



## Management and Progress Report At PM 30

**30/03/2014**

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<sup>1</sup> Alphabetical order

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## **Declaration by the scientific representative of the project coordinator**

**Grant Agreement number:** 283543

**Project acronym:** VERCE

**Project title:** Virtual Earthquake and seismology Research Community e-science environment in Europe

**Funding Scheme:** Combination of CP & CSA

**Date of latest version of Annex I against which the assessment will be made:** 16/08/2011

**Intermediate Periodic report:** 1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> X 4<sup>th</sup>

**Period covered:** from 30 September 2013 to 30 March 2014

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<sup>2</sup> Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement.

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate) <sup>3</sup>:
  - has fully achieved its objectives and technical goals for the period;
  - X has achieved most of its objectives and technical goals for the period with relatively minor deviations.
  - has failed to achieve critical objectives and/or is not at all on schedule.
- The public website, if applicable
  - X is up to date
  - is not up to date
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: **Jean-Pierre Vilotte**

Date: 30/03/2014



For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism.

<sup>3</sup> If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.

## Publishable summary

### Context and objectives

Seismology addresses both fundamental problems in understanding Earth's internal wave sources and structures and augmented societal applications; and put a great premium on open-access data archives integrated globally. Today our ability to acquire data outpaces our ability to explore and analyse them – new discoveries will emerge from statistical analysis and modeling of the wealth of data generated by observation and monitoring systems.

The VERCE strategy is driven by the needs of the earthquake and seismology research community and aims to deliver an e-science environment for data-intensive research that enables and productises a core of pilot advanced data analysis and modelling applications of the seismology research community. Augmented objective is to deliver 'intellectual ramps' providing safe and supported means for seismology researchers to engage incrementally with the methods and the tools of innovative data-intensive research.

The VERCE e-science environment is built on a service-oriented architecture. At the upper level, a user development platform supporting seismologists and data-intensive experts through an extensive and evolving set of portals, workflow tools and development environments in line with the diversity of the seismology research practice and applications. At the lower level, an *enactment platform*, supported by data and computing engineers and delegating the execution of the workflows to a community of resource providers - i.e. the European public Grid, HPC and Cloud infrastructures; and private seismology resources. At the neck of this hourglass architecture, a tightly defined and stable *gateway interface* through which the two diverse and dynamic layers communicate, and allowing the communities to invest and secure in the knowledge that changes in this interface.

Following the second review meeting of the VERCE project, held on 25 April 2013, a number of recommendations were made for implementation. These recommendations were analysed, and the VERCE strategy and roadmap for their implementation have guided the work done during this period.

### Work carried in the last six months

#### *Pilot applications and use cases*

Taking into account the last review recommendations, the priority has been given to the integration of the HPC wave simulation and use case within the VERCE Scientific Gateway in order to be provided as a service through user-friendly services and GUI portal interfaces for evaluation.

The main achievements during this period are:

- The enabled HPC wave-simulation application and use case has been further defined and evaluated, through continuous iterations with WP7, WP8 and WP5, for integration within the Scientific Gateway. The wave-simulation software SPECFEM3D was selected for the first demonstrable implementation since it is widely used both in the seismological and the seismic engineering community.
- A number of user-oriented interfaces in phase with the research practice were specified and evaluated, including interactive geological and geological WMS layers and interactive services for workflow composition and parameterization. The VERCE portal provides access to the full features of SPECFEM3D, including the possibility to simulate a selected number of point and finite-size earthquake sources to predict waveforms for a specific model at specified seismic receivers in terms of displacement, velocity and acceleration. Wave propagation movies, snapshots; shake maps, and sensitivity kernels can also be generated and visualized.
- A significant effort was devoted to provide a first library of tomographic models and associated unstructured hexahedral meshes, spanning different resolution scales, together with information such as the coordinate system and the geographical limits. The library is expandable and users can use their own model and mesh or submit them to be included and shared through the portal interface after a validation procedure where WP2 is acting as VERCE-application manager. New submitted meshes and models are under evaluation. First feedbacks at various meetings were quite positive, and other domains of application expressed their interest, like for induced seismicity monitoring related to the exploration and exploitation of new energy resources induced seismicity applications for new energy resources.

- Simplified and user-friendly identity management (AAI) tools have been designed through iterations between WP2, WP7 and WP5, lowering the barrier of uptake. In collaboration with WP7 and WP3, tutorial videos and demos of the portal tools have been defined and made available through the portal to new users.

The work in progress for the next six months was defined including:

- Improving automation of the mesh and model evaluation to accelerate the time response of a user submission to the mesh-and-model library;
- Adding new functionality based upon the feedback of a selected number of users and tailored by a number of research practice.
- Integration of the data-intensive analysis use case, making use and extending the Scientific Gateway tools and services in particular toward data management and replication across distributed data stores within the VERCE iRODS federated platform.
- Evaluation, in collaboration with WP9 and WP8, of the scalability and the performance of the improved implementation of the seismic noise correlation application using Dipel4Py that includes STORE and MPI mappings.

### *Training and user documentation*

Taking into account the last review recommendations, the priority was given to “intellectual ramps”, through training and education in phase with the VERCE’s Scientific Gateway development and the research practice, to engage the research community in seismology and seismic engineering with the VERCE e-science environment and the data-intensive analysis and modelling methods and tools provided as a service this environment. Beside a slight shift in time related the comprehensive and intensive evaluation and validation, in collaboration with WP7, WP2 and WP8, of the Scientific Gateway tools and services, and of the integrated HPC wave simulation and use case developments, a significant effort was made to leverage the knowledge, the ontology and the community of practice within the VERCE project.

The main achievements during this period are:

- The knowledge base has been revised and updated in order to describe a number of concept and acronym employed in the VERCE project and that may be foreign to many seismologists and ITs. The collected knowledge base is accessible through the project website.
- New tutorials and videos have been designed from presentations of the VERCE Scientific Gateway tools and services, in collaboration with WP2 and WP7, and made available through the VERCE website and Scientific Gateway portal.
- A comprehensive and incremental training plane has been designed and planed in phase with the VERCE e-science environment development. This includes two on-line training sessions of one day devoted to the VERCE Scientific Gateway and the HPC wave-simulation use case, July 2014, and the data-intensive seismic noise correlation use case, October 2014. The on-line sessions are open to a limited number of internal and external users - up to 10 – and are advertised through the VERCE website with on-line registration. This also includes 3-days training workshops on the VERCE e-science environment and data-intensive methods and tools, to be held February 2015, probably in Munich and in synergy with the Munich Winter School that attract a wide seismology community and the ObsPy community, and July 2015, in Liverpool. These workshops are open to internal and external participants, up to 25, from the seismology and seismic engineering community, and the e-infrastructures projects and providers.
- The training activity is advertised and in synergy with a number of European projects – i.e., EPOS (ESFRI PROJECT), WHISPER and WAVETOMO (ERC projects) – and European e-infrastructures – i.e. PRACE, EGI, and EUDAT. It is also directed toward the research community that was built by the former Quest (ITN project).
- A list of selected external training and conference events is continuously updated and made available to the whole project through the project website and the Redmine platform.

The work in progress for the next six months was defined including:

- The immediate objective is the organization of the one-day on-line training session devoted to the Scientific Gateway and the HPC wave-simulation use case, mid July 2014. Advertisement and on-line registration is now available on the project website. Registration will close end of June 2014. Incentive contacts with a selected number of external researchers, Post-Docs and PhDs are in progress and the target of 10 participants seems today quite feasible. The training material is being finalized in collaboration with WP7, WP2, WP8 and WP9 and will be made available through the project website and the Scientific Gateway portal.
- An on-line feedback session, with formal evaluation form, is being prepared and scheduled for September 2014. This feedback will be analysed in coordination with WP7, WP2, WP8 and WP9 and will served as a basis for improving and adding functionalities to the Scientific Gateway and to the HPC wave-simulation use case. This will also be used for a number of VERCE presentations at the AGU Fall meeting in December 2014, at San Francisco.
- New training material and documentation material is being prepared for the next October 2014 on-line training activity devoted to the Scientific Gateway and the integrated Dispel4Py environment, the Data-intensive seismic noise correlation use case, with a special focus on distributed data and metadata management. Incentive contacts are already being taken and synergy with the new NERC funded project TerraCorrelation is being investigated.
- The on-line feedback session is scheduled for early December 2014, and efforts are made to be able to use those results for the VERCE presentations at the AGU Fall meeting, mid December 2014.

#### *Dissemination and Public Outreach*

Identified targeted audience includes: the VERCE partners and the solid Earth science community at large; the IT community through the European e-Infrastructures providers and related projects; the Industry actors, e.g. in hydrocarbon and resource exploration geophysics; and the general public and national agencies. Existing communication and outreach channels provided by VERCE partners were efficiently used, i.e. in particular those provided by ORFEUS and EMSC - the two seismology NPOs – that reach a broad international audience.

The main achievements during this period are:

- Communication tools and channels - to promote and explain VERCE – has been reviewed and improved. The VERCE website has been improved in coordination with WP1 and its contents regularly updated - and its security improved. The website traffic was continuously monitored with for this period about 39 000 page views and visitors from 55 countries.
- Two newsletters during this period were published and disseminated. The last one – spring 2014 – was devoted on the VERCE HPC use case and demonstrator, and largely distributed during the EGU (European Geoscience Union) general assembly (27 April – 2 May, 2014).
- The dissemination and outreach strategy of VERCE make also use of a number of social media channels to target toward: the general public (Facebook, Twitter, Google+); and the professional and scientific community (Linkedin). Seventeen messages were posted through these channels during this period, and a continuous monitoring was performed indicating a significant increase of VERCE awareness and of the number of contacts and followers during this period: Facebook: +177% fans; Twitter, +146% followers; Google+, +201% subscribers; Linkedin, +161% contacts.
- The Science Gateway tools were externally promoted through three tutorial videos produced in March 2014: waveform simulation set-up and control; metadata, provenance and results visualization; access to VERCE data storage via the iRODS front end.

The work in progress for the next six months was defined including:

- Regular improvements of the VERCE website and of its material contents in coordination with the VERCE partners
- Prepare outreach and dissemination material for the next AGU Fall meeting, December 2014, where VERCE will be present at the CNRS-INSU booth.

- Define and prepare outreach and dissemination material with WP3, in phase with the training plane to advertise the training sessions both in the social media channels and the project website. This material will also make use of the feedback provided after those sessions enrolling external users.

#### *Management and operation of the research platform*

The VERCE platform is deployed and operated on top of a set of distributed and heterogeneous public and private data and computing resources provided by the European Grid, Cloud and HPC e-Infrastructures, and by the VERCE partners. During this period, significant efforts were provided to enable the Scientific Gateway on the VERCE platform and resources and the HPC wave-simulation use case. The integration of the INGV's departmental cluster can be regarded as a proxy for integration of new sites that are not participating to European e-Infrastructures such as PRACE or EGI.

The main achievements during this period are:

- Improved and well-structured procedure for integrating new site within the VERCE platform together with an updated set of documentation and best practices toward site administrators and resource providers;
- Integration of the production portal of the VERCE Scientific Gateway and support channels within the VERCE.eu Virtual Organization. Two instances of the Scientific Gateway has been set-up: a development-and-test instance for project-internal use; a production instance for end-users. To simplify the integration of the VERCE Scientific Gateway and UNICORE, the most recent release was deployed and tested within the CINECA HPC development environment.
- Management and operation of the VERCE distributed data platform is based upon iRODS and a GridFTP storage interface in synergy with EUDAT and CINECA together with a testing environment based upon OpenNebula virtual machines for the development of iRODS micro services including workflow metadata. The VERCE federated iRODS platform includes storage resources at CINECA, INGV, SCAI, UEDIN, IPGP, ISTerre.
- Continuous improvement and refinement of the Inca monitoring system now includes monitoring of the HPC resources made available to VERCE.
- Improvement of the end-user support makes use of a new public web-based OTRS ticketing service including membership requests. Users that want to use the VERCE Science Gateway should possess a valid e-Science certificate issued by national authority of the EUGridPMA and can now easily register through the VO web interface.
- Taking into account the last review recommendations, Cloud middleware and resources, are under evaluation, for possible integration to the VERCE platform, through a proof-of-concept application for seismological pre- and post-processing using the ObsPy Python Framework for Seismology, FDSN compliant web service standards, and for now the OpenNebula middleware. Preparation of other use-cases for Cloud evaluation was evaluated, together with a GUI front-end providing query tools to find relevant seismological data.

The work in progress for the next six months was defined including:

- Integration of additional iRODS storage nodes, with catalogue process running on the data staging front-end server.
- Implementation of user-driven replication policies for data that may be reused, preserved or published.
- Implementation of backup/restore mechanisms for production VMs, including the gateway services, user documents store, provenance DB, etc.
- Continuous enhancement of the Inca monitoring
- Integration of new computational resources
- Collection of statistics and creation of reports based on tickets to support SA2 in calculating Key Performance Indicators and Quality of Service.
- Special efforts will be devoted to the integration of the data-intensive seismic noise correlation within the Scientific Gateway through the support of extended data management services.

### *Integration and evaluation of the platform services*

A Plan-Do-Check-Act (PDCA) cycle has been selected to manage the platform software components release process. Each cycle is estimated to be one year with two overlapping cycles to facilitate a six-monthly release of the platform. A release schedule and recommended work practices is documented and regularly updated. During this period, priority was given to the production version of the HPC wave-simulation use case and to its integration within the Scientific Gateway. A minimal change in the production environment was therefore recommended.

The main achievements during this period are:

- The fourth PDCA cycle was completed February 30<sup>th</sup>, 2014 and released: only one component was evaluated and approved, i.e. ObsPy and Python update. The lessons learned in the previous releases resulted in a very smooth and efficient evaluation cycle with the support of WP8 and WP5.
- Key Performance Indicators (KPIs): (1) a first set of KPIs have been refined in coordination with WP5 and include availability of services, quality of software components, security, and quality of supports; (2) this first set of indicators was augmented in order to support the opening of the VERCE platform to a selected number of external users in relation with the first beta-release version of the data-intensive HPC use case.
- The main focus of the WP2/SA2, as all the other work packages, in this period was to support the provision of a working version of the Scientific Gateway and of the integrated HPC wave-simulation use case, involving close collaboration with WP7/SA3 and WP1/SA1.

The work in progress for the next six months was defined including:

- The next six months roadmap and the schedule for the next release cycle, April 1, 2014 – September 30, 2014 have been defined.
- Requirements of tools and services to be evaluated will be collected through the Request Form.
- Define tests to perform – in particular functionalities that will be used – for new external tools and in-house development components.
- Significant efforts will be deployed for enabling the integration of the data-intensive seismic noise cross-correlation use case and its integration within the Scientific Gateway.

### *Scientific gateway and user interfaces*

During the last six months, the efforts have focused on the development of the production release of the VERCE Science Gateway together with the integration of the HPC wave-simulation use case in order to produce a demonstrable demo case. Collaboration with the SCI-BUS team, under the MOU between VERCE and SCI-BUS, was very fruitful and led through regular iterations to the integration and adaptation of SCI-BUS components.

The main achievements during this period are:

- The first production release of the VERCE Scientific Gateway, together with the integration of the HPC wave-simulation use case as a service, is on time.
- This release integrates the computational and data-management components of the VERCE platform together with access and security policies.
- Taking into account the last review recommendations: (1) integration of the SCI-BUS technology – WS-PGRADE/gUSE – has been pursued in close collaboration and iteration with the SCI-BUS team and proved to be useful in delegating tasks mainly related to workflow, jobs and security management.
- Priority has been given toward user-friendly services and tools for the integration of the HPC wave-simulation use case in close collaboration with WP2, WP8, WP5 and WP6. During this period work with internal beta-testers have provided valuable feedback leading to a number of improvements, better documentation available on the portal and the VERCE website, in particular with regard to Grid access and certificates.
- New functionalities were added: submission of new meshes and models; application configuration, workflow submission and control.

- The multi layered WS-PGRADE workflow - that has been implemented for the HPC wave-simulation use case – includes two main tasks: the actual computation and the staging out of the result data from DCIs to the VERCE data management system, together with the cleaning up of the computational resources. The latter allows the extraction and storage of fine-grained lineage data at runtime.
- The storage system for provenance data is based on a document store exposed via provenance web API that allows an integrated view on data and metadata stores through a Provenance Explorer providing interactive navigation user interfaces. The data store consists of a VERCE federation of iRODS instances that supports authorization and authentication, data replication and metadata services.
- The VERCE gateway provides to the end user a front end GUI, which enables direct access to the data stores within the nodes of the federation.
- The GUI includes integrated interactive maps based on WMS standards adopted by other related projects such as OneGeology and EFEHR.
- User management support three different profiles: Verce-user, Verce-developper, Verce-admin. Two other classes are being developed: Verce-support, linked to the VERCE ticketing system; Verce-application-manager, for validation and checking relative to specific scientific application of the gateway under the responsibility of WP2/NA2.
- A ticketing system has been put in place in collaboration with WP5/SA1. Support for authorization and authentication allow users to produce and upload their proxy certificates interactively.

The work in progress for the next six months was defined including:

- The upcoming period will be focused on improving the current services on the basis of the feedback that will be collected, in particular after the July 2014 WP3 training session. At the same time, the implementation and the integration of the data-intensive seismic noise correlation use case will be prioritized.
- Some of the new features that have already been identified are related to data replication, advanced provenance exploitation and to an improved user experience via a revised profiling strategy.
- Policies to enable users to control the persistence of their own product, making instance, location and time configurable options will be evaluated.
- A new use profile, allowing the exploration of the data and the resources available on the VERCE platform, will be defined and provided. This would allow a registered users that has not been entitled to use the computational resources to benefit of the data products generated within VERCE that fall under open-data policies.
- Synergy and collaboration with ER-flow will be reinforced through the MOU between VERCE and ER-flow that is being signed.

### *Harnessing intensive applications*

The initially selected pilot applications and scientific use cases - and their software implementation on the VERCE platform and architecture - have been analysed and evaluated against the seismology research practice and the last review recommendations in a close interaction between research seismologists, IT experts and computer scientists. Taking into account the last review recommendations, the HPC wave-simulation use case has been prioritized for a first version release to be integrated within the Science Gateway and evaluated by a selected number of external users.

The main achievements during this period are:

- The HPC wave-simulation use case was integrated within the Scientific Gateway and a demonstrable production version was achieved on time.
- In close collaboration and through iterations with WP7 and WP2 the designed and functionalities of the Scientific Gateway interfaces were refined in phase with the research practice and the needs of the end users.
- Priority was given the SPECFEM3D software, which is widely used in the seismology and the seismic engineering community.
- The application use case was defined with the feedback of researchers in and out VERCE.

- The roadmap and priority for the next six months have been defined emphasizing toward the extension of the HPC wave-simulation use case in phase with the different research practices and toward the integration of the data-intensive analysis use case for scalability and performance evaluation.
- In parallel, improvement and integration of the ObsPy tools was pursued in collaboration with the ObsPy developers including full support of QuakeML and StationXML standards and integration of new FDSN services; analysis of the data format challenges in relation with efficient and usable parallel I/Os led to the definition of more abstract data format based on existing technologies – StationXML, QuakeML and HDF5 – allowing significant reduction of the number of files to be manipulated and of the I/O bottleneck, together with the efficient management associated with the data provenance; a generic input file generator was developed supporting the different VERCE wave simulation solvers and their integration within Scientific Gateway workflow environment.

The work in progress for the next six months was defined including:

- Integration of other wave-simulation solver within the Scientific Gateway workflow environment, together with optimisation of the IOs components of the wave-simulation solvers.
- Integration of an end-to-end workflow to explore and analyse the synthetic waveforms produced by the wave-simulation application against selected observed waveforms in synergy with the data-intensive analysis use case.
- Integration in collaboration with WP7 and WP2 of the data-intensive analysis use case, making use and extending the Scientific Gateway tools and services in particular toward data management and replication across distributed data stores within the VERCE iRODS federated platform.
- Evaluation, in collaboration with WP9 and WP2, of the scalability and the performance of the improved implementation of the seismic noise correlation application using Dipel4Py that includes Store and MPI mappings.

#### *Architecture and platform tools for data analysis and modelling*

Efforts are devoted to the design of an appropriate architecture, and prototypes, enabling data-intensive research in seismology and in line with the research practice. Much of this concerns the development of DISPTEL, which Edinburgh contributed to VERCE, so that it will scale, perform well and be useable on heterogeneous distributed computing infrastructures (DCIs). Experience was also brought from the UK's NERC-funded EFFORT project, developing a science gateway for rock physics and volcanology. In conjunction with VERCE partners in Edinburgh and Liverpool, a new collaboration framework is being investigated with the NERC-funded TerraCorrelator project at Edinburgh, again for data-intensive work. In the last period synergy with SCI-BUS were finalized by a MOU leading in the last six months to very fruitful collaborations. Similar synergy with ER-flow is being finalized by another MOU and will foster collaborations in the next months.

The main achievements during this period are:

- Close work with WP7 led to the production release of the VERCE Science Gateway, and with the whole HPC wave-simulation team on using SCI-BUS. Initial meetings were arranged and drew up the MOU with SCI-BUS.
- The capacity, scalability and dependability of Dispel were further developed. This was reformed into Dispel4Py (originally called Dispy), a Python-based Dispel-powered library to make it more usable for Earth scientists who use Python, which allows researchers to define and collaborate on data-intensive workflows.
- The initial mapping onto OGSA web services and Java has been replaced by mappings to (Twitter's underpinning scalable technology) Storm and MPI. To make use of shared memory systems, we will also map to OpenMP. The MPI mapping has been tested on SuperMUC for post processing the wave-simulation modelling result data, while the Storm system has been tested on Edinburgh's EDIM1.
- VERCE's data management platform of choice was selected to be iRODS. After consultation with other projects and initiatives, such as EUDAT, iRODS was deployed on several partner sites (currently available at CINECA, Edinburgh, IPGP, INGV SCAI and ISTERre). This allows users authenticating from one site to access resources on other sites, while preserving different data policies on each site. iRODS has been tested on Edinburgh's EDIM1, supporting the forward-modelling use-case workflow.

- To provide a more uniform data access, a centralised catalogue for provenance data and metadata was used. Such provenance metadata, associating results with iRODS data, are produced by a Dispel4py graph and by the HPC gUse workflows submitted to HPC facilities, clusters or cloud DCIs. These metadata are then used in the interfaces supported by the VERCE portal to select data and to review the processing conducted in previous or current workflows. This results in an improved understanding of the workflows and processing steps.
- The usability of technologies such as Dispel4Py depends on effective registries to enable geoscientists to find, create and share methods. For this purpose a VERCE Registry has been prototyped. The current work is extending the Registry with authentication and authorisation mechanisms.
- Recent discussions at the ENVRI conference in Helsinki and in a follow up visit to the University of Amsterdam, has led to developing architectural plans to protect Solid Earth scientist's investments in digital methods from the many changes sweeping the digital world. This will allow exploitation of developments such as EGI's federated cloud.
- Recent discussions with SCI-BUS and ER-flow have led to a MoU proposal with ER-flow to better integrate Dispel4Py into the generic multi-DCI submission facilities and workflow sharing repositories.
- The presentations at the EGI CF 2014 have alerted us to the trends to be accommodated in the provisions of communities such as EGI and EUDAT. These will need consideration in the near future.
- A set of simple training examples is being developed, in collaboration with WP3, to introduce others into the mechanisms and power of Dispel4Py. These will be made web accessible and used at the planned October 2014 VERCE on-line training event.

The work in progress for the next six months was defined including:

- With help from LRZ and IPGP undergoing work is targeted to the measurement of the Dispel4Py+MPI system on SuperMUC, and on IPGP clusters, using different number of nodes and processes, to assess performance and establish optimisation strategies that will draw on the provenance system developed by WP7.
- Extension and improvement of the provenance solution for VERCE is being investigated, taking into account the different enactments enabled by Dispel4Py, that will be based on a suitable W3C-PROV implementation with a standard representation of provenance, e.g., PROV-JSON, while supporting VERCE-specific formats
- Regarding the iRODS data-management layer, work is in progress towards distributing the data and provenance catalogues to independent multiple sites, at a later stage, applications should be able to query multiple catalogues.

### **Impact of the VERCE project**

VERCE will lay the basis for a transformative development in data exploitation and modelling of the seismology research community in Europe; and strengthen the European earthquake and seismology research competitiveness. VERCE will provide an important contribution to the European solid Earth e-science environment of EPOS, and improve the scientific exploitation of the Data and Computing European e-infrastructures. VERCE will enable data-intensive analysis and data modelling for societal applications, i.e. natural hazards and risk assessment, energy resources, environmental change and national security.

**Website:** <http://www.verce.eu>

## 1. Project objectives and work progress for the period

This document is the third review report of the VERCE project. The intermediate management and progress report - i.e., D-NA1.2.1 – covers the first six months of the third reporting period. This document focuses on the last six months – from month 24 to month 30 – to avoid unnecessary repetition.

VERCE is structured into nine work packages (WPs): Management activities (NA1/WP1), Network activities (NA2/WP2 to NA4/WP4), Service activities (SA1/WP5 to SA3/WP7), and Research & Development activities (JRA1/WP8 and JRA2/WP9).

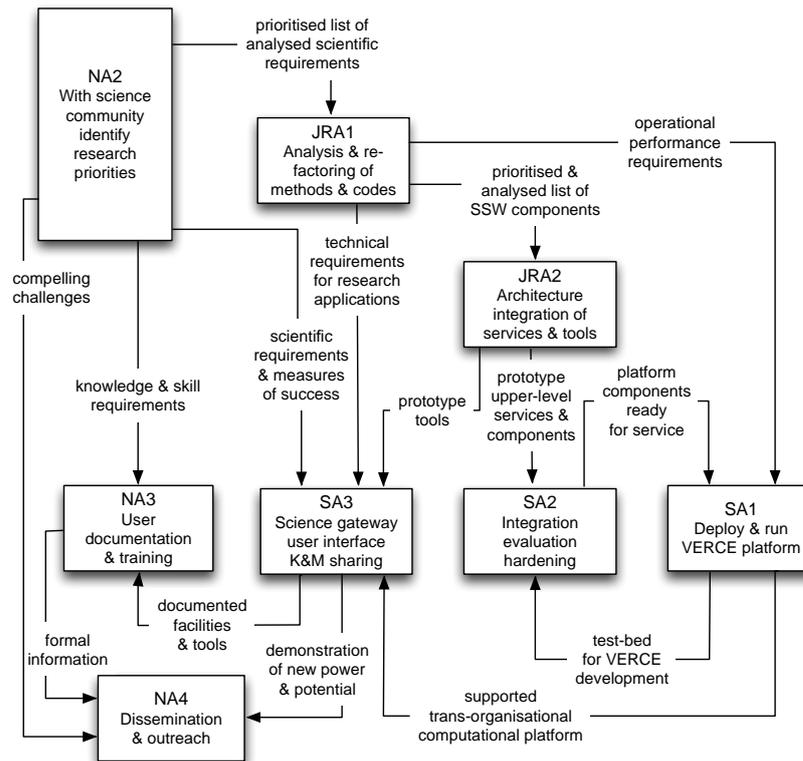


Figure 1 - Work packages in VERCE

### 1.1. Network activities

The network activities are user-and-application driven horizontal orchestration activities. The main strategy of the WP2/NA2 work package is to:

- Smooth the path from theoretical research to a dependable research e-science environment in phase with the research practice in seismology.
- Create and share data-intensive analysis and modelling methods, tools and practices for exploiting the wealth of continuous waveform seismological observations.
- Provide in coordination with WP3/NA3 education and training “intellectual ramps” aimed at fostering the VERCE e-science environment by the earthquake seismology community and beyond.

The main deliverables and achievements for the last six months were:

- Definition and validation of the enabled HPC application use case and of its integration within the Scientific Gateway as a service (D-NA2.3.2, NA2), in close collaboration with WP7/SA3, WP8/JRA1, WP5/SA1 and WP6/SA2: this includes a number of user-oriented interfaces providing WMS geological and geophysical layers, and interactive services for the workflow parameters definition.
- During this period, WP2/NA2 acted as VERCE-application manager, in close coordination with WP8/JRA1, providing a first library of validated seismic models and associated meshes of different scale resolution including northern, central and southern Italy. New submitted models and meshes to this library are under evaluation and validation including central and northern Chile, together with new external collaborations for the creation of models and meshes in the context of induced seismicity applications.
- The WP2/NA2 activity is on time according to the revised use case and demonstrator strategy - taking into account the last review recommendations – giving priority to a first beta-version of the HPC data-intensive use case for external evaluation by seismology researchers. The next six months roadmap and priority has been defined (D-NA2.3.2) with two main tasks: (1) collecting feedbacks from external users to shape and improve the HPC use case by adding new functionalities and services in phase with the different research practices; (2) building up on the HPC use case developments and integrate the data-intensive analysis use case within the scientific gateway for investigating the scalability and the performance against actual use cases.
- Documentation and best practice guides on the pilot HPC data-intensive application and use case to support education and training of end users in collaboration between WP2/NA2, WP3/NA3 and WP7/SA3 was made available through the VERCE website and the Scientific Gateway portal.
- Beside a slight time shift linked to a comprehensive intensive evaluation and validation of HPC data-intensive application and use case developments, and its integration within the Scientific Gateway, an updated training strategy and roadmap - targeted to external users – is now defined by WP3/NA3 as follow.

HPC beta-tester on-line workshop	<b>Mid-July 2014</b> 1 day session Registration end of June	Up to 10 PhDs and Post-Docs interested in the wave-simulations use case for their research	Open to external beta-testers	September 2014 -Feed back session and reports on how to improve the system and new services
DI analysis beta-tester on-line workshop	<b>Mid-October 2014</b> 1 day session Registration end of September	Up to 10 PhDs and Post-Docs interested in the seismic noise-correlation use case for their research	Open to external beta-testers	December 2014 – feed back session on how to improve the system, performance, and scalability
VERCE training workshop (Munich or Paris)	<b>February 2015</b> 3 days session Advertisement July 2014 Registration October 2014	Up to 25 participants interested in the VERCE e-science environment and use cases for their research or their projects Possibly co-organized with the Munich WinterSchool and ObsPy	Open to a wide community including the European ERC and infrastructure projects/providers	April 2015 – feedback on how to improve the system and potential synergies with other infrastructure projects
VERCE training workshop (Liverpool)	<b>Mid-July 2015</b> Advertisement January 2015 Registration May 2015 3 days session On-line and webinar sessions	Up to 25 participants interested in the VERCE e-science environment and use cases for their research or projects	Open to a wide community including the European ERC and infrastructure projects/providers	September 2015 – feedback on the VERCE platform and architecture

- Taking into account last review recommendations, updated documents providing explanation and reference for a number of concepts and acronyms employed by the project - and that may be foreign to the seismology or the IT communities – was made available by WP3/NA3 on the VERCE website.
- In collaboration between WP1/NA1 and WP4/NA4, the VERCE website was improved and its security reinforced, following a major hacking incident in February 2014. The website traffic has been continuously monitored with for this period about 39 000 page views and visitors from 55 countries.
- Two newsletters<sup>4</sup> during this period have been published and distributed by WP4/NA4. The last one – spring 2014 – was devoted on the VERCE HPC use case and demonstrator, and distributed during the EGU (European Geoscience Union) general assembly (27 April – 2 May, 2014).
- The dissemination and outreach strategy of VERCE make also use of a number of social media channels to target: the general public (Facebook<sup>5</sup>, Twitter<sup>6</sup>, Google+<sup>7</sup>); and the professional and scientific community (Linkedin<sup>8</sup>). WP4/NA4 posted 17 messages through these channels during this period, and a continuous monitoring have been performed indicating a significant increase of the number of contacts and followers during this period: Facebook: +177% fans; Twitter, +146% followers; Google+, +201% subscribers; Linkedin, +161% contacts. Finally the Science Gateway tools were externally promoted through three videos<sup>9</sup> produced in March 2014: waveform simulation set-up and control; metadata, provenance and results visualization; access to VERCE data storage via the iRODS front end.

## 1.2. *Service activities*

The service activities are at the interface between the user-oriented coordination activities and the application and architecture oriented research and development activities. The main strategy is to:

- Evaluate and integrate a platform of tools, services and application software components, relevant to the selected pilot applications, and the platform operation including software components already adopted by the existing European e-Infrastructure and service providers like EGI, PRACE, IGE, or supported by other EU projects or other related projects like EUDAT, SCI-BUS, ER-flow.
- Deploy and operate the successive versions of the platform providing a framework that eases the access across a set of public and private data and computing resources.
- Manage the release process of the research platform through a Plan-Do-Check-Act (PDCA) cycle.
- Define and support a VERCE Virtual Organization (VO) providing a flexible and integrating framework for the users and the resource provider community including AAI mechanisms.
- Define and integrate a user-oriented science gateway: enabling the use of a targeted set of tools and services for data-intensive applications; providing access to the underlying set of computing and data resources; hiding some of the complexity and the heterogeneity of task submission; monitoring execution and provenance at the different steps.

The main objectives and deliverables of the last 6 months of this reporting period were:

- Operation and management of the VERCE platform. The updated operation and management report (D-SA1.3.1, SA1 in collaboration with SA2 and NA2) is on time. The main achievements are: (1) improved and well structured procedure for integrating new site within the VERCE platform together with an updated set of documentation and best practices toward site administrators and resource providers; (2) integration of the Scientific Gateway<sup>10</sup> through a

<sup>4</sup> <http://verce.eu/Repository/Newsletters.php>

<sup>5</sup> <https://www.facebook.com/EMSC.CSEM>

<sup>6</sup> <https://twitter.com/LastQuake>

<sup>7</sup> <https://plus.google.com/+EMSCCSEM-earthquakes>

<sup>8</sup> <https://www.linkedin.com/pub/verce-project/66/a44/57b>

<sup>9</sup> <http://www.youtube.com/user/VERCEproject>

<sup>10</sup> <http://portal.verce.eu>

production portal and support channels within the VERCE.eu Virtual Organization; (3) management and operation of a VERCE distributed data platform based upon iRODS and a GridFTP storage interface in synergy with EUDAT and CINECA together with a testing environment based upon OpenNebula virtual machines for the development of iRODS micro services including workflow metadata; (4) continuous evolution and refinement of the Inca monitoring system<sup>11</sup> including now monitoring of the HPC resources made available to VERCE; (5) improvement of the end-user support with a new public web-based OTRS ticketing service<sup>12</sup>, including certificate and membership requests. Taking into account the last review recommendations, Cloud middleware and resources are under evaluation through a proof-of-concept application for seismological pre- and post-processing using the ObsPy Python Framework for Seismology, FDSN compliant web service standards, and initially the OpenNebula middleware. The next six months road map has been defined taking into account the data-intensive analysis use case requirements, extension of the data management and data replication services, and backup strategies.

- VERCE platform integration. The updated release and integrated services and tools report (D-SA2.3.1, SA2 with JRA2, JRA1, SA3 and SA1) is on time and the fourth release successfully completed within the schedule time frame. Only one component was evaluated and approved, i.e. ObsPy and Python update. The main focus of the WP2/SA2, as all the other work packages, in this period was to support the provision of a working version of the Scientific Gateway and of the integrated HPC wave-simulation use case, involving close collaboration with WP7/SA3 and WP1/SA1. As such a minimal change to the VERCE platform was recommended leading to a temporary reduction in the number of requests in terms of new tools and middleware. The next six months roadmap and the schedule for the next release cycle, April 1, 2014 – September 30, 2014 have been defined.
- Scientific Gateway and use case integration. The first production release of the VERCE Scientific Gateway, together with the integration of the HPC wave-simulation use case as a service, is on time and described in the scientific gateway report (D-SA3.3.1). This release integrates the computational and data-management components of the VERCE platform together with access and security policies. Taking into account the last review recommendations: (1) integration of the SCI-BUS technology – WS-PGRADE/gUSE – has been pursued in close collaboration and iteration with the SCI-BUS team and proved to be useful in delegating tasks mainly related to workflow, jobs and security management; (2) priority has been given toward user-friendly services and tools for the integration of the HPC wave-simulation use case in close collaboration with WP2/NA2, WP8/JRA1, WP5/SA1 and WP6/SA2. In the last months work with internal beta-testers have provided valuable feedback leading to a number of improvements, better documentation available on the portal and the VERCE website, in particular with regard to Grid access and certificates. New functionalities have been added: submission of new meshes and models; application configuration, workflow submission and control. The multi layered WS-PGRADE workflow - that has been implemented for the HPC wave-simulation use case – includes two main tasks: the actual computation and the staging out of the result data from DCIs to the VERCE data management system together with the cleaning up of the computational resources. The latter allows the extraction and storage of fine-grained lineage data at runtime. The storage system for provenance data is based on a document store exposed via provenance web API that allows an integrated view on data and metadata stores through a Provenance Explorer providing interactive navigation user interfaces. The data store consists of a VERCE federation of iRODS instances that supports authorization and authentication, data replication and metadata services. The VERCE gateway provides to the end user a front end GUI, which enables direct access to the data stores within the nodes of the federation. The GUI includes integrated interactive maps based on WMS standards adopted by other related projects such as OneGeology and EFEHR. User management support three different profiles: Verce-user, Verce-developper, Verce-admin. In addition two other classes

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<sup>11</sup> <http://inca.verce.eu>

<sup>12</sup> <http://support.verce.eu>

are under development: Verce-support, linked to the VERCE ticketing system; Verce-application-manager, for validation and checking relative to specific scientific application of the gateway and who is under the responsibility of WP2/NA2. User documentation is available via the portal pages and a ticketing system has been put in place in collaboration with WP5/SA1. Support for authorization and authentication allow users to produce and upload their proxy certificates interactively. The next six months priority and roadmap has been defined with special emphasis toward exploration and analysis of the data and the integration of the data-intensive analysis use case. A new collaboration is also being set up with the ER-flow team. External experts in induced seismicity provided an immediate positive feedback on the application, which has been also demonstrated with very positive feedback at the EGI forum meeting and a SCI-BUS meeting.

### ***1.3. Research and Development activities***

The Research and Development activities draw on the selected data-intensive pilot applications and use cases to enable the transition from proof-of-concept demonstration to dependable research e-science environment in the seismology community. The main strategy is to:

- Analyse and adapt the data-intensive pilot applications software implementation to facilitate their adoption and sharing by a wider users community through reusable data and work flow environments on the VERCE architecture and platform;
- Define and provide a data-intensive application-oriented architecture and platform of data and work tools and services enabling the data-intensive applications and providing a flexible hub between the seismology research-oriented world and the infrastructure-oriented world of data archives, HPC, Grid and Cloud computing.
- Maintain a balance between long-term sustainability considerations and fast use case implementation for scientific imperative in the architecture and platform development, and in the software refactoring and adaptation.

The main objectives and deliverables during the last 6 months of this reporting period were:

- Enabling data-intensive pilot applications and validation of the VERCE architecture. This WP8/JRA1 activity is on time. Taking into account the last review recommendations, the HPC wave-simulation use case has been prioritized for a first version release to be integrated within the Science Gateway and evaluated by a selected number of external users. Close collaboration and iteration with WP7/SA3, WP2/NA2 have been very fruitful both in improving the Scientific Gateway services and user interfaces, and in the adaptation of the wave-simulation software applications and environment. For the first version priority has been given to the SPECFEM software that is today the most widely used within the seismology research community. The application use case has been defined with the feedback of researchers within and out of VERCE. The roadmap and priority for the next six months have been defined emphasizing toward the extension of the HPC wave-simulation use case in phase with the different research practices and toward the integration of the data-intensive analysis use case for scalability and performance evaluation.
- VERCE architecture with prototyped and upgraded services and tools. The design of an appropriate architecture and development of prototypes remains the primary focus of WP9/JRA2. Much of this concerns the development of DISPEL, which Edinburgh contributed to VERCE, so that it will scale, perform well and be useable on heterogeneous distributed computing infrastructures (DCIs). Experience was also brought from the UK's NERC-funded EFFORT project, developing a science gateway for rock physics and volcanology. In conjunction with VERCE partners in Edinburgh and Liverpool, a new collaboration framework is being investigated with the NERC-funded TerraCorrelator project at Edinburgh, again for data-intensive work. WP9/JRA2 has worked closely with WP7/SA3 developing the VERCE science gateway, and with the whole forward modelling VERCE HPC team on using SCI-BUS (JRA2 arranged the initial meetings and drew up the MoU with SCI-BUS). WP9/JRA2 has been developing the capacity, scalability and dependability of Dispel. This was reformed into Dispel4Py (originally called Dispy), a Python-based Dispel-powered library to make

it more usable for Earth scientists who use Python, which allows researchers to define and collaborate on data-intensive workflows. The initial mapping onto OGSA web services and Java has been replaced by mappings to (Twitter's underpinning scalable technology) Storm<sup>13</sup> and MPI. To make use of shared memory systems, we will also map to OpenMP. The MPI mapping has been tested on SuperMUC for post processing the forward modelling result data, while the Storm system has been tested on Edinburgh's EDIM1. VERCE's data management platform of choice is iRODS. After consultation with other projects and initiatives, such as EUDAT, iRODS was deployed on several partner sites (currently available at CINECA, Edinburgh, IPGP, INGV, SCAI and ISTERre). This allows users authenticating from one site to access resources on other sites, while preserving different data policies on each site. iRODS has been tested on Edinburgh's EDIM1, supporting the forward-modelling use-case workflow. In order to provide a more uniform data access, we use a centralised catalogue for provenance data and metadata. Such provenance metadata, associating results with iRODS data, are produced by a Dispel4py graph and by the HPC gUse workflows submitted to HPC facilities, clusters or cloud DCIs. These metadata are then used in the interfaces supported by the VERCE portal to select data and to review the processing conducted in previous or current workflows. This results in an improved understanding of the workflows and processing steps. The usability of technologies such as Dispel4Py depends on effective registries to enable geoscientists to find, create and share methods. For this purpose a VERCE Registry has been prototyped. The current work is extending the Registry with authentication and authorisation mechanisms. Recent discussions at the ENVRI conference in Helsinki and in a follow up visit to the University of Amsterdam, has led to developing architectural plans to protect Solid Earth scientist's investments in digital methods from the many changes sweeping the digital world. This will allow exploitation of developments such as EGI's federated cloud. Recent discussions with SCI-BUS and ER-flow have led to a MoU proposal with ER-flow to better integrate Dispel4Py into the generic multi-DCI submission facilities and workflow sharing repositories. The presentations at the EGI CF 2014 have alerted us to the trends to be accommodated in the provisions of communities such as EGI and EUDAT. These will need consideration in the near future. Edinburgh is developing a set of simple training examples to introduce others into the mechanisms and power of Dispel4Py. These will be made web accessible and used at the planned October 2014 VERCE on-line training event (WP3/NA3). The main objectives for WP9/JRA2 in the next six months are: (1) with help from LRZ and IPGP undergoing work is targeted to the measurement of the Dispel4Py+MPI system on SuperMUC, and on IPGP clusters, using different number of nodes and processes, to assess performance and establish optimisation strategies that will draw on the provenance system developed by WP7/SA3; (2) further on going work is related to extending and improving the provenance solution for VERCE, taking into account the different enactments enabled by Dispel4Py, that will be based on a suitable W3C-PROV implementation with a standard representation of provenance, e.g., PROV-JSON, while supporting VERCE-specific formats; (3) regarding the iRODS data-management layer, work is in progress towards distributing the data and provenance catalogues to independent multiple sites, at a later stage, applications should be able to query multiple catalogues. This approach would make the system more scalable as well as it would cater for different metadata policies different sites might want to enforce; (4) new synergy and collaboration will be developed with ER-flow through a MOU that has been formalized and is being signed between VERCE and ER-flow.

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<sup>13</sup> <http://storm.incubator.apache.org>

### 1.4. Milestones and Deliverables

Table 1- Milestones

MILESTONES							
Milestone no.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
MS1	M-NA1.1	1	CNRS	Month 6	yes	25/05/2012	
MS2	M-NA2.1	2	INGV	Month 6	yes	25/05/2012	
MS3	M-NA3.1	3	ULIV	Month 6	yes	25/05/2012	
MS4	M-NA1.1.1	4	CNRS	Month 6	yes	31/03/2012	
MS5	M-NA4.1.1	4	EMSC	Month 6	yes	25/05/2012	
MS6	M-SA1.1	5	CNRS	Month 6	yes	25/05/2012	
MS7	MSA3.1	7	KNMI	Month 6	yes	25/05/2012	
MS13	M-JRA2.1	9	UEDIN	Month 6	yes	25/05/2012	Slight deviation; see paragraph 2.8 in periodic report 1. "WP9 - JRA2: Tools for data analysis on modeling"
MS8	M-NA1.1.2	1	CNRS	Month 12	yes	01/10/2012	
MS9	M-NA2.4	2, 4	INGV, EMSC	Month 12	yes	01/10/2012	

MS10	M-SA2.1	5, 6	<b>CNRS, BADW-LRZ</b>	<b>Month 12</b>	yes	01/10/2012	
MS11	M-SA3.2	7	<b>KNMI</b>	<b>Month 12</b>	yes	01/10/2012	
MS12	M-JRA1.1	2, 8	<b>INGV, LMU</b>	<b>Month 12</b>	yes	01/10/2012	
MS24	M-JRA2.2	9	<b>UEDIN</b>	<b>Month 12</b>	yes	01/10/2012	
MS14	M-NA1.2	1	<b>CNRS</b>	<b>Month 18</b>	yes	01/04/2013	
MS15	M-NA2.2	2, 3	<b>INGV</b>	<b>Month 18</b>	yes	01/04/2013	
MS16	M-NA3.4.1	3	<b>ULIV</b>	<b>Month 18</b>	yes	01/04/2013	
MS17	M-SA2.2	5, 6	<b>BADW-LRZ</b>	<b>Month 18</b>	yes	01/04/2013	
MS18	M-SA3.3	7	<b>KNMI</b>	<b>Month 18</b>	yes	01/04/2013	
MS19	M-JRA1.2	2, 6, 8	<b>LMU</b>	<b>Month 18</b>	yes	01/04/2013	
MS20	M-NA1.2.1	1	<b>CNRS</b>	<b>Month 24</b>	yes	01/10/2013	
MS21	M-SA2.3	5,6	<b>CNRS, BADW-LRZ</b>	<b>Month 24</b>	yes	01/10/2013	
MS22	MS-SA3.4	7	<b>KNMI</b>	<b>Month 24</b>	yes	01/10/2013	
MS25	M-NA1.3	1	<b>CNRS</b>	<b>Month 30</b>	yes	01/04/2014	
MS26	M-NA3.4.2	3	<b>ULIV</b>	<b>Month 30</b>	yes	01/04/2013	

MS27	M-SA2.4	5, 6	<b>LRZ</b>	<b>Month 30</b>	yes	01/04/2013	Slightly revised platform components
MS28	M-SA3.5	7	<b>KNMI</b>	<b>Month 30</b>	Yes	01/04/2014	
MS29	M-JRA1-4	2,6,8	<b>LMU</b>	<b>Month 30</b>	Yes/no	01/04/2014	Slightly delayed and revised following reviewer's suggestions

Table 2- Deliverables

DELIVERABLES											
Del. no.	Deliverable name	Version	WP no.	Lead beneficiary	Nature	Dissemination level <sup>14</sup>	Delivery date from Annex I (proj. month)	Actual / Forecast delivery date	Status	Contractual Yes/No	Comments
D2.1	D-NA2.1	1	2	INGV	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D3.1	D-NA3.1	1	3	ULIV	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D4.1	D-NA4.1	1	4	EMSC	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D5.1	D-SA1.1	1	5	CNRS	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D6.1	D-SA2.1	1	6	BADW-LRZ	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D7.1	D-SA3.1	1	7	KNMI	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D8.1	D-JRA1.1	1	8	LMU	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D9.1	D-JRA2.1	1	9	UEDIN	Report	Public	Month 6	25/05/2012	Submitted	Yes	
D1.1.1	D-NA1.1.1	1	1	CNRS	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D2.2	D-NA2.2	1	2	INGV	Report	Public	Month 12	01/10/2012	Submitted	Yes	

D2.2.1	D-NA2.2.1	1	2	INGV	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D3.2	D-NA3.2	1	3	ULIV	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D4.3	D-NA4.3	1	4	EMSC	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D5.2	D-SA1.2	1	5	CNRS	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D6.2	D-SA2.2	1	6	BADW-LRZ	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D7.2	D-SA3.2	1	7	KNMI	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D8.2.1	D-JRA1.2.1	1	8	LMU	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D9.1.1	D-JRA2.1.1	1	9	UEDIN	Report	Public	Month 12	01/10/2012	Submitted	Yes	
D2.2.2	D-NA2.2.2	1	2	INGV	Report	Public	Month 18	01/04/2013	Submitted	Yes	
D5.2.1	D-SA1.2.1	1	5	CNRS	Report	Public	Month 18	01/04/2013	Submitted	Yes	
D6.2.1	D-SA2.2.1	1	6	BADW-LRZ	Report	Public	Month 18	01/04/2013	Submitted	Yes	
D7.2.1	D-SA3.2.1	1	7	KNMI	Report	Public	Month 18	01/04/2013	Submitted	Yes	
D1.2.1	D-NA1.2.1	1	5	CNRS	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D2.3	D-NA2.3	1	2	INGV	Report	Public	Month 24	01/10/2013	Submitted	Yes	

D2.3.1	D-NA2.2.1	1	2	INGV	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D3.2.1	D-NA3.2.1	1	3	ULIV	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D4.3.1	D-NA4.3.1	1	4	EMSC	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D5.3	D-SA1.3	1	1	CNRS	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D6.3	D-SA2.3	1	6	BADW-LRZ	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D6.3.0	D-SA2.3.0	1	6	BADW-LRZ	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D7.3	D-SA3.3	1	7	KNMI	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D8.2.2	D-JRA1.2.2	1	8	LMU	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D9.1.2	D-JRA2.1.2	1	2	UEDIN	Report	Public	Month 24	01/10/2013	Submitted	Yes	
D2.3.2	D-NA2.3.2	1	2	INGV	Report	Public	Month 30	01/04/2014	Submitted	Yes	
D5.3.1	D-SA1.3.1	1	5	CNRS	Report	Public	Month 30	01/04/2014	Submitted	Yes	
D6.3.1	D-SA2.3.1	1	6	LRZ	Report	Public	Month 30	01/04/2014	Submitted	Yes	
D7.3.1	D-SA3.3.1	1	7	KNMI	Report	Public	Month 30	01/04/2014	Submitted	Yes	

## 2. Project management during the period

### 2.1. *VERCE consortium: management, structure and governance*

No change in the Consortium composition and beneficiaries'. In the work package 4 (NA4), Santhi Veloupoulé (EMSC) left the project in July 2013 and Caroline Etivant-Dernoncour (EMSC) was recruited in September 2013 with the same missions.

The **Project Management Office** (PMO): Arthur Mulle (CNRS-INSU) has been appointed February 2014 as project manager for 20% of his time and will work together with Antoine Weexsten (CNRS-INSU). The new composition of the PMO is now as follow:

- Jean-Pierre Vilotte (IPGP-CNRS) - Project Coordinator
- Arthur Mulle (CNRS-INSU) – Project Manager
- Antoine Weexsten (CNRS-INSU) – Legal officer
- Rosa Bernal-Carrera (IPGP)
- Geneviève Moguilny (CNRS-INSU)

One of the last review recommendations was a clearer separation between the SC and the PEB with respect to their respective role and relationship in order to ensure the accomplishment of the project objectives.

Since the beginning of the project, regular joint SC/PEB online meetings - on average every four weeks – have contributed to active collaboration across the VERCE consortium, and to ensure a common understanding and ontology, and drive progress towards project objectives.

At the end of the first year, two VERCE Task Forces (TFs) were set up as a means to establish cross-WP collaboration to progress the driving Data-intensive analysis (seismic noise correlation) and CPU-intensive modelling use-cases (seismic waveform simulation). The Task Forces have been instrumental for: a better understanding and documentation of the requirements of the scientists in terms of adaptation of the VERCE infrastructure to the research practice as well as the technological heterogeneities of the participating sites; the beta-version release - at a proof-of-concept capacity and capability - of two use-case demonstrators - including stream-based Dispel workflow and Python-based framework – that were presented at the last review meeting.

As the technical requirements became clearer and the TF groups larger, it was decided that the TF organization - concluded successfully in April 2013 - was no more at this stage of the project the right organization to progress. At the same time, one of the last review recommendations was a clearer separation between the SC and the PEB with respect to their respective role and relationship in order to ensure the accomplishment of the project objectives.

Separation in role and composition of the SC and the PEB was discussed at the SC meeting held early July 2013. It was decided in line with the VERCE management description provided in the DOW document that:

- The project Steering Committee (SC) directs the strategic orientation of the project and safeguards the interests of all participants. It directs the project work plane, establishes priorities and quality control criteria, evaluate the overall performance and progress of the project and takes appropriate action if needed. It explores opportunities for furthering project collaborations and endeavour strategic actions with other related projects and infrastructures. The SC meets remotely on a monthly basis or whenever a particular need arises. Each partner of the consortium is represented in the SC together with the project manager.
- The Project Executive Board (PEB) is in charge of the day-to-day technical and science management and operation of the project. It meets remotely frequently on a weekly basis and shape technical decisions in accord with the project strategic goals. The PEB is in charge of organizing and following the day-to-day work across the different WPs, as well as across the IT and seismology researchers and engineers researchers and engineers involved in the project. The PEB can set up whenever needed specialized and temporary transversal working groups. An IT and a seismologist chair the PEB, where each WP is represented. The PEB reports regularly to the Project Coordinator, and on a monthly basis

to the SC on a monthly basis or whenever a particular need arises. The IT deputy and/or the project coordinator can assist to PEB meetings.

The SC committee composition is as follows:

- Jean-Pierre Vilotte (IPGP-CNRS) – project coordinator and chair
- Malcolm Atkinson (UEDIN)
- Torild van Eck (KNMI)
- Remy Bossu (EMSC)
- Alberto Michelini (INGV)
- Heiner Igel (LMU)
- Andreas Rietbrock (ULIV)
- Anton Frank (LRZ)
- Horst Schwichtenberg (SCAI)
- Giovanni Erbacher (CINECA)

Permanent invited: Alessandro Spinuso (KNMI, PEB chair); Antoine Weexsteen (PMO)

The PEB committee composition is as follows:

- Alessandro Spinuso (SA3 - KNMI) – PEB chair
- Lion Krischer (JRA1 - LMU) – PEB co-chair
- Geneviève Moguilny (SA1 – IPGP-CNRS)
- Irakli Klampanos (JRA2 – UEDIN)
- Emanuele Casarotti (NA2/JRA1 – INGV)
- Caroline Etivant-Dernoncour (NA4, EMSC)
- Siew Hoon Leong (SA2 – LRZ)
- André Germünd (SA1/SA2 – SCAI)
- Michele Carpené (SA1 – CINECA)

Permanent invited: M. Atkinson (UEDIN) or J.P. Vilotte (IPGP/CNRS, project coordinator)

The PEB committee remotely meets on a regular bi-weekly basis, and face-to-face has been organized January 2014 at INGV. The SC committee remotely meets on a regular monthly basis. The SC and the PEB have a wiki section on the Redmine, where the minute of the meetings are available to all the participants of VERCE. This reorganization of the VERCE management has proved to be quite useful and efficient providing a better transition of work from proof-of-concept prototypes to production component and services.

## **2.2. Internal communication**

No major change has occurred in the organisation of internal communication beside the effective use of two separate channel of communication for the SC and the PEB in Redmine. Overall the use of the VERCE Redmine online collaborative environment is now well adopted, and partners seem to be familiar and at ease with its structure and tools.

The Redmine wiki section is the heart of the internal communication system, and is growing fast with minor time-to-time reorganisation in order to reduce the number of pages by regrouping some of its content. In each WP, one person is in charge to keep each WP's wiki section up-to-date.

The NA1 (WP1) wiki section contains all SC and PEB meetings' minutes and many of the transversal issues such as: collaboration with other projects - each project has a wiki page that the partners and the coordinator keep updated, reporting deadlines, procedures, templates, deliverables' state of the art, risk management, sustainability strategy, etc.

Participation of partners at related events and relevant seminars and the representation of VERCE in national and international contexts are tracked in an *ad hoc* wiki page in the NA4 section, called "Other events and VERCE presentations".

The News section as an internal tool for sharing information on other related events is still not sufficiently used by partners and needs to be regularly updated by the PMO. Nevertheless it represents the most appropriate way to keep partners informed on important issues without sending them too many emails.

The Meeting section is where all information on on-going and past meetings, both within and across WPs and at project level, can be found, either on the space made available from that tool or on a linked wiki page that contains further details. Finally the Doodle tool for online polls has proved to be very useful and used especially for the organisation of the various VERCE meetings.

The Document section is mainly updated by the PMO to share official documents or project internal templates.

The Repository (SVN) is used for uploading/downloading the different versions of the deliverables, codes and other drafts that need a version tracking.

Forums are not used frequently but are still an important means of communication and allow keeping track of important on-going discussions.

An ad-hoc Issues Tracking System has been set up for NA3 (WP3) and is part of the training strategy allowing to deal with direct user requests on technical questions regarding the VERCE tools and technologies. During the last period, the Redmine Issue tracking system has been configured as part of the deployment and monitoring strategy for the VERCE test bed and platform, as well as for the unified access strategy.

The rate of usage by partners - and the level of their feedback - of the Redmine environment are being monitored continually; and partners asked to suggest improvements in order to plan relevant adjustments.

A significant part of the internal communication still passes through emails, especially for communications from the PMO to the project's boards and for communication within WPs. The mailing lists system works well and helps targeting groups. The full integration of new personnel during this last period helped to better differentiate roles and delegate some tasks from scientific representatives. Mailing lists are regularly updated by the PMO on the basis of the Manpower file that lists all personnel working on VERCE and their roles and involvement in the different WPs.

### 2.3. Meetings

Project and WP meetings are very important for the effective management of the Consortium and to foster work progress. Between October and end March 2014, many online SC, PEB, WP, cross-WPs meetings have taken place, focusing on specific issues. Those have facilitated the collaboration between IT experts and seismologists across all the involved partners in the consortium. Minutes of those meetings are available on the Redmine platform.

Partners also participate and meet at major international events in relation with the VERCE activities, for updating, exchanging and dissemination purposes. Those meetings also provide opportunities to organize coordination meetings with other related projects, and make sure VERCE develops coherently with the Community's needs and wishes. A full and always updated list of these events is kept on the Redmine by WP4. Some examples are:

- 16-19 September 2013, **EGI Community Forum**, Madrid, Spain. Participants: Siew Hoon Leong (LMU), Horst Schwichtenberg (SCAI), Geneviève Moguilny (CNRS-IPGP), two presentations.
- 28 – 30 Octobre 2013, **EUDAT second conference**, Rome, Italy. Participants: Alberto Michellini (INGV). Invited talks. <http://www.eudat.eu/2nd-conference>.
- 6-8 November 2013, **ICT'13 conference** (EU conference on ICT in H2020), Vilnius, Lithuania. Participants: Anton Frank.
- 26 Novembre 2013, **EGI Federated Cloud meeting**, Participants: André Germünd (SCAI), Horst Schwichtenberg (SCAI)
- 9-13 Décembre 2013, **AGU Fall meeting**, San Francisco. Participants: Geneviève Moguilny (IPGP/CNRS), Iraklis Klampanos (UEDIN), Jean-Pierre Vilotte (IPGP/CNRS), Heiner Igel (LMU), Andreas Rietbock (ULIV), Alberto Michellini (INGV), Massimo Cocco (INGV). Two Posters. <http://fallmeeting.agu.org/2013/scientific-program-2/>
- 26-28 February, **BDEC meeting**, Fukuoka, Japan. Participant: Jean-Pierre Vilotte (IPGP/CNRS). 2 invited talks.

- 4-6 March 2014, **APARSEN-EGI Community Workshop on Managing**, Computing and Preserving Big Data for Research Scientific Domain, Amsterdam, Netherland. Participants: Alessandro Spinuso (KNMI), Malcolm Atkinson (UEDIN). Invited presentation: Case Study 4 - Seismology (VERCE)
- 2-4 April, **2<sup>nd</sup> International Conference on International Research Infrastructures (ICRI'14)**, Athens, Greece. Participants: Anton Frank (LRZ) with a booth shared with the DRIHM project.
- 8 April, HPC info day Horizon 2020, Paris, France. Participants: Jean-Pierre Vilotte (IPGP/CNRS), Anton Frank (LRZ).
- 27 April – 02 May 2014, **EGU General Assembly**, Vienna. Participants: Geneviève Moguilny (IPGP/CNRS), Horst Schwichtenberg (SCAI), Alessandro Spinuso (KNMI), Malcolm Atkinson (UEDIN), Ammy Kraus (UEDIN), Anton Frank (LRZ), S.H. Leong (LRZ). 5 talks and invited talks
- 7-9 May 2014, **SCI-BUS project meeting**, Cesme, Turkey. Participants: Alessandro Spinuso (KNMI), Malcolm Atkinson (UEDIN), S.H. Leong (LRZ). 3 talks.
- 19-22 May 2014, **EGI/EGCF meeting**, Helsinki, Finland. Participants: Torild van Eck (KNMI) ; Geneviève Moguilny (IPGP/CNRS), Horst Schwichtenberg (SCAI), Anton Frank (LRZ). 3 talks
- 3 June 2014, **IWSG14 6th international workshop on Science Gateways**, Dublin, Ireland. Participants : Alessandro Spinuso (KNMI). One talk
- 24-29 August 2014, **General Assembly of the European Seismological Commission**, Istanbul, Turkey. Participants: Alessandro Spinuso (KNMI) Torild van Eck (KNMI). Talk and poster.

#### **2.4. On-going Cooperation with other projects**

The main cooperation and coordination strategy with related European and International projects was detailed in the first management and progress report and is continuously updated since.

Part of the effort to build a sustainable and interoperable infrastructure is the investigation of possible collaborations with other sharing relevant projects.

A first aspect of this strategy is to foster synergies and collaborations with other projects in the seismology and the solid Earth sciences.

- Of particular importance is the collaborations between VERCE and EPOS, the solid Earth science ESFRI project, i.e. especially with regard to the core services and the architecture of the EPOS e-science environment to which VERCE is seen as a major contribution.
- VERCE has collaborations with other international NPOs in seismology like IRIS, Earthscope in the US; JAMSTEC and NIED in Japan.
- Another important aspect is the synergy and the collaborations between VERCE and a number of strategic projects in the seismology research infrastructure, i.e. for example NERIES, SHARE, REAKT.
- Synergy and collaboration has been initiated with the Belmont Forum e-infrastructure initiative in environmental sciences within the G8 framework.
- Finally, with regard to the research applications and the dissemination of the VERCE environment in the seismology research community, the synergy and the collaborations between VERCE and a number of European seismology projects: QUEST (ITN), WaveTomo (ERC), WHISPER (ERC), and more recently with the NERC-funded TerraCorrelation projects.

Another aspect of the strategy is to foster synergies and collaborations with the European infrastructures, i.e. EGI, PRACE and EUDAT.

- VERCE is currently participating to two pilot case studies within the EGI-PRACE-EUDAT synergy.
- VERCE is currently collaborating with EUDAT with regard to iRODS based data management federation and the movement of large data sets using gridFTP, GLOBUSonline, Griffin.

In line with the last review recommendations, the last aspect of this strategy is to develop synergies and collaborations with other related projects that develop methodologies and software components that can be integrated within the VERCE platform.

- **SCI-BUS:** providing science gateway/portal technology to integrate access to computing, storage and other facilities and infrastructures. The gateways are based on widely used production quality frameworks and solutions (Liferay and WS-PGRADE/gUSE), which aligns also with the preliminary technological preferences mentioned in D-SA3.3 and D-JRA2.1.2 reports. A common understanding and a collaboration roadmap have been finalized and formalized as a MOU between the two projects.
- **IGE:** providing tools to share computing resources, databases and other on-line tools. IGE is a member of the Globus Alliance. Collaborations between VERCE and IGE have been formalized by a signed MOU. This collaboration has been important and has led to the adoption by VERCE of a number of components provided by IGE, as detailed in the D-SA2.2.1 report.
- **ER-Flow:** a follow-on project to SHIWA, which developed technologies to allow interoperability between workflow systems. This includes the SHIWA Simulation Platform (SSP) which allows users to upload and run workflows created by different workflow systems on different distributed computing infrastructure, to create meta-workflows, i.e. workflows composed of other workflows in the SHIWA repository, and where each of the constituent workflows may have been created by different systems. Collaboration between ER-flow and VERCE is has been formalized by a MOU, which is being signed.

Finally, this strategy includes also international components.

- Through EPOS, VERCE is developing synergies with the EU-US bilateral initiatives, i.e. COOPEUS and i-CORDI.
- Through the participation of some of VERCE partners to the EU Big Data and Extreme-scale initiatives, i.e. for example EESI2 and BDEC, VERCE is developing synergies with EU-US initiatives.
- Collaboration with the US CIG initiative is related to the HPC data-intensive use case with in particular the issue of data formats and orchestrated workflows. Selected CIG external users are foreseen for the evaluation of the first beta-version release of the HPC data-intensive use case and its integration within the VERCE Science Gateway.
- Finally active collaboration between VERCE and the developer team of ObsPy has led to a new version of the ObsPy library supporting abstract data formats as well as a prototype of a Larfe-scale Seismic Inversion Framework (LASIF).

This strategy is continuously reviewed and updated as the project evolves keeping track in order to collect experience and acquired know-how not only for the VERCE project but also for further projects of the solid Earth sciences.

## **2.5. *Project activities monitoring***

Partners have finalized their recruitments in the past months. The situation had been closely monitored by the PMO until all vacancies had been filled. With the new staff, VERCE is now running at full capacity and the risk of manpower shortage identified in the last review meeting solved.

## **2.6. *Risk Management Plan***

Following one of the recommendation at the last review meeting, the Risk Management Plan was actualized and refined. The Risk Management Plan and the monitoring strategy and tools were detailed in the Management and Progress Report D-NA1.1.1.

The PEB monitors the Risk Management Plan periodically. Each risk is assessed in terms of likelihood and impact, and is recorded in the Risks Register. This metric allows defining a Risk Exposure factor, which help to prioritize the different risks for management control. This dynamic document is continuously reviewed and updated throughout the project in interaction with the different work package leaders.

No issue was identified and the manpower use by each of the VERCE's partners and work package is on track.

End of February 2014, the Verce website was hacked and used to send more than 5000 spams as a result the server was backlisted. Immediate response of the WP5/SA1 team allows resolving this problem within a week. Security was reinforced.

## 2.7. Sustainability Strategy

A sustainability strategy plane is under preparation through regular SC/PEB meetings. The VERCE sustainability strategy plane is linked also to: (a) the sustainability of the European infrastructures, e.g. PRACE, EGI; (b) the sustainability of EPOS both in terms of observational, data and e-science infrastructures; (c) the sustainability of the seismology community at the international level. This activity is presently led by LRZ, UEDIN, ORFEUS, INGV and the CNRS-INSU.

Collaboration with EPOS and the Earth Science community toward such a sustainability plane and a European Earth Science roadmap has been initiated during the last August-September meeting in Erice, Italy.

## 2.8. Last review recommendations

The last review report made a number of explicit recommendations:

- **Consider the roles of SC and PEB with respect to their mutual relationship in order to ensure the accomplishment of project objectives.**
  - This has been taken into account as explained in the VERCE management section.
- **Intensify collaboration with members of the SCI-BUS project. Aim at making full use of their technology and frameworks and possibly adapt their solutions for the VERCE platform.**
  - This has been taken into account. A collaboration roadmap has been agreed between the two projects and formalized by a MOU. Integration and adaptation of SCI\_BUS components in the development of the VERCE Science Gateway and architecture is actively pursued - in collaboration with the SCI-BUS project – as detailed in the SA3 and JRA2 reports. In parallel, a MOU is being finalized with the ER-FLOW project. The current collaboration with the SCI-BUS team has been very fruitful during the last months and has helped VERCE to become more relevant and sustainable.
- **Develop beta-versions for at least two use case applications (HPC use case with Specfem; HTC use case with noise correlation) and invite external/independent researchers to test/use the VERCE platform. Develop benchmarks for the beta-test applications to assess the performance and scalability of the VERCE platform.**
  - This has been taken into account and led to a revision of the implementation strategy. Priority has been given to providing a beta-version release of the HPC data-intensive use case - and to its integration within the VERCE Science Gateway - for evaluation by a selected number of external and independent seismology users from the EPOS (EU) and CIG (US) community. Priority for the Data-intensive analysis use case has been given to internal evaluation of the scalability/performance issues against realistic data sets currently analysed in research practice involving a proper data management layer. The adopted strategy overlays a pragmatic short-term software-oriented approach, making use of the development environment of the seismology researchers, allowing rapid and agile prototyping of data-stream based workflow structures and precise requirements driven by research practice for the VERCE architecture and platform; and a mid-term IT-oriented approach allowing the integration of those applications within a consistent and well architecture infrastructure.
- **Define a process and technology strategy to explore the use of public clouds within the VERCE platform.**
  - A first step has been initiated and currently the possibility of integrating Cloud resources within the VERCE platform is being investigated – as detailed in the SA1 report – with the EGI Federated Cloud Task Force, which offers a kind of “Grid of Clouds” and the SCAI Cloud Environment based on OpenNebula. In parallel, an analysis of the Public Cloud business model and capability with respect to the European and International seismology community observational organization and research practice has been initiated in collaboration with EPOS.

Together with

- **Make more explicit the strategy for dissemination and "marketing" of the VERCE platform. Consider also the use of professional services. Manage user expectations very carefully and plan**

***implementing the strategy once independent researchers have successfully beta-tested the VERCE system.***

- An updated dissemination and public outreach strategy has been initiated and a reshaping of the Verce public website and material has been done. Collaboration with a selected potential external users within the EPOS (EU) and the QUEST (EU) community with regard to their expectation and their evaluation of the first beta-version release of the HPC wave simulation use case has been initiated and will shape the forthcoming training session that will be open to those selected users.
- ***Many of the concepts employed in the VERCE project, and many of the acronyms of projects that VERCE relates to, are foreign to many if not most seismologists. A one-page PDF file or a web site with hyperlinks or tooltips briefly describing a concept or an acronym would significantly help the readers to grasp the full picture and better appreciate VERCE's added value.***
  - This has been incorporated in the Knowledge base provided by NA3 and will be continuously updated both in direction to the seismology community and to the IT community with regard to the seismology concepts and methods. This is further detailed in the NA3 report.

### 3. Next steps

During the next reporting period, the PMO will continue monitoring the updates of the Risk Register. It will also continue to focus on the drafting of a Sustainability Plan in a moving landscape, as asked by reviewers during the first Project Review. VERCE is closely following and participating the RDA activities for Open-Data and was also invited to participate to the Belmont initiative on e-infrastructure in environmental sciences, including sustainability issues and funding by national research agencies, that will issue a white paper mid September 2014.

It will keep coordinating and monitoring the partners' contributions and project activities making sure they are coherent with the DoW while at the same time guaranteeing the needed flexibility to adapt to research developments, changing needs of the Community and collaboration with other projects.

The PMO will make sure all deliverables (and milestones) are ready for the next deadline on 1 October 2014.

The VERCE management continue with a clear separation of concern between the SC and the PBE following the adopted reconfiguration.

The collaboration strategy will be continuously monitored and updated.