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Specification of the virtual playground functionality

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1 Introduction

1.1 Overview

As a general trend, scientific research moved from narrow domain specific problems to systemic issues, where, by systems we mean complex sets of interacting and cross dependent mechanisms resulting in complex phenomena. At the same time, technologies available in scientific research made a huge leap forward triggering high specialization so that no scientist, can no longer, cover all needed topics and activities.

Full encyclopaedic knowledge coverage by a single person is no longer possible. Collaborative research is invoked to overcome such limitations. Researchers get together, bringing their contributions to understand and solve complex issues and problems that they would not be able to address alone.

Scientific collaborative research is a wide area that spans several thematic fields and that, due to the introduction of Information Technologies (IT) and the Internet, is changing radically towards e-research: a perspective where the life of researchers is augmented by on-line interactions, high computing power, communities and knowledge.

The exciting opportunities that this moment offers embed also the risk that, in case the change would be driven by technology only, the real needs of scientific research could be overlooked, so that it is necessary to analyse the way researchers collaborate. The traditional view states that scientific research in all disciplines should be built upon the common perspective of a common and standard scientific method. This has been questioned by several authors that instead call for flexibility in the possibility to create workflows and practices. Scientific disciplines can have rather different approaches and peculiarities that make them diverge from a common perspective, so that when cross-disciplinary studies are forecast the interaction between researcher on a prescriptive platform could be perceived as problematic.

This is particularly true in the case where a discipline studies complex systems, where experiments are reproducible only with difficulties and natural processes involve complex interactions over a range of spatial and temporal scales that are difficult to break down into elementary processes. This is common in many fields, such as the geosciences and oceanography but also many more where there could be problems in performing measurements that could settle debates or concurrent but different visions. Coupling distant points of view and disciplinary backgrounds together with the difficulties in referring to solid facts creates a complicated situation that needs to be carefully considered in the perspective of collaborative research.

1.2 Context

A strong link exists between collaborative research and large scientific facilities such as, for example: Eurofleets+ itself or large collaborative data sharing initiatives such as SeaDataNet or EMODnet or, in other fields, satellites, particle colliders, telescopes and the like.

Collaborative research brings in the picture big promises but also challenges. High specialization of researchers can result, during teamwork, in a possible lack of understanding and difficulties in handling data in a consistent way.

This is only seldom addressed. In fact, current trends in collaborative science support mostly focus on the technical issues related to the consolidation of data in a facility, where it can be processed using top computing resources and from where data can be retrieved remotely, many times and by multiple researchers. With some specific extensions this is the perspective common to most of the Virtual Research Environments (VRE).

In the context of the Eurofleets+ project we propose to extend the notion of VRE towards a virtual playground (VP) aiming to pave the road to a new vision of collaborative science that will facilitate to

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bridge the gaps between different scientific domains and ways of thinking while at the same time preserving peculiarities and backgrounds. Since collaboration targets a common goal, a common cognitive space (the VP) must be created, maintained and referred to by all partners.
A classic distinction is made between Data, Information and Knowledge. Data is the set of observations available; information adds meaning to data while knowledge considers information in its context. In collaboration, sharing should reach all levels.
A pragmatic vision that considers all limitations in scientific reasoning, would be based on the fact that the explanation of a phenomenon would be grounded in sets of claims or judgments which truth values are not determined privately. Here knowledge would be based on a form of intentional portray of things, such as, for example, beliefs, perceptions, sentences and pictures, that can be defined representation. Representations can be theories and models, linguistic and mathematical entities, computer simulations, concrete objects and so on and so forth. Representation can be based on natural language, software, algorithms, or graphs such as diagrams or maps.

2 General Description

2.1 Product / System Functions

In the perspective drawn above, the Eurofleets+ Virtual Playground that will be made available within the JRA 3 task T3.1.4 aims to create a space of data, information and knowledge in which collaborative research can take place in the easiest way.
Knowledge is associated with the acquisition and processing of information to retain meaning that under certain conditions (the context) can be used, expressed and transmitted.
Knowledge can be systematized using multiple means, and language is only one of them. The "deliteralization" of Knowledge opens the door to inclusion of multiple forms of human expression that can be gathered around the concept of Culture. Here Science and Technology are only a part of a whole picture that is composed also of values (ideologies), social structures and conventions.
In collaborative science, researchers need to confront their knowledge with other people. In this perspective the VP is a method to pack, transmit, decode and use knowledge.
In this it is necessary first to describe what researchers retain in their minds. Two paths can be followed in this:

1. Knowledge formalization, which is based on the identification and definition of the concepts that constitute that particular abstraction, point of view, or vision of the world and of the relations that link those concepts;
2. Non formalized knowledge, which is based on the introduction of artifacts that "resonate" knowledge into someone else's mind.

In the first case, concepts and relations must be defined as comprehensively as possible, in the second case, the evocative power of the artifact does not require concepts and link to be explicitly defined.

Now, the main problem with knowledge formalization emerges right here.
To be able to formalize an abstraction we need to be able to identify and properly describe all the pieces of the puzzle. This is only seldom possible, because a portion of what we know cannot be made explicit as it is obscured in socio-political phenomena or embedded in practices or even tools. This is called tacit knowledge. Following Polanyi (1966) "we know more than we can tell" and therefore we know more than we can formalize, which means of course that the whole process of formalization can be then considered problematic.
Therefore, a mix between those two approaches with the possibility to retrieve information and data is needed. This can be identified by an artifact that following the studies by Star and Griesemer in the

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nineties can be based on an artifact called boundary object that allows to integrate at the same time different backgrounds and cultures while guiding the actual collaborative work.
These types of entities can take place as a graphic map where nodes are essentially labels of concepts/entities. At the same time, these nodes can be considered repositories for data and information. In this perspective the system with its map and data, information and knowledge that populate each node becomes the current status of knowledge of the designated community.

COLLA is a Web based tool to support and foster collaborative activities among members of a working group. Colla is a dynamic web framework developed by OGS. Any content is produced on the fly after user interaction and is stored in a database. The basic idea behind COLLA is to concentrate server side all information that needs to be available to all members of a working group.

This moves the focus from the common e-mail based collaboration practice to a server side paradigm where users are encouraged to directly use the facilities offered by the system. This bypasses all e-mail limitations: the file size limit, the lack of a shared repository, inconsistent file naming, the lack of a shared search tool and many others. Using the COLLA framework, a knowledge space can be built on top of an ontology that can guide researcher's activities. The ontology can be built using software such as '*Protégé'*.

2.2 User Characteristics and Objectives

Users of the VP will be initially researchers that work within the EF+ project. Later it is envisaged that the framework could be extended outside. Users can be of any background, as the VP itself will not be bound with specific practice or scientific discipline. However, prototypes focused in particular on geophysics will be tested.
Users will be introduced to the VP from the EVIOR portal. From within the VP, users will also be enabled to access SeaDataCloud VRE as an additional service.

The activity will have synergy with the Virtual Research Environment (VRE) developments that are taking place in SeaDataCloud, ODIP, LifeWatch and a few EMODnet lots and as planned for EOSC and the Blue Cloud Initiative. The Task will also tune with TASK 3.1.4 concerning near-real-time e-access to collected data sets for annotations, quality control, rescheduling of observations, and zooming in on specific locations for a closer look and more observations. This experience will incentivise researchers to see the benefits of the Open Data and Open Science strategy, thus contributing to acceptance and possible wider adoption.

The VP will offer the possibility to create projects where PIs will be enabled to load an ontology as a concept map that will act as the boundary object of the collaborative work. The VP will offer prototype tools to work together interacting with the data (viewing, analysing, annotating) and communicating and discussing (messaging, forums, posting) with other members of teams and communities.
To create the ontology some knowledge of software such as Protégé is expected.

2.3 Operational Scenarios

The expected scenarios will correspond to collaborative research where scientists will discuss their evidences and refer to available data, structuring knowledge upon a common boundary object that is the map/ontology of the domain of interest.
Users, will enter their project and will be presented with a graphic representation of the ontology (map) describing the topic they are working on. Each node of the map corresponding to a concept will act also as a container of data and files, but also will offer a messaging facility from which users will be able to reach the other researchers.

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Users will be enabled to navigate the knowledge space and find well organized data, information and knowledge.

2.4 Constraints

The system will be developed with opensource software only and will be an extension of the already existing framework COLLA developed by OGS. Collaborative functionalities are not expecting to require high computational needs so that initially the system will be installed on a single central point that could reside on a simple server. More complex configurations can be imagined in the future.

3 Functional Requirements

Messaging

- **Description –** Messaging in the perspective of the VP, will embody the unformalized part of knowledge, in order that researchers will be enable to exchange points of view. If that could be possible also simply using e-mail within the VP this will take place within the map built on the ontology, gathering therefore communication upon the topics and the relations between topics, as formalized in the ontology
- **Criticality –** Messaging is essential in order to exchange what cannot be referred through data, processing or other. Users will need to be notified of any message posted in the system, with a proper way to reference them within the structure of the ontology. All messages will need to be graphically linked each other in order to understand what replies to what and what is the tail of the discussion.
- **Technical issues –** notification will need to provide ways to be sent backward in the VP from where the message was sent without the need to login. Possibily to email back through a reply to the system
- **Dependencies with other requirements –** messages will should allow embedding of URL, links to the VRE, external data or files.

Data

- **Description –** Data is the base layer of the system, where the actual observations resides. Data can be internal or external, the latter accessible through URLs or linking to VRE processing flow (external). A specific focus will be put on geophysical data, preferably as collected during EF+ cruises. Data viewers will be offered as for other datatypes links to external viewers will also be used. Data residing within the VP will be located within the corresponding node of the ontology map
- **Criticality –** data is critical because it's the layer on top of which the actual collaboration and discussion will take place.
- **Technical issues –** Possible issues may rise considering that external data and viewer could ask for a different account management.
- **Dependencies with other requirements –** external data and processing links will need to consistent and permanent

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Data processing

- **Description –** Data processing for physical and chemical oceanographic data will be done in the SeaDataNet VRE (webODV, Diva). Il should be possible to enter links to processing flows and data on VRE from all the features of the VP. Specific focus will be devoted for geophysics data, making use of the SNAP framework as developed and managed by OGS.
- **Criticality –** data is critical because it's the layer on top of which the actual collaboration and discussion will take place.
- **Technical issues –** Possible issues may rise considering that external data and viewer could ask for a different account management.

Annotation

- **Description –** Annotation of data will be possible on raster images uploaded in the VP and in the focus case of geophysics where direct data access will be possible through the SNAP framework. Annotations will be accessible from any user of the project and all functionalities of the VP
- **Criticality –** Annotation is critical because it allows representation and pinpointing features on data
- **Technical issues –** Possible issues may rise considering that external data and viewer could ask for a different account management.

4 System Architecture

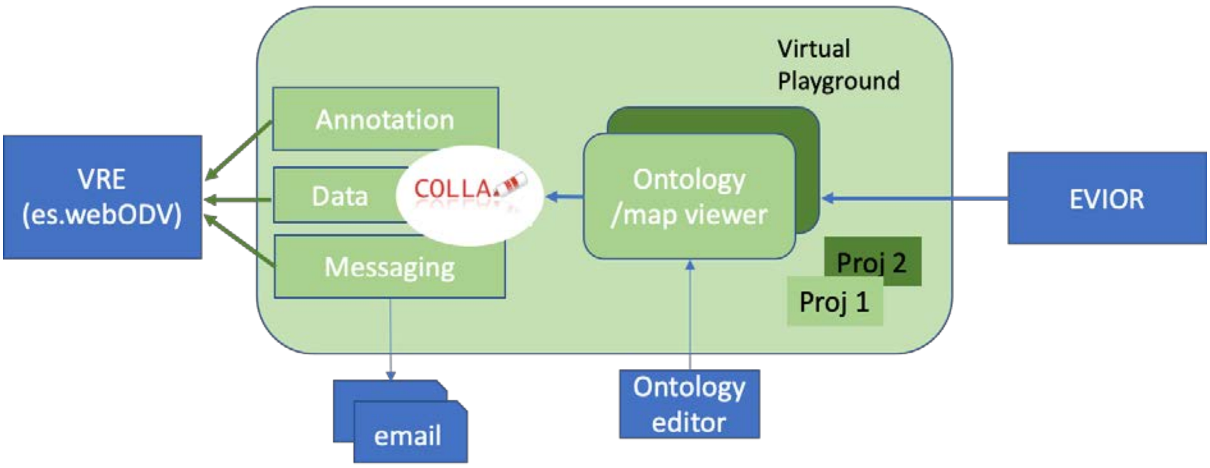

Figure 1 A schema of the Virtual Playground and its connections with external resources such as the EVIOR and VRE

5 Preliminary Schedule

Step 1: specification of the virtual playground needs (M18 – M26)
Step 2: design of architecture and modules (M27 – M32)
Step 3: trials of possible tools and connection with the EVIOR portal (M33 – M42)

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