3.51 R PROTOTYPING LAB

This VLab was conceived to provide its users with a complete development and integration environment for R. In particular, the environment is powered by RStudio®, an open source development environment including a code editor, and debugging and visualization tools. Moreover, it is powered by the gCube data analytics platform enabling users to (i) integrate R algorithms into the platform, (ii) execute integrated algorithms by benefitting from a distributed computing infrastructure, and (iii) automatically generate research objects out of any computation. Finally, it is integrated with social networking facilities and a shared workspace, enabling VRE members to put in place collaborative working practices.

The R Prototyping Lab VLab is available at https://bluebridge.d4science.org/web/rprototypinglab

This VLab has been in **operational** status since **September '16,** and it is currently serving **127 users**. A screenshot of the VLab is in Figure 108; it shows the home page and the menu items for accessing the VLab facilities.

Figure 108. R Prototyping Lab VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Species Data Discovery*: a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a)

GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, ITIS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Species View*: a facility enabling users to discover and browse species products (namely species distribution maps). This facility supports discovery mechanisms ranging from simple search based on species names to very specific search criterion, and it offers a comprehensive set of products visualisation approaches;

- *Geospatial Data View*: a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps that have been generated and published. This facility relies on the GeoExplorer portlet and makes it possible to effectively exploit the generated maps and perform comparisons and analysis of the diverse distributions by enabling maps overlay, transects production and values inspection;

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18, this environment has been configured to give access to ***more than 370 diverse algorithms***;

- *Algorithm Importer*: a facility enabling users to transform user-defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code thus making it possible for Data Miner to properly execute it;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace.

Figure 109 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

Figure 109. R Prototyping Lab VRE / VLab Operations per Month

3.52 RSTUDIO LAB

This VLab was conceived to provide its users with a development environment for R. This development environment is powered by RStudio® and it is integrated with social networking facilities and a shared workspace, enabling VRE members to put in place collaborative working practices.

The RStudio Lab VLab is available at https://bluebridge.d4science.org/web/rstudiolab

This VLab has been in **operational** status since **September '16,** and it is currently serving **81 users**. A screenshot of the VLab is provided in Figure 110; it shows the home page and the menu items for accessing the VLab facilities.
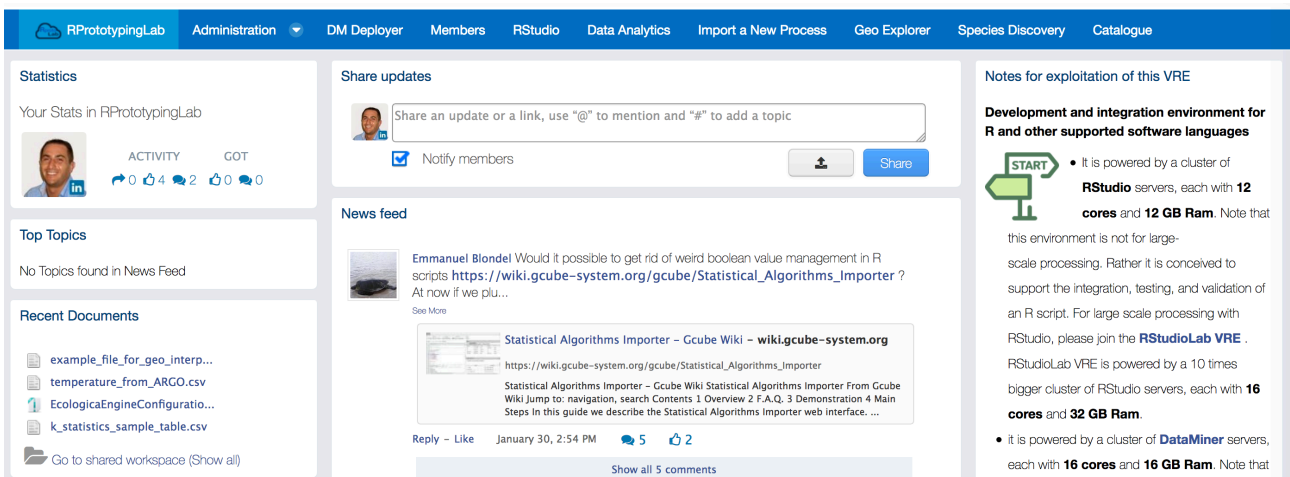

Figure 110. RStudio Lab VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with:

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace;

- ShareLaTeX: a facility enabling users to access a fully-fledged ShareLaTeX® working environment directly from the VRE.

Figure 111 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
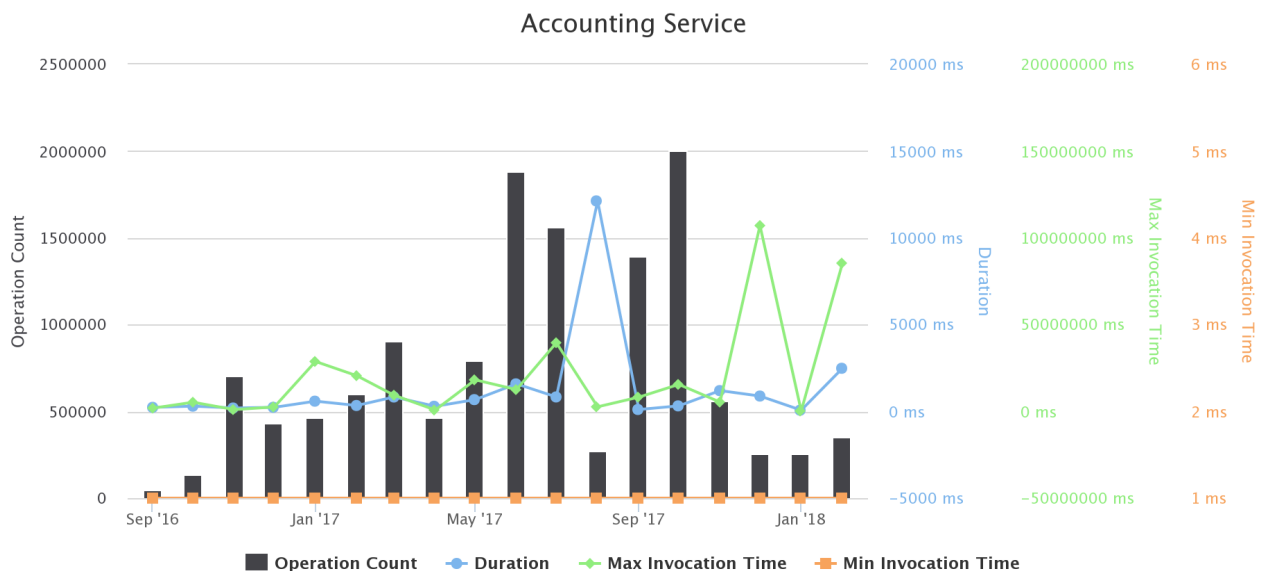

Figure 111. RStudio Lab VRE / VLab Operations per Month

3.53 SCALABLE DATA MINING

The Scalable Data Mining VLab is designed to apply Data Mining techniques to biological data. The algorithms are executed in a distributed fashion on the e-Infrastructure nodes or on local multi-core machines. Scalability is thus meant as distributed data processing but also as services dynamically provided to the users. The system is scalable in the number of users and in the size of the data to process. Statistical data processing can be applied to perform generic Data Mining, Ecological Niche Modelling or Ecological Modelling experiments. Other applications can use general purpose techniques like Bayesian models. Time series of observations can be managed as well, in order to classify trends, catch anomaly patterns and perform simulations.

The idea behind the distributed computation for data mining techniques is to overcome common limitations that can occur when using statistical algorithms, like training and projection procedure time, the linear or non-linear time increase when the number of data to process increases, multiple runs needed for reducing overfitting or local minima problems, or multiple models topologies to be evaluated for assessing the optimal model's configuration. All the above issues strongly limit the amount of time a scientist can dedicate to the evaluation of the results and to the combination and comparison of the outcomes of different experiments. Using a distributed e-Infrastructure endowed with collaborative approach may overcome these issues.

The Scalable Data Mining VLab is available at https://bluebridge.d4science.org/web/scalabledatamining

This VLab was inherited by iMarine, and thus it has **operational** since **September 2015,** from the perspective of BlueBRIDGE. It is currently serving **171 users**. A screenshot of the VLab is provided in Figure 112; it shows the home page and the menu items for accessing the VLab facilities.
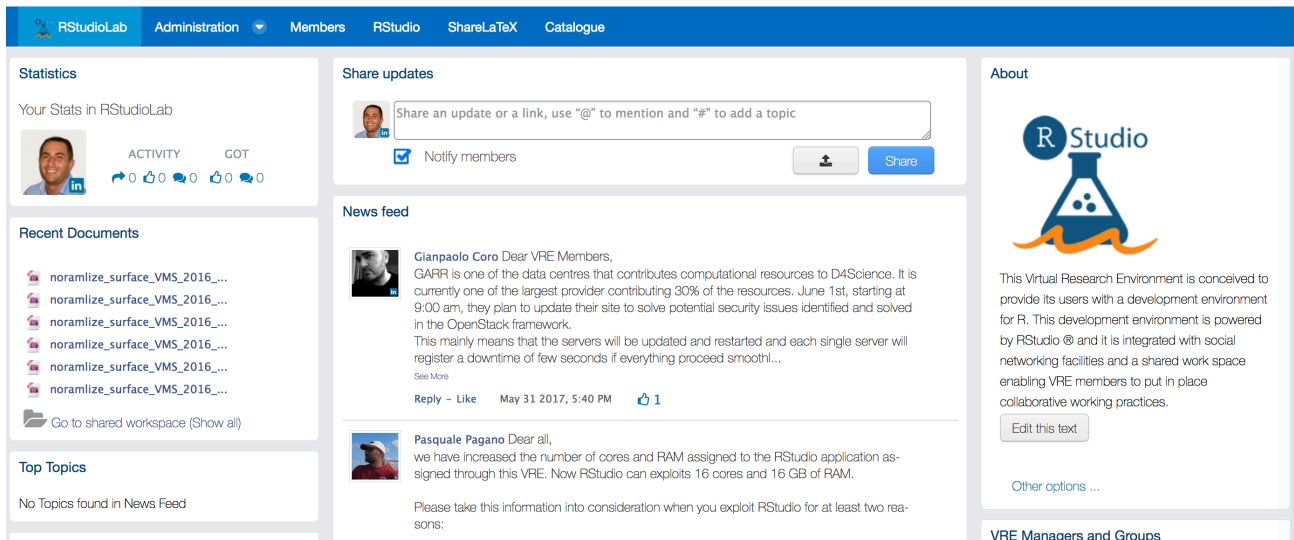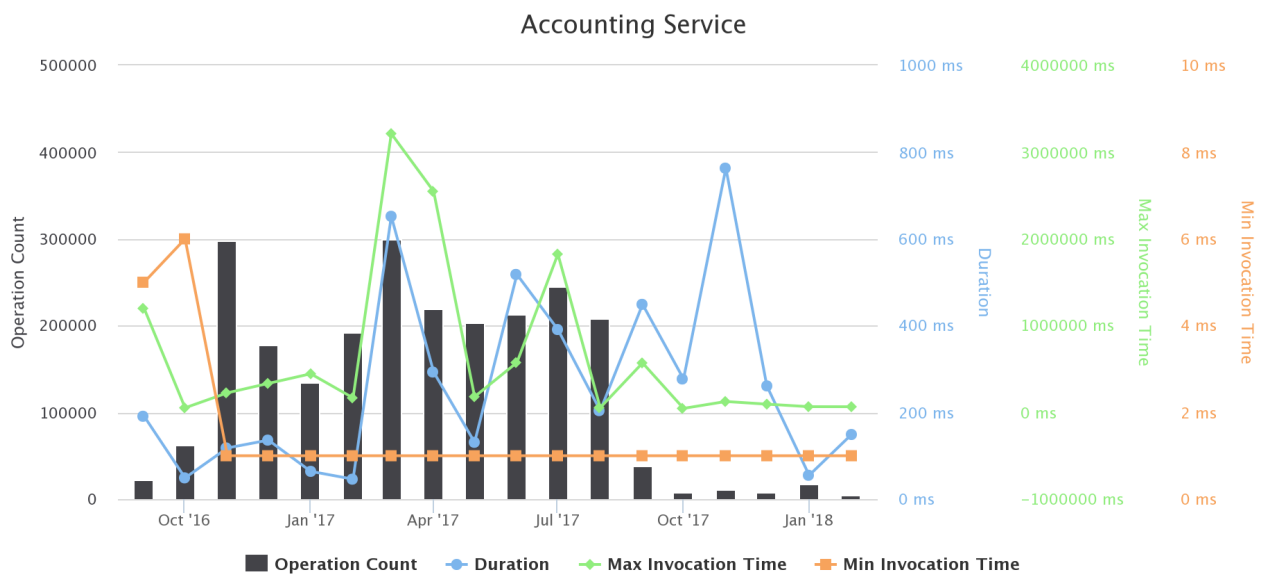

Figure 112. Scalable Data Mining VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to **more than 90 diverse algorithms**;

- *Resource Catalogue*: a facility enabling members to access the BlueBRIDGE products catalogue. As of February 2018, this catalogue give access to more than **70,000 items** including datasets, virtual research environments, services, and "research objects".

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. In particular, this VLab is benefitting from the new data analytics framework and its support for Open Science practices, the facility for importing new methods, and the data catalogue.

Figure 113 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
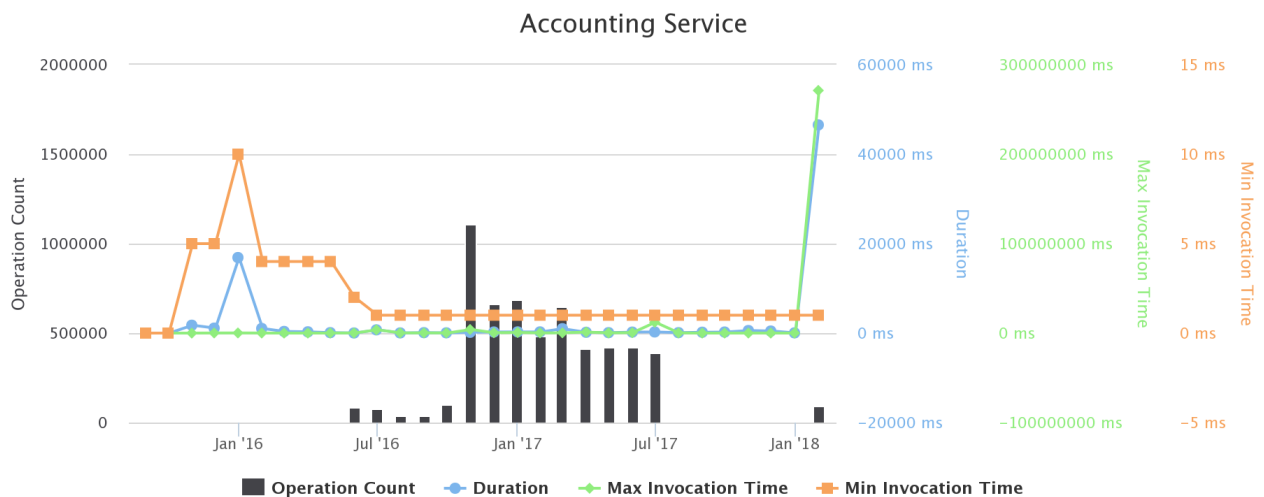

Figure 113. Scalable Data Mining VRE / VLab Operations per Month

3.54 SDG INDICATOR 14.4.1

This VLab supports the FAO training workshop on "Best-practices for the implementation and reporting of SDG Indicator 14.4.1 - Percentage of biologically sustainable fish stocks" by Dr. Yimin YE, FAO FIAF Branch Chief at FAO Headquarters – India Room - November 21 to 24, 2017. This workshop is part of FAO's initiative to support the process of Sustainable Development Goals (SDGs). Its main objectives are to raise awareness on SDG 14 and the significance and global reporting process for Indicator 14.4.1 - Percentage of biologically sustainable fish stocks. It will also provide technical training to national practitioners in data requirements, data collection process, analytical methods to produce Indicator 14.4.1, to facilitate and support the global reporting process.

The Vlab is available at https://bluebridge.d4science.org/web/sdg-indicator14.4.1

This VLab stems from the Blue Assessment needs [5]. It has been in "*operational*" status since *November '17,* and it is currently serving *29 users*. A screenshot of the VLab is provided in Figure 114; it shows the home page and the menu items for accessing the VLab facilities.
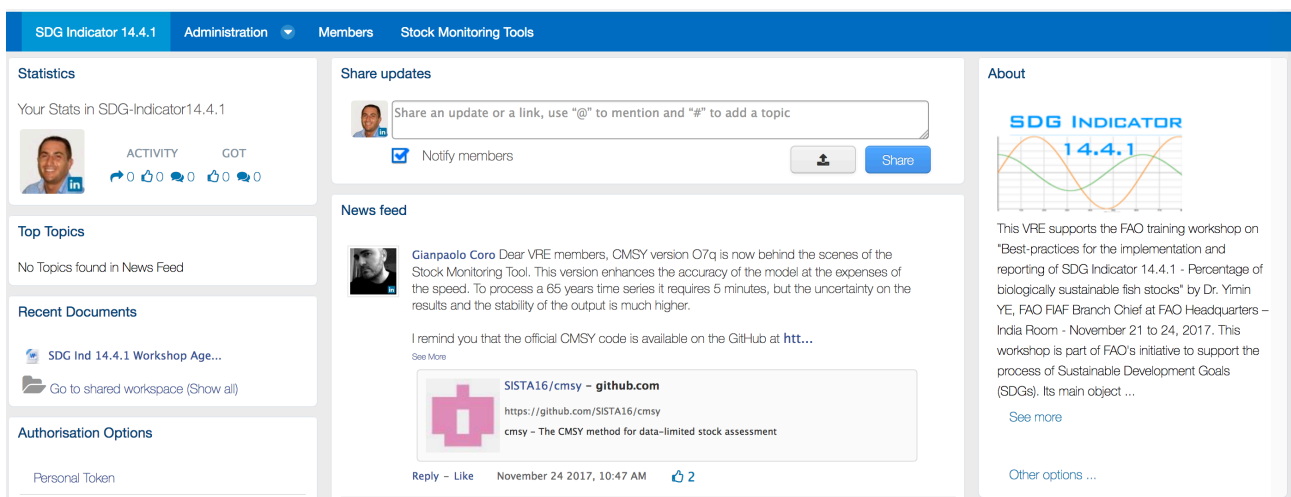

Figure 114. SDG Indicator 14.4.1 VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Stock Monitoring Tool:* a facility offering a set of stock assessment methods including CMSY [11], ELEFAN [12] and YPR / SBPR [12].

Figure 115 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.

Figure 115. SDG Indicator 14.4.1 VRE / VLab Operations per Month

3.55 SDI LAB

This VLab supports a workshop gathering data managers (around 30 people) from different French institutes (e.g. CNRS, INRA, IRD) to discuss methods to set up a workflow for spatial metadata, data and related services. The VRE is equipped with components to run the workshop, share material and get some feedback from the users (survey).

The Vlab is available at https://bluebridge.d4science.org/web/sdi_lab

This VLab stems from the Blue Assessment needs [2]. It has been in "*operational*" status since *January '18,* and it is currently serving *31 users*. A screenshot of the VLab is provided in Figure 116. It shows the home page and the menu items for accessing the VLab facilities.
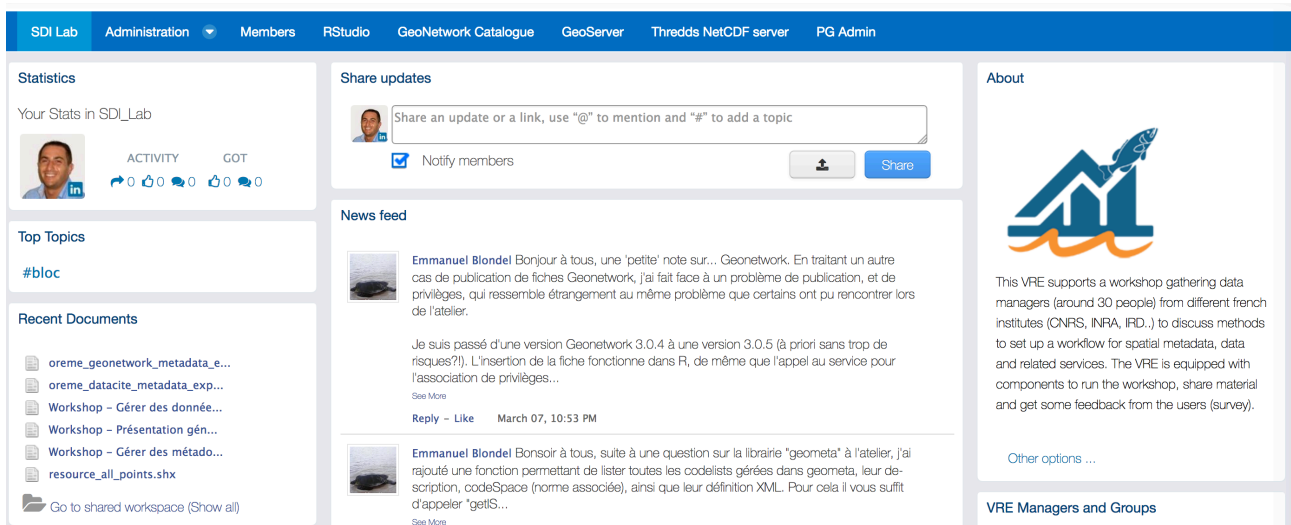
Figure 116. SDI Lab VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *R Studio as-a-Service:* a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files in the workspace;

- Geospatial Specific Catalogue: a facility enabling to search and browse datasets and other products of interest for the specific VRE / VLab. As of February '18 this environment has been configured to give access to **more than 200 datasets** provided by French institutes.

Figure 117 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
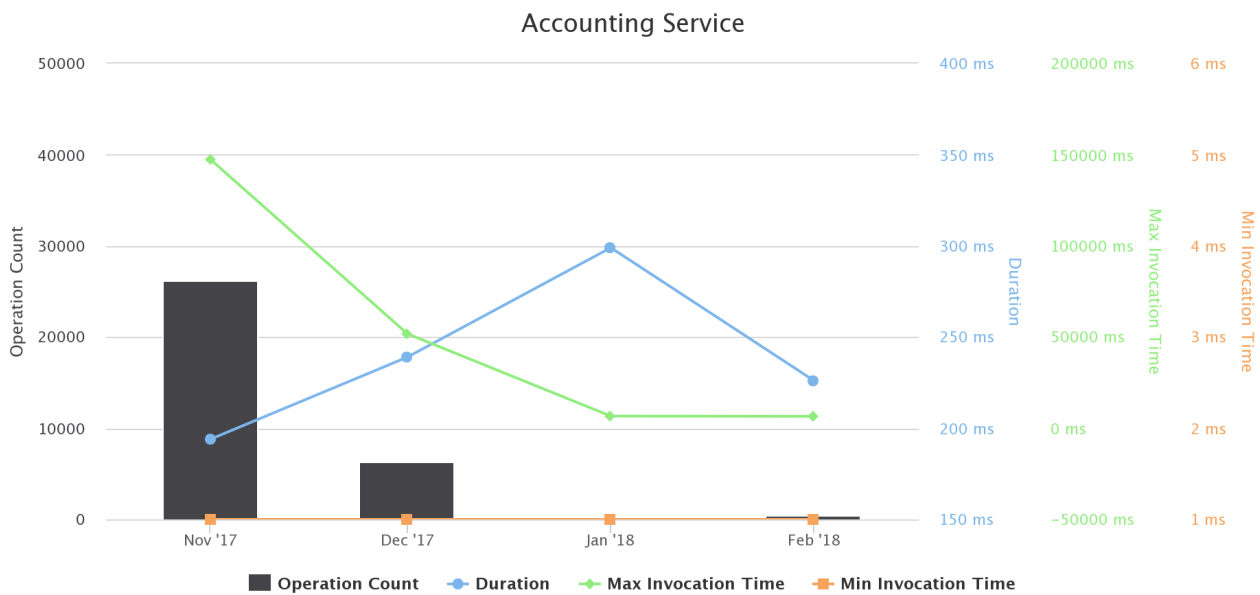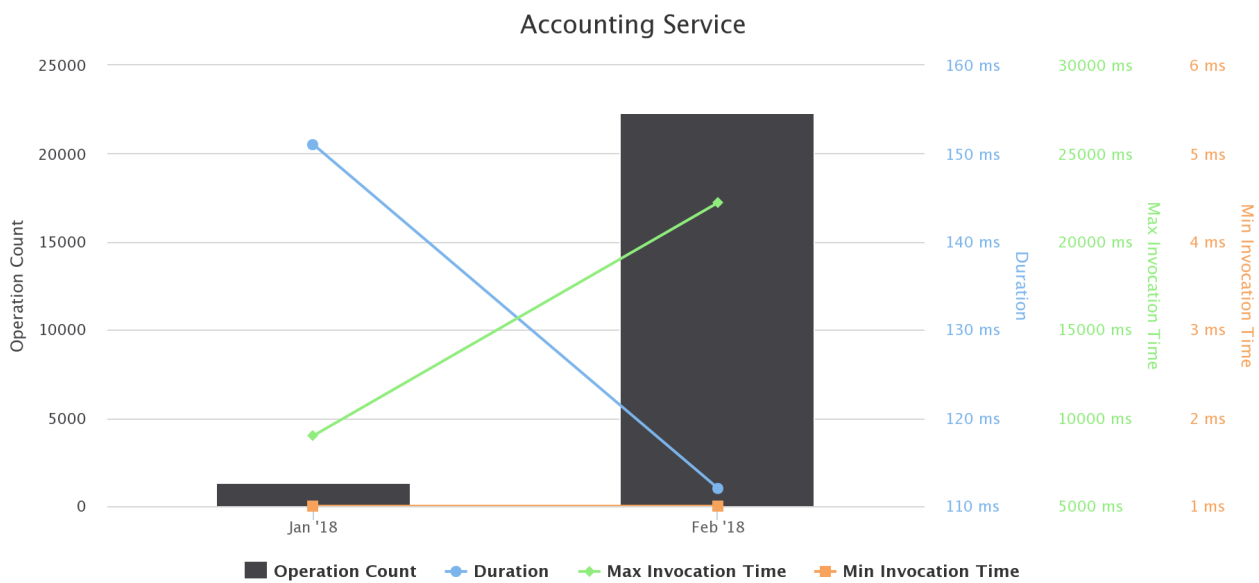

Figure 117. SDI Lab VRE / VLab Operations per Month

3.56 SIASPA: STRATEGIC INVESTMENT ANALYSIS AND SCIENTIFIC PLANNING/ALERTING

The Strategic Investment analysis and Scientific Planning/Alerting (SIASPA) VLab offers geospatial multi-factor optimization services that support intelligent identification of locations of interest for investors and stakeholders (from an economic and environmental point of view) seeking optimization of intended investments. Furthermore, the analytics functions that are executed over the existing or candidate aquaculture zones can facilitate scientists seeking areas of environmental importance. The SIASPA VRE is mainly referred to investors and stakeholders that try to identify locations of interest related to aquaculture industry. Moreover, scientists and local authorities can also benefit from the services provided by this VRE.

The SIASPA VLab is available at https://bluebridge.d4science.org/web/siaspa

This VLab stems from the Blue Economy needs [9]. It has been in "**available**" status since **November '16**, and it is currently serving **32 users**. A screenshot of the VLab is provided in Figure 118; it shows the home page and the menu items for accessing the VLab facilities.

Figure 118. SIASPA VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Geoanalytics*: a facility enabling users (e.g. investors, scientists) to efficiently identify strategic locations of interest that meet multifactor selection criteria. It includes project management facilities that let users create projects (i.e. identification tasks) with layer selection and sharing among existing groups or individual users, exploration of existing geospatial datasets and analytics techniques execution on geospatial data in order to guide decision making in aquafarm industry;

- *Data importer*: a facility enabling users to import geospatial data in the geoanalytics platform from various data sources. There is built-in support for importing data from services and formats following open standards such as Web Feature Service (WFS) services and tsv files. In addition, the data importer tool offers a mechanism to inject custom plugable logic in order to seamlessly support any other possibly available data source. This tool also provides the ability to define taxonomies that can be used by the geoanalytics platform to classify and retrieve geospatial layers.

Figure 119 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

Figure 119. SIASPA VRE / VLab Operations per Month

3.57 SINAY

A VRE managed by the Sinay company, with the aim to (a) produce model-based habitat maps of cetaceans, (b) produce model-based noise footprint maps of selected offshore activities, (c) assess risk and potential impacts. The involved data and models are: abundance data of cetaceans, grid environmental variables,

generalized additive (mixed) models (GAM and GAMM), and generalized linear (mixed) models (GLM and GLMM). The focus areas are the eastern waters of the English Channel and the Mediterranean Sea.

The VLab is available at https://bluebridge.d4science.org/web/sinay

This VLab has been in "**_operational_**" status since **_November '17,_** and it is currently serving **_10 users_**. A screenshot of the VLab is provided in Figure 60; it shows the home page and the menu items for accessing the VLab facilities.
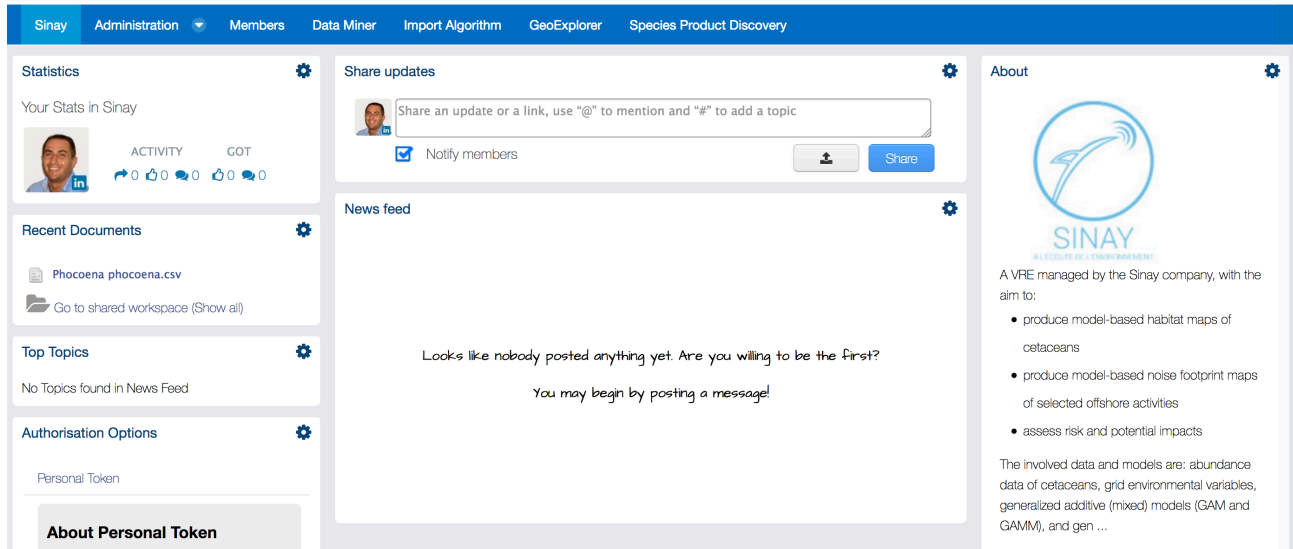
Figure 120. Sinay VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Data Analytics at scale:* a facility enabling users to benefit from the offerings of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 the VLab gives access to **_9 algorithms_**, e.g. data clustering, maps comparison;

- *Algorithm Importer:* a facility enabling users to transform user defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code, thus making it possible for Data Miner to properly executing it;

- *Species Data Discovery:* a facility enabling users to discover and manage species data products (occurrence data and taxonomic data) from a number of heterogeneous providers (including (a) GBIF and speciesLink for occurrences data, and (b) ASFIS, BrazilianFlora, CatalogueOfLife, IRMNG, ITIS, NCBI, WoRDSS, WoRMS for taxonomic data) in a seamless way. Once discovered, objects can be stored in the workspace for future uses;

- *Geospatial Data View:* a facility enabling users to discover and visualize GIS layers, e.g. species distribution maps that have been generated and published. This facility relies on the GeoExplorer portlet, and makes it possible to effectively exploit the generated maps and to perform comparisons and analysis of the diverse distributions by enabling map overlay, transects production and values inspection.

Figure 121 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
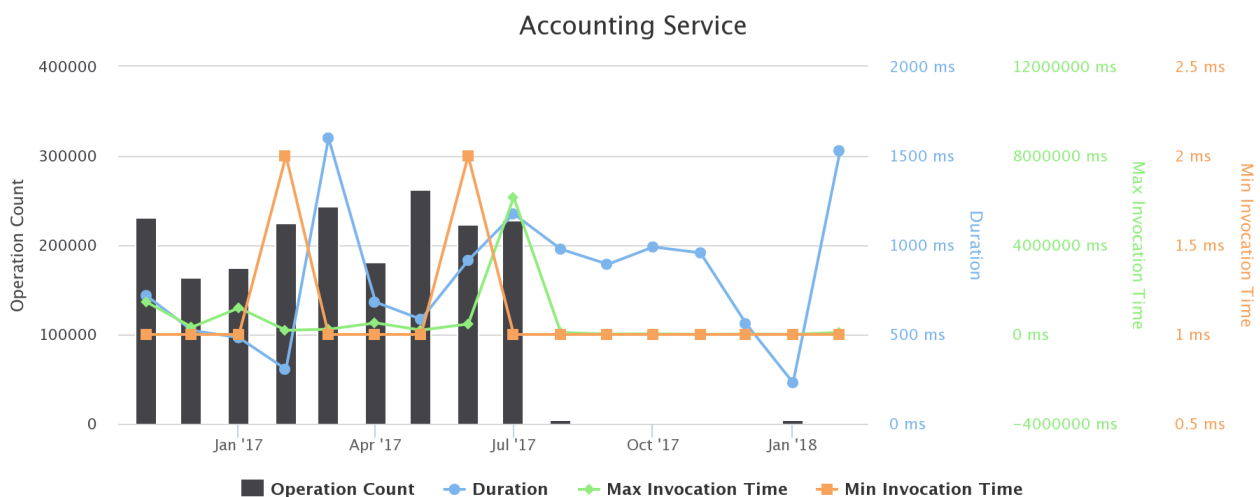
Figure 121. Sinay VRE / VLab Operations per Month

3.58 STOCK ASSESSMENT

This VLab[13] is used for development and validation of data services in support to stock assessment, and accessible for developers and advanced users only. Keep following us to learn when specific features will be released through public or specialized VREs. The Stock Assessment VRE supports the assessment process from harmonizing datasets, selection of model to use, managing the input and output parameters, to publishing and persisting the results. It takes an Open Science approach to stock assessment; it implements a collaborative environment for Reproducible-Repeatable and Reusability (R-R-R) scientific experiments. The assessments are supported through a portal that includes several state of the art assessment models and tools, that include CMSY-as-a-service, SS3, FLR and an adapted version of DLM Toolkit. This VLab aims at the validation of the models and tools and is generic in design. It will be the container VRE, and mainly used for development and validation by developers and software managers. Targeted VREs for specific regions and / or models will be defined as subsets of this VRE, and these can be produced in a few hours for stock assessment scientists. The VRE ultimate aim is to support new and innovative models for stock assessment that can support the sustainable management of stocks by decision makers.

The Stock Assessment VLab is available at https://bluebridge.d4science.org/web/stockassessment

This VLab stems from the Blue Assessment needs [5]. It has been in "*operational*" status since *September '15,* and it is currently serving *63 users*. A screenshot of the VRE is provided in Figure 122; it shows the home page and the menu items for accessing the VLab facilities.

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[13] This started as a VRE for supporting Blue Assessment tasks and have been transformed in a VLab to extent the membership to non-project members in the second phase, once a set of stock assessment methods have been made available.

Figure 122. Stock Assessment VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to more than **25 diverse algorithms** stemming from Blue Assessment activities [5], e.g. CMSY, LWR, VPA;

- *Algorithm Importer*: a facility enabling users to transform user defined algorithms and methods into DataMiner algorithms, i.e. methods that can be executed by the data analytics platform. This transformation assists in annotating the code thus to make it possible for Data Miner to properly executing it;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files into the workspace;

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Resource Catalogue:* a facility enabling EAB members to access the BlueBRIDGE products catalogue. As of February 2018, this catalogue give access to more than 70,000 items including datasets, virtual research environments, services, and "research objects".

Figure 123 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
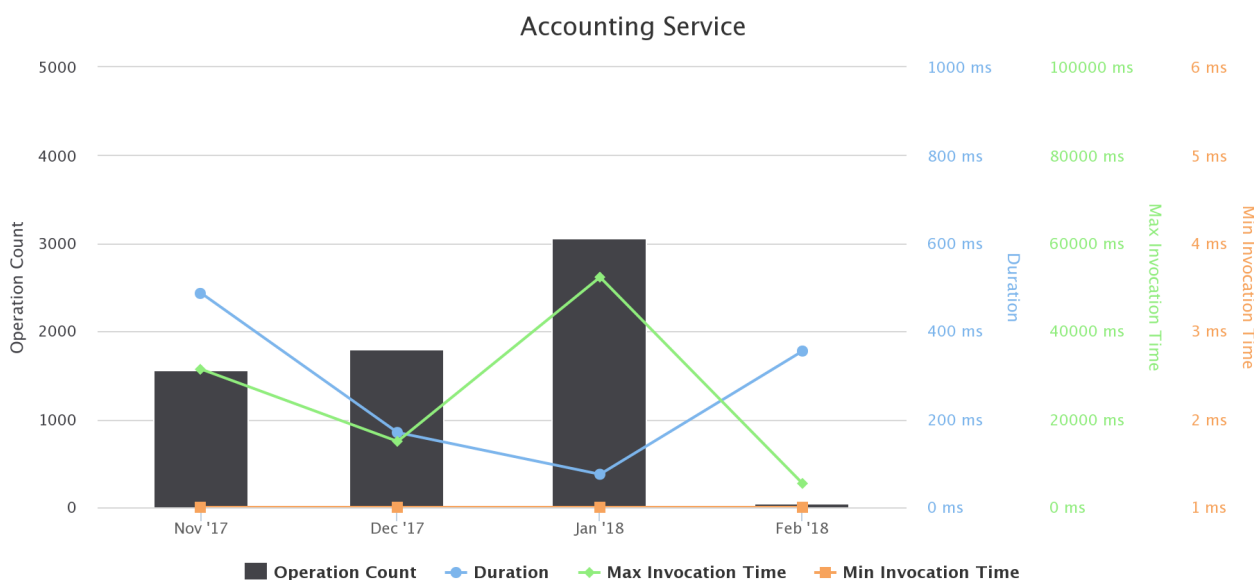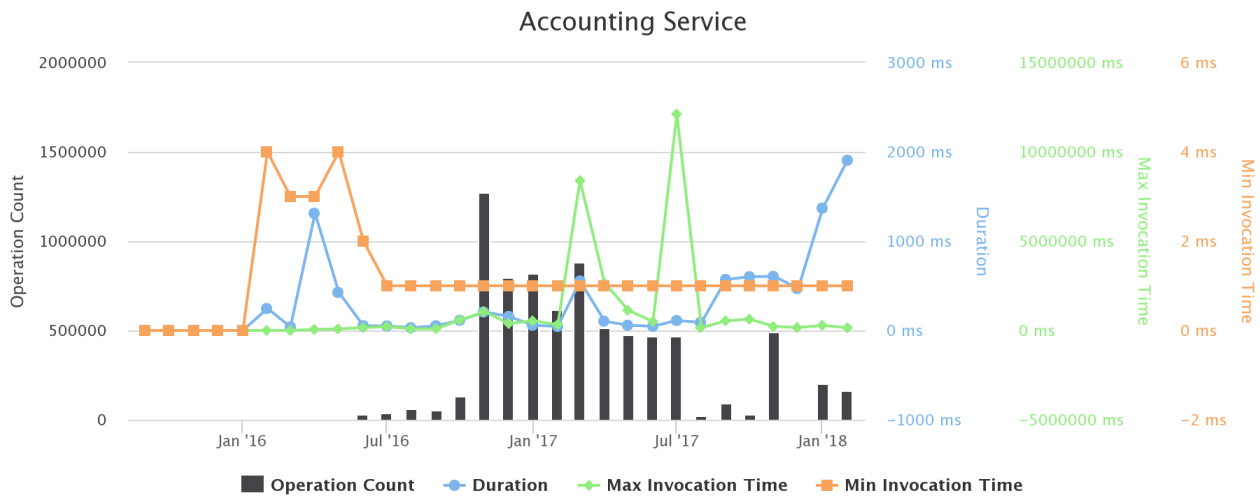
Figure 123. Stock Assessment VRE / Vlab Operations per Month

3.59 STOCKS & FISHERIES KNOWLEDGE BASE

This VRE has been created to support the activities and discussions occurring in Task 5.2 [5], i.e. to define and implement solutions realising a collaborative environment to build and maintain a global knowledge base of stocks and fisheries (i.e. the Global Record of Stocks and Fisheries).

The Stocks and Fisheries KB VRE is available at https://bluebridge.d4science.org/web/stocksandfisherieskb

This VRE stems from the Blue Assessment needs [5]. It has been in "*operational*" status since *September '15,* and it is currently serving *37 users*. A screenshot of the VRE is provided in Figure 124; it shows the home page and the menu items for accessing the VRE facilities.
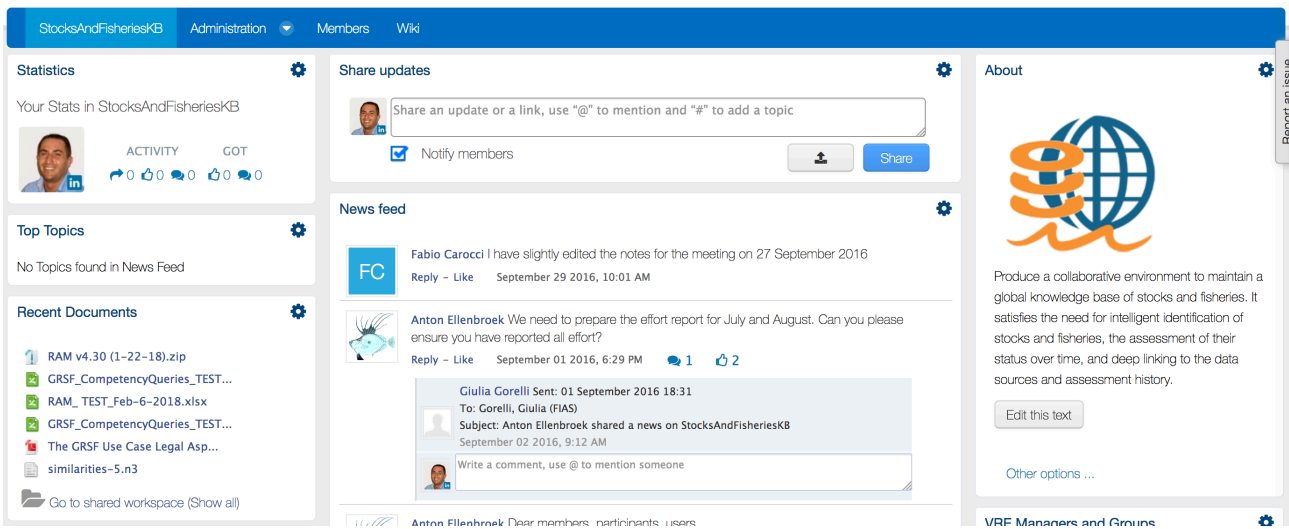
Figure 124. Stock and Fisheries KB VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *GRSF Wiki*: a facility enabling users to access a dedicated Wiki recording requirements, discussions and decisions characterizing the development of the GRSF knowledge base and the supporting VREs / VLabs and services.

Figure 125 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

Figure 125. Stocks and Fisheries KB VRE / VLab Operations per Month

3.60 STRATEGIC INVESTMENT ANALYSIS

The Strategic Investment Analysis VRE facilitates BlueBRIDGE partners participating in the design and implementation of services related to Blue Economy [9]. More precisely this VRE is dedicated to the development of services aiming at propose innovative approaches aiming at satisfying the need for intelligent identification of locations of interest in the aquaculture domain.

The Strategic Investment Analysis VRE is available at https://bluebridge.d4science.org/web/strategicinvestmentanalysis

This VRE stems from the Blue Economy needs [9]. It has been in "*operational*" status since *September '15,* and it is currently serving *62 users*. A screenshot of the VRE is provided in Figure 126; it shows the home page and the menu items for accessing the VRE facilities.

Figure 126. Strategic Investment Analysis VRE / VLab Home Page Screenshot

This VRE is not equipped with any facility other than the basic ones, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership.

Figure 127 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
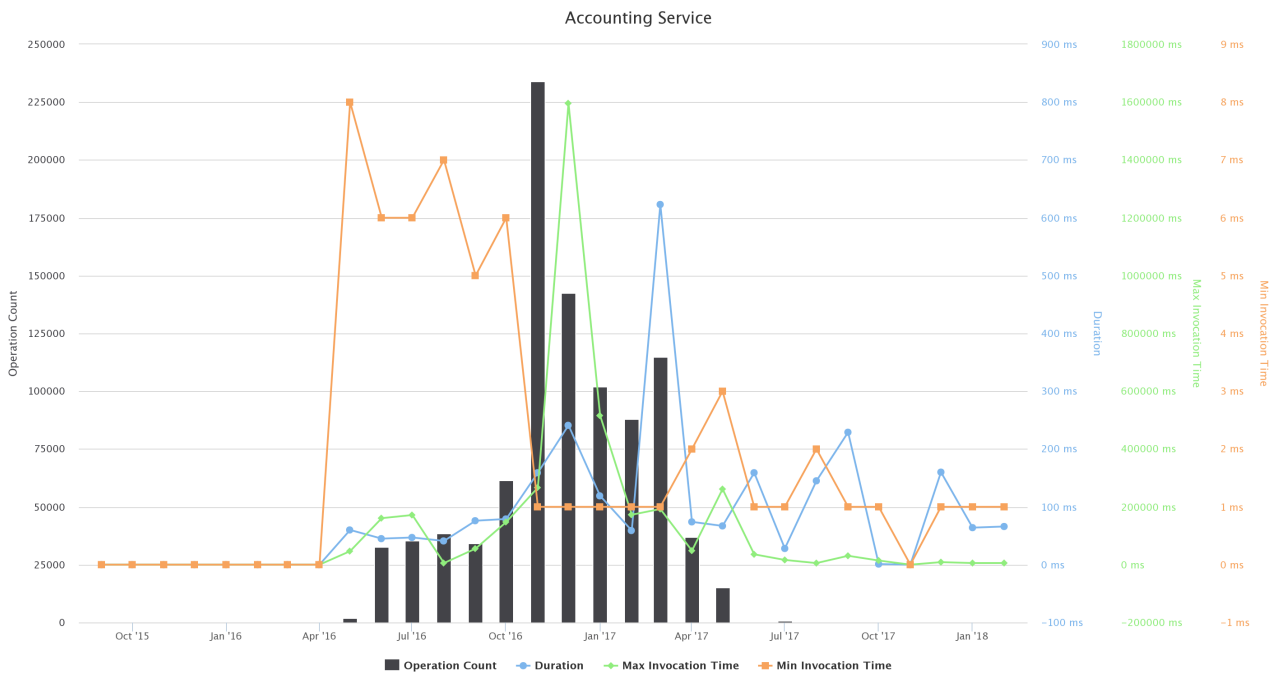
Figure 127. Strategic Investment Analysis VRE / VLab Operations per Month

3.61 STRATOS AQUACULTURES

STRATOS AQUACULTURES S.A. VLab supports the performance evaluation, benchmarking and decision making process of STRATOS AQUACULTURES S.A, a Greek aquafarming company, to improve its profitability and minimise environmental impacts. The VRE enables STRATOS aquafarmers to: (a) evaluate and optimize their performance in terms of production Key Performance Indicators (KPIs), (b) carry out benchmarking analysis comparing their performance against best practices and the competition, and (c) perform a techno economic investment analysis. Access to this working environment is restricted to STRATOS AQUACULTURES company members only.

The Vlab is available at https://bluebridge.d4science.org/web/stratos_aquacultures

This VLab stems from the Blue Economy needs [9]. It has been in "*operational*" status since *June '17,* and it is currently serving *5 users*. A screenshot of the VRE is provided in Figure 128; it shows the home page and the menu items for accessing the VRE facilities.

Figure 128. STRATHOS Aquaculture VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth

Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- *Techno-economic investment analysis*: A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9].

Figure 129 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
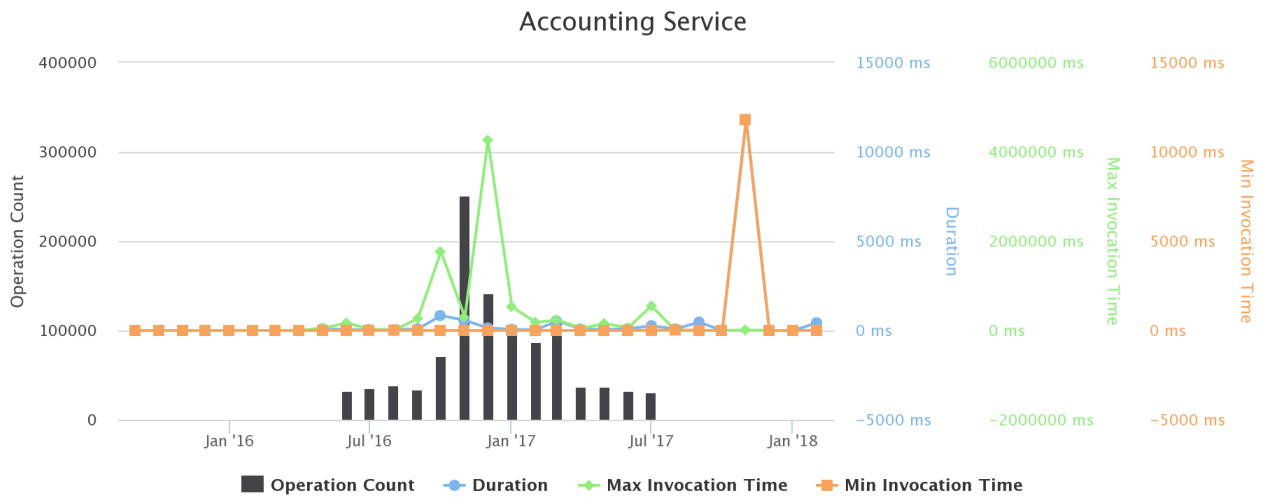

Figure 129. STRATHOS Aquaculture VRE / VLab Operations per Month

3.62 SUSTAINABLE BLUE ECONOMY

The Sustainable Blue Economy VRE offers a complete set of tools developed for the Blue Economy community [9], targeting stakeholders, investors, researchers and others. It offers a set of aquafarming assessment tools enabling them to perform evaluation growth analysis, techno-economic investment analysis and geospatial multi-factor optimization services for intelligent identification of locations of interest for investors and stakeholders (from an economic and environmental point of view) seeking optimization of intended investments.

The VLab is available at https://bluebridge.d4science.org/web/sustainableblueeconomy

This VRE stems from the Blue Economy needs [9]. It has been in "*operational*" status since *December '17,* and it is currently serving *42 users*. A screenshot of the VRE is provided in Figure 130; it shows the home page and the menu items for accessing the VRE facilities.
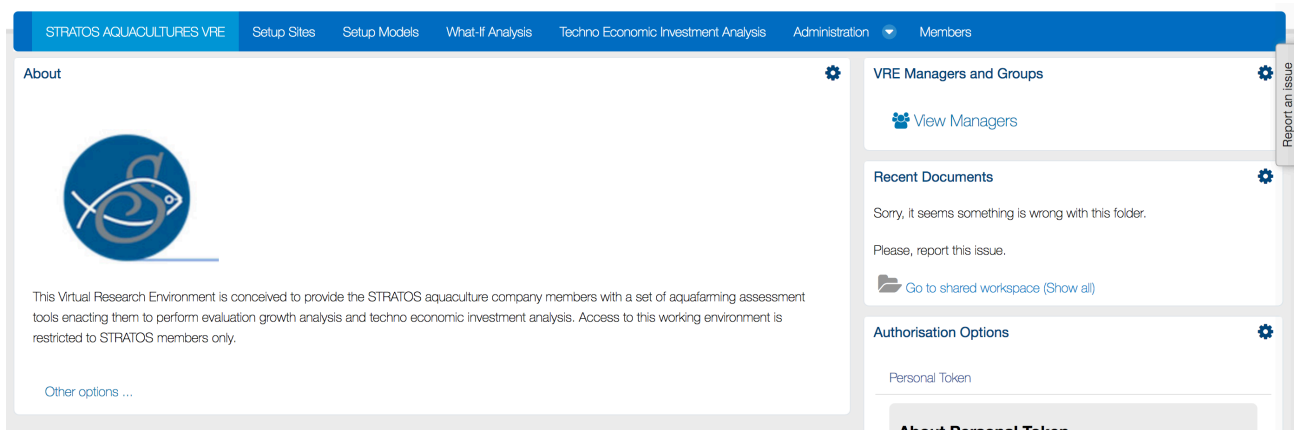
Figure 130. Sustainable Blue Economy VRE / VLab Home Page Screenshot

In addition to the basic functionality, namely a workspace for sharing objects of interest and a user management facility for managing membership, this VLab is specifically equipped with the following functionalities:

- *Setup site*: a facility to create one or more profiles representing a site of interest (an installation of aquafarm facilities) by specifying its geographic location, the oxygen rate, the current rate, and the average temperature per half of each month along the year;

- *Setup model*: a facility to create one or more simulation models estimating the KPIs for the growth of a species based on the historic samplings data. KPIs include Feed Conversion Rate (FCR), Growth Rate per Day (GPD), Specific Growth Rate (SGR), Suggested Feeding Rate (SFR), and Mortality Rate (MR) [9]. Each model is characterised by the site, the name of the species of interest, the broodstock quality, the feed quality, whether the broodstok is improved genetically, and a series of datasets recording monthly sampling data;

- *What-if analysis*: a facility enabling users to perform what-if analysis by using a model among the defined ones. This facility produces an estimation of the main KPIs according to the selected model given the initial stock count, the initial fish weight, and the period of interest. Users are provided with an estimation of main KPIs including Average Weight, Life To Date (LTD) Growth, LTD SGR, LTD Biological and Economical FCR, and LTD Mortality. Moreover, graphs reporting Weight, FCR comparing with the global trend of FCR for benchmarking purposes, and Food Consumption graphs for the specific time period can be produced;

- A facility for producing financial forecasts and plans for investments based on a given aquafarming task by selecting a preconfigured production model and a series of economic and environmental parameters including feed price, fry price and selling price. The outcome of the analysis is two KPIs for the assessment of the investment, which are the Net Present Value (NPV) and the Internal Rate of Return (IRR). Also, a series of plots on calculated values of variables such as expenses, income, Earnings Before Interest Taxes Depreciation Amortization (EBITDA), Earnings Before Interest After Taxes (EBIAT), Cumulative profit/loss and yearly net profit margin are provided [9];

- *Geoanalytics*: a facility enabling users (e.g. investors, scientists) to efficiently identify strategic locations of interest that meet multifactor selection criteria. It includes project management facilities that let users create projects (i.e. identification tasks) with layer selection and sharing among existing groups or individual users, exploration of existing geospatial datasets and analytics techniques execution on geospatial data in order to guide decision making in aquafarm industry.

Figure 131 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VLab operational as well as human tasks.
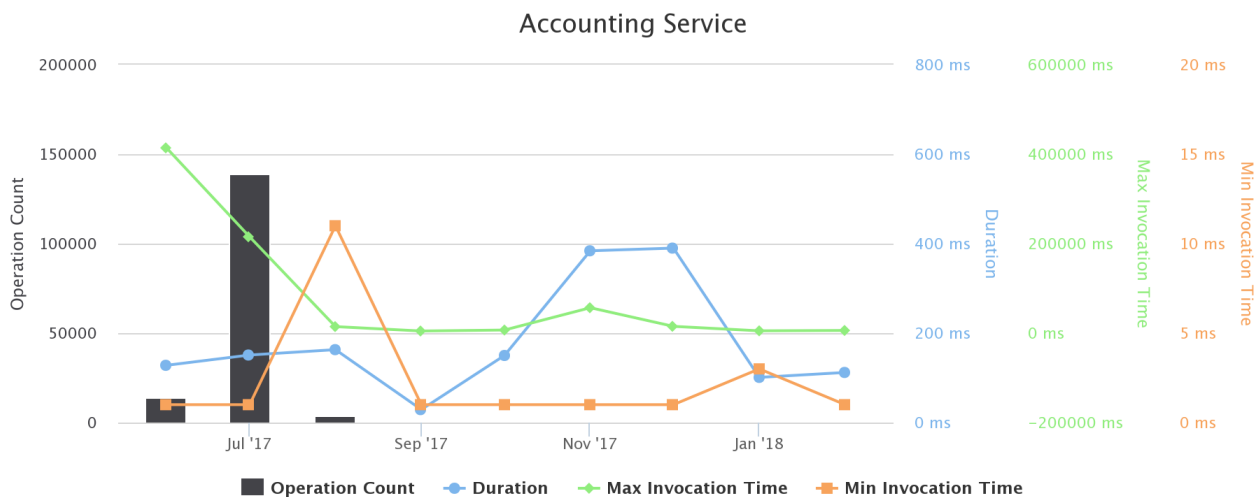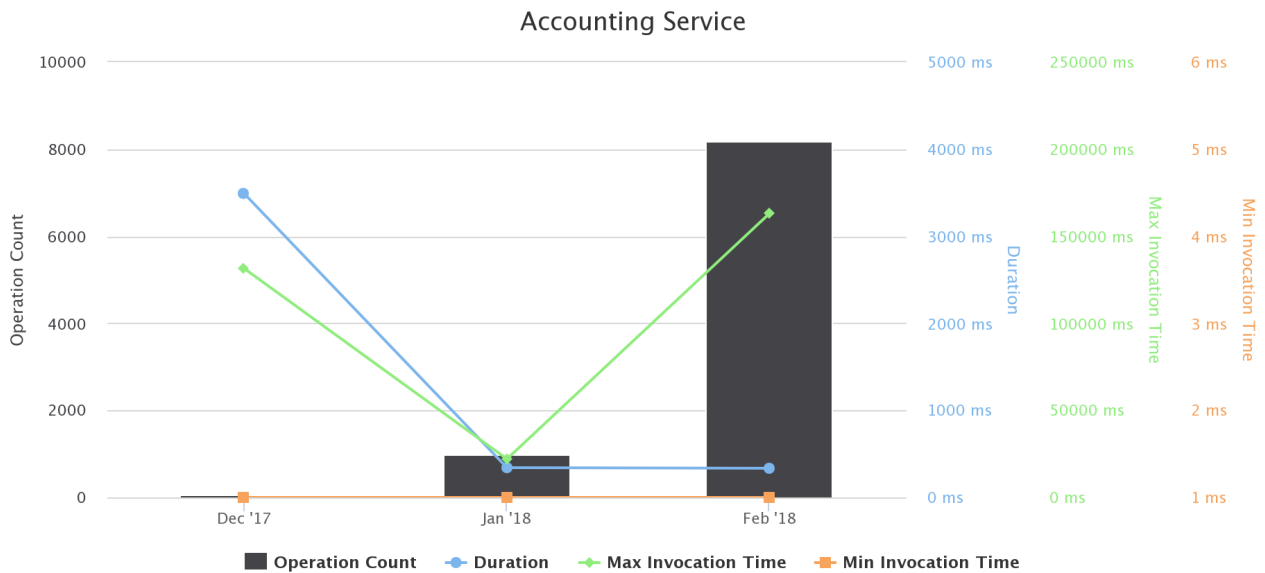
Figure 131. Sustainable Blue Economy VRE / VLab Operations per Month

3.63 TABULAR DATA LAB

The TabularDataLab VLab was conceived to provide its users with a working environment supporting the management of tabular data, i.e. any dataset that can be represented in a table format. In particular, the environment offers a suite to import, curate, analyse and publish tabular data resources in a collaborative way. Moreover, the environment offers a suite to import, curate, and publish code lists in a collaborative way.

The Tabular Data Lab VLab is available at https://bluebridge.d4science.org/web/tabulardatalab

This VLab is inherited by iMarine thus it has been in **operational** status since **September 2015,** from the perspective of BlueBRIDGE. It is currently serving **193 users**. A screenshot of the VLab is provided in Figure 132; it shows the home page and the menu items for accessing the VLab facilities.

Figure 132. Tabular Data Lab VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with

columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments, namely the enhancements on the basic facilities.

Figure 133 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
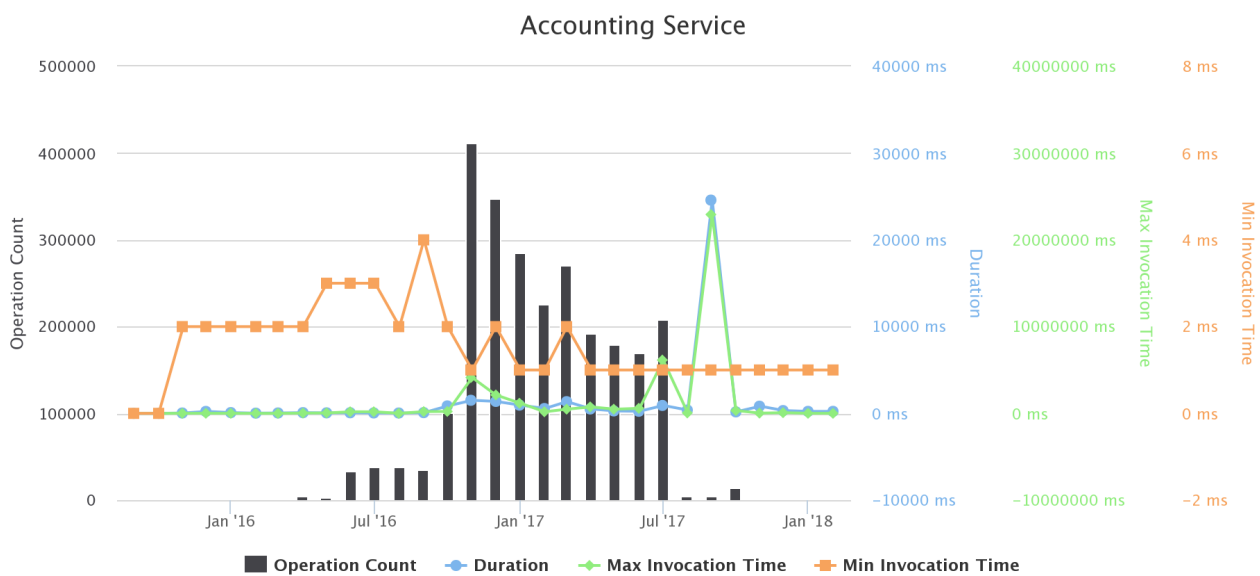
Figure 133. Tabula Data Lab VRE / VLab Operations per Month

3.64 TUNA ATLAS

The Tuna Atlas VRE is a tool to handle public domain data from various (Tuna) Regional Fisheries Management Organizations (T-RFMOs). Data include catches, fishing efforts and size frequencies of the species managed by the five tuna RFMOs: CCSBT- Commission for the Conservation of Southern Bluefin Tuna, IATTC- Inter-American Tropical Tuna Commission, ICCAT- International Commission for the Conservation of Atlantic Tunas, IOTC- Indian Ocean Tuna Commission, and WCPFC - Western and Central Pacific Fisheries Commission. Tuna Atlas provides services to discover the available datasets at regional and global levels, extract them in several formats widely used by the scientific community (e.g. CSV, NetCDF, SDMX) and visualize them in an interactive web-viewer of indicators and maps. It also includes tools for the users to generate their own Tuna atlas by applying own processing (e.g. applying specific choices for scientific corrections) on the tuna RFMOs data. Target Users include (a) scientists willing to discover available public domain data on tuna fisheries, understand and reproduce the workflow that has been applied to generate a dataset (eventually modifying it using their own expertise), download the data in the format that they are used to work with, store newly produced datasets and share them to the community; (b) Tuna Regional Fisheries Management Organizations willing to give more visibility to their data and more transparency to the processing steps driving to the datasets used as inputs for stocks assessments, and to provide tools to facilitate data extraction and visualization to anyone interested in tuna fisheries; and (c) non Governmental Organizations, policy makers, general public willing to visualize tuna fisheries data at regional or global scale though interactive web-viewers.

The Tuna Atlas VRE is available at https://bluebridge.d4science.org/web/fao_tunaatlas

This VLab is inherited by iMarine[14], and thus it is considered **operational** status since **September 2015** from the perspective of BlueBRIDGE. It is currently serving **49 users**. A screenshot of the VLab is provided in Figure 134; it shows the home page and the menu items for accessing the VLab facilities.
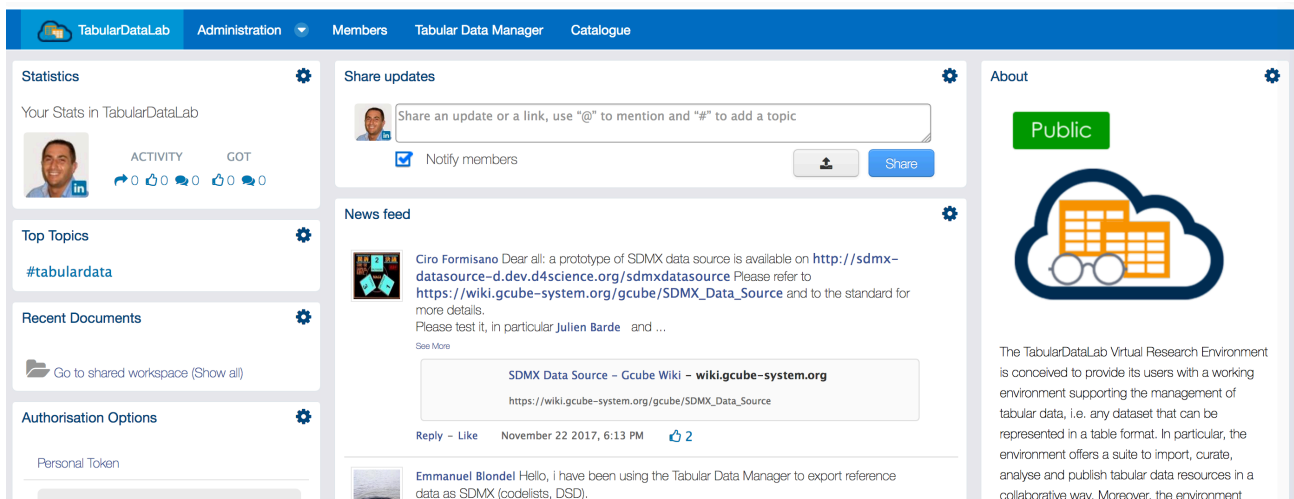

Figure 134. Tuna Atlas VRE / VLab Home Page Screenshot

In addition to the basic functionality, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VLab is specifically equipped with the following capabilities:

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and to interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to more than **10 diverse algorithms** including that for creating own regional or global tuna atlas, methods for performing specific geospatial transformations (e.g. transforming FAO Ocean Area CWP codes value in longitude, latitude and resolution), methods for accessing data from a relational database;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files within the workspace;

- *Tuna Atlas View:* a facility allowing to exploring Tuna fisheries data at regional and global scales;

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[14] It has been renamed from FAO Tuna Atlas to Tuna Atlas.

- *ShareLaTeX*: a facility enabling users to access a fully-fledged ShareLaTeX® working environment directly from the VRE.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. In particular, this VLab is benefitting from the new data analytics framework and its support for Open Science practices, the facility to support the integration of new algorithms / methods, the data catalogue, and the RStudio ® integration.

Figure 135 reports the total amount of operations performed in the context of this VRE. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
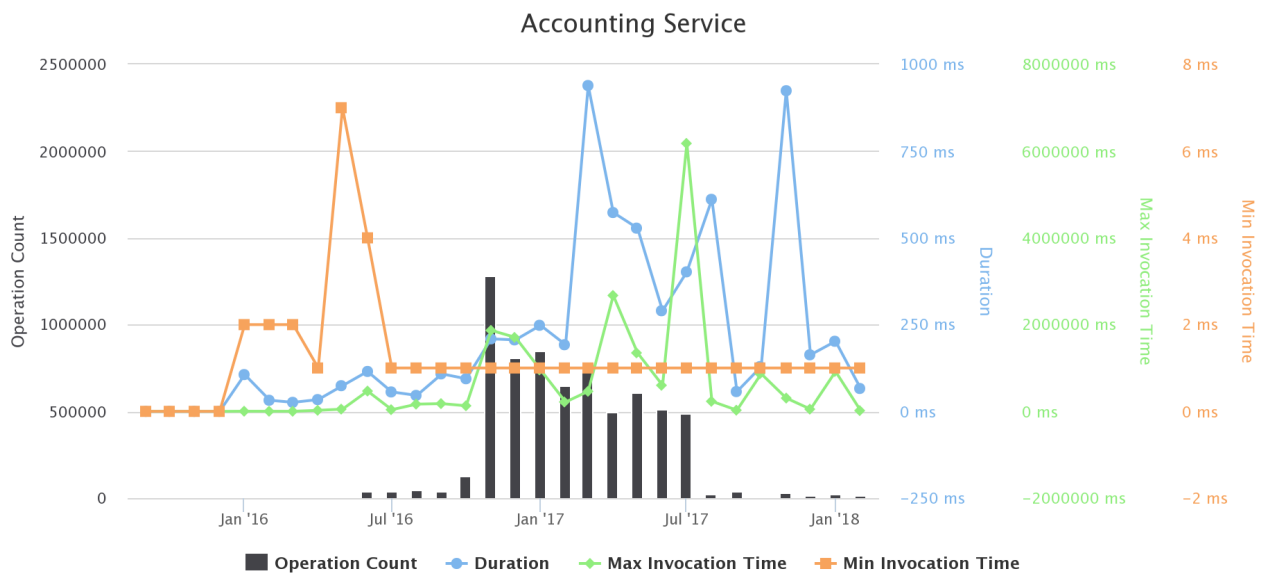

Figure 135. Tuna Atlas VRE / VLab Operations per Month

3.65 VULNERABLE MARINE ECOSYSTEM (VME) DB

Vulnerable Marine Ecosystems (VMEs) DB is a VRE created to support the development and storage of Fact Sheets on VMEs. The main functionalities is a template-based reporting environment exploited to populate the FAO VME DB[15].

The VME-DB VLab is available at https://i-marine.d4science.org/web/vme-db

This VLab is inherited by iMarine, and thus it has been in **operational** status since **September 2015,** from the perspective of BlueBRIDGE. It is currently serving **18 users**. A screenshot of the VLab is provided in Figure 136; it shows the home page and the menu items for accessing the VLab facilities.
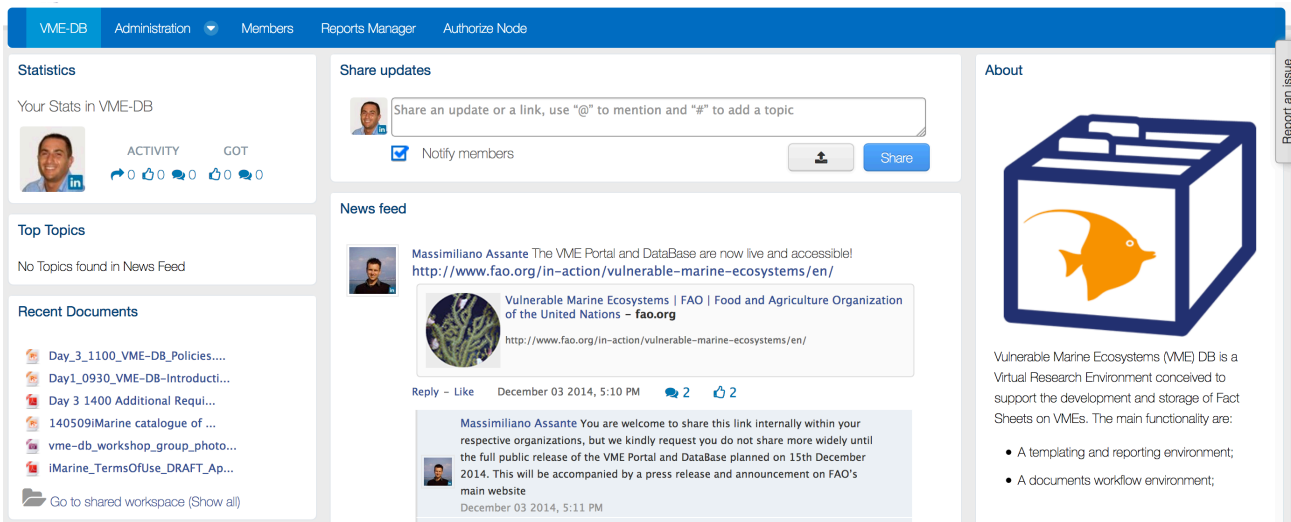
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[15] http://www.fao.org/in-action/vulnerable-marine-ecosystems/vme-database/en/

Figure 136. VME-DB VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- *Report Management facilities*: to enable users to collaboratively produce reports consisting in complex "documents" characterised by well-defined structures (templates). This facility is similar to a Content Management System supporting the population and management of the content of the FAO VME DB, a global inventory of fisheries measures to protect vulnerable marine ecosystems in areas beyond national jurisdiction.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. No major change worth reporting.

Figure 137 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.

Figure 137. VME-DB VRE / VLab Operations per Month

3.66 WECAFC-FIRMS

WECAFC-FIRMS is a VLab created to support the development of the "WECAFC project 2015-2016 – Strengthening national data collection and regional data sharing through Fisheries and Resources Monitoring Systems (FIRMS) to support priority regional fishery management plans in the Western Central

Atlantic Fishery Commission (WECAFC) area". The VLab is mainly conceived to provide the members of the project with an environment for collecting and curating the data of interest.

The WECAFC-FIRM VLab is available at https://bluebridge.d4science.org/web/wecafc-firms

This VLab is inherited by iMarine, and thus it has been in **operational** status since **September 2015,** from the perspective of BlueBRIDGE. It is currently serving **24 users**. A screenshot of the VLab is provided in Figure 138; it shows the home page users and the menu items for accessing the VLab facilities.

Figure 138. WECAFC-FIRMS VRE / VLab Home Page Screenshot

In addition to the basic functionalities, as a workspace for sharing objects of interest, a social networking area for supporting the discussions among members and a user management facility for managing membership, this VRE is specifically equipped with the following capabilities:

- WECAFC Fisheries Viewer: a facility allowing to explore fisheries data of the Caribbean region;

- *Tabular Data management*: a facility enabling users to import, curate and manage tabular data. This feature can support data managers during the whole life cycle of data management from data capture to publication and visualisation. It enables data managers to import and transform datasets (CSV, SDMX, JSON) into tabular resources (i.e. tabular data having proper types associated with columns eventually referring to code lists) and reference datasets (code lists) representing recognized value instances of the elements the dataset is about (e.g., species, zones, countries). This functionality guarantees that the tabular resources are compliant with the defined types and code lists. Besides the curation, the facility supports the analysis of the data by enabling a user to (i) perform operations like grouping and filtering, (ii) producing charts and GIS maps (if the data have geographic features), (iii) analysing the data via an R environment as well as via the data analytics facilities (see below). Finally, the environment supports the publishing of tabular resources in the infrastructure by equipping them with rich metadata so that such resources can be used in other application contexts;

- *Data Analytics at scale*: a facility enabling users to benefit from the offering of the DataMiner service and to interactively execute a large array of data analytics tasks on datasets. As of February '18 this environment has been configured to give access to **1 algorithm**, namely Bionym;

- *R Studio as-a-Service*: a facility enabling users to access a fully-fledged RStudio® working environment directly from the VRE. This environment is integrated with the rest of VRE / VLab facilities, e.g. it is possible to use files from the workspace and to store new files within the workspace.

The major changes occurred in this VRE with respect to the version developed and operated by iMarine derive from the exploitation of the latest services and facilities resulting from BlueBRIDGE developments. No major change worth reporting.

Figure 139 reports the total amount of operations performed in the context of this VLab. Operations include service tasks needed to maintain the VRE operational as well as human tasks.
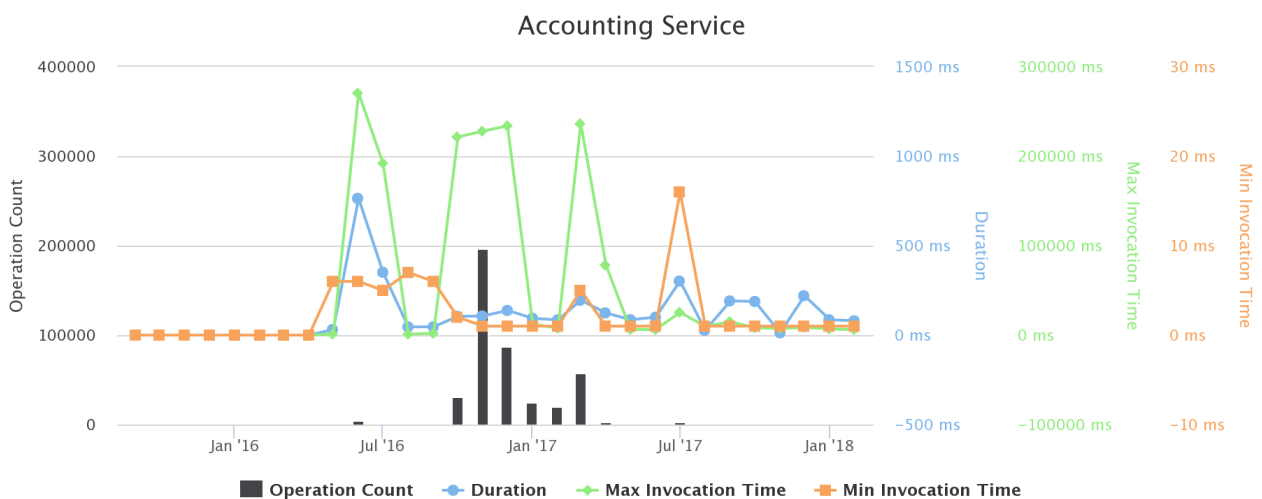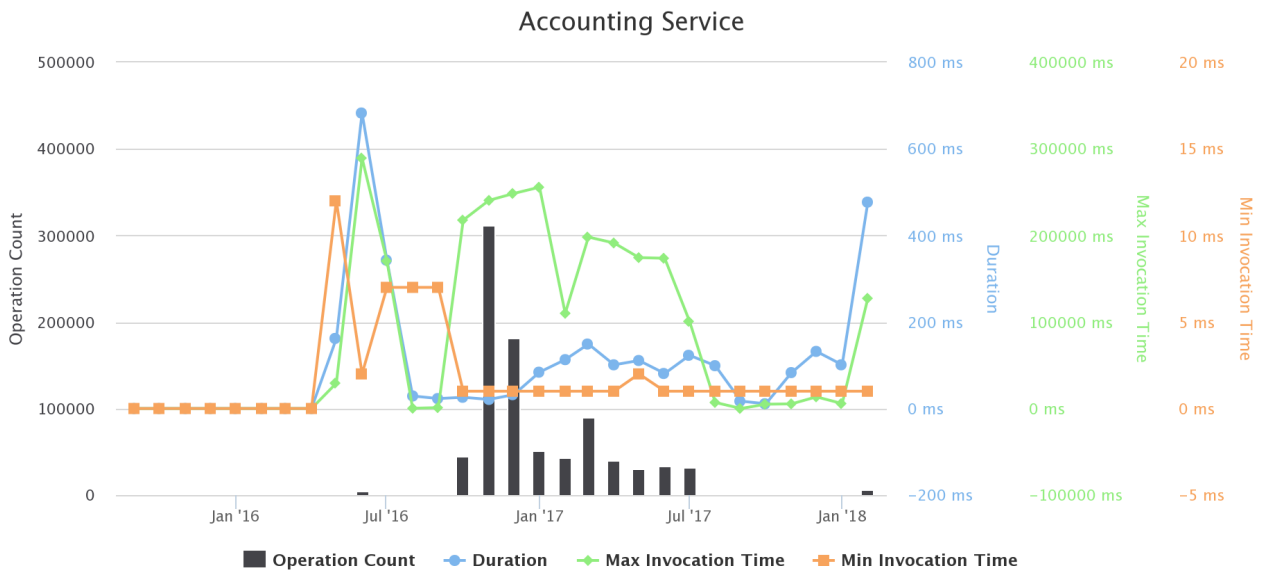

Figure 139. WECAFC-FIRMS VRE / VLab Operations per Month

4   CONCLUDING REMARKS

Virtual Research Environments and Virtual Laboratories are among the key products to be delivered by the BlueBRIDGE project to meet the needs of its target community and application scenarios. They are "systems" aiming at providing their users with web-based working environments that offer the entire spectrum of facilities (including services, data and computational facilities) needed to accomplish a given task by dynamically relying on the underlying infrastructure.

This deliverable has detailed the Virtual Research Environments and Virtual Laboratories deployed and operated during BlueBRIDGE (from September 2015 to February 2018). Overall, *66 VREs and VLabs* have been deployed and operated. These VREs / VLabs include "private" ones (66% circa), i.e. environments whose membership is by invitation only, "restricted" ones (15% circa), i.e. environments users can request to join yet the requests have to be explicitly approved by the managers, and "open" ones (18% circa), i.e. environments any user can request to join and no approval is needed.

These VREs / VLabs are serving *more than 3000 users* in total spread across *32 countries* and *124 different organizations*. The 45% circa of the served users is exploiting "open" environments, the 34% circa is exploiting "private" environments, and the 19% circa is exploiting "restricted" environments. The *top 10 countries* are: France (12.39%), Italy (11.23 %), Greece (9.79 %), UK (7.92%) Denmark (7.34%), Norway (5.33%), Germany (5,00%), Spain (4.84 %), Ireland (3.39%), Netherland (2.74 %). The *top 10 organisations* are: International Council for the Exploration of the Sea - ICES (4.12%), National Research Council of Italy - CNR (3.61%), The International Centre for Research on the Environment and the Economy - ICRE8 (3.48%), Institute of Marine Research - IMR (3.09%), Institut de recherche pour le développement - IRD (2.97%), Food and Agriculture Organization of the United Nations - FAO (2.96%), Centre for Environment, Fisheries and Aquaculture Science - CEFAS.gov.uk (2.19%), Marine Institute Foras na Mara - Marine.ie (2.06%), French Research Institute for Exploitation of the Sea - Ifremer (1.93%), Wageningen University - (WUR.NL) (1.90%).

The creation and operation of these environments required to manage more than *980 requests for support, incident or bug* (441 requests for support and 546 requests for incidents and bugs).

REFERENCES

[1]   Antzoulatos, G.; Katris, D. (2017) Blue Economy VRE Integrated Resources: Revised Version. BlueBRIDGE Deliverable D6.4

[2]   Assante, M.; Barde, J.; Coro, G.; Davies, A.; Mangiacrapa, F.; Petra, E. (2018) Blue Skills Activity: Final Report. Blue BRIDGE Deliverable D8.2

[3]   Assante M, Candela L, Castelli D, Coro G, Lelii L, Pagano P. (2016) Virtual research environments as-a-service by gCube. PeerJ Preprints 4:e2511v1 https://doi.org/10.7287/peerj.preprints.2511v1

[4]   Assante, M.; Candela, L.; Cirillo, R.; Dell'Amico, A.; Pagano, P.; Perciante, C. (2016) BlueBRIDGE VREs Operation Activity: Interim Report. BlueBRIDGE Deliverable D4.3

[5]   Barde, J.; Ellenbroek, A.; Formisano, C.; Large, S.; Marketakis, Y. (2016) Blue Assessment VRE Specification: Revised Version. BlueBRIDGE Deliverable D5.3

[6]   BlueBRIDGE Consortium. VREs Planning and Procedures Wiki page. https://support.d4science.org/projects/bluebridge/wiki/VREs_Deployment_and_Operation

[7]   Candela, L.; Castelli, D., Pagano, P. (2013) Virtual Research Environments: An Overview and a Research Agenda. Data Science Journal, Volume 12, July 2013, pp GRDI75-GRDI81 doi: 10.2481/dsj.GRDI-013

[8]   Di Girolamo, M.; Giammatteo, G. (2018) Software Release Activity: Final Report. BlueBRIDGE Deliverable D4.4

[9]   Dimitrakopoulos, C.; Antzoulatos, G.; Kakaletris, G. (2016) Blue Economy VRE Specification: Revised version. BlueBRIDGE Deliverable D6.3

[10]   Formisano, C.; Ellenbroek, A.; Longépé, N.; Macmillan-Lawler, M.; Westerweld, L.; Lebras, J.-Y. (2017) Blue Environment VRE Specification: Revised Version. BlueBRIDGE Deliverable D7.3

[11]   Froese, R., Demirel, N., Coro, G., Kleisner, K. M., Winker, H. (2016). Estimating fisheries reference points from catch and resilience. Fish and Fisheries, 18(3). 10.1111/faf.12190

[12]   Large, S.; Ellenbroek, A. (2017) Blue Assessment VRE Integrated Resources: Revised Version. BlueBRIDGE Deliverable D5.4

[13]   Macmillan-Lawler, M.; Ellenbroek, A.; Longépé, N.; Westerveld, L.; Lebras, J.-Y.; Blondel, E.; Fabriani, P. (2017) Blue Environment VRE Integrated Resources: Revised Version. BlueBRIDGE Deliverable D7.4