



GENERAL PROJECT REVIEW CONSOLIDATED REPORT (HE)

COVER PAGE

PROJECT	
Project number:	101057388
Project acronym:	EuroScienceGateway
Project name:	leveraging the European compute infrastructures for data-intensive research guided by FAIR principles
Call:	HORIZON-INFRA-2021-EOSC-01
Topic:	HORIZON-INFRA-2021-EOSC-01-04
Type of action:	HORIZON-RIA
Service:	REA/C/04
Project starting date:	1/9/2022
Project duration:	36 months

PROJECT REVIEW	
Period covered:	from 1/9/2023 to 31/8/2025
Reporting period number:	Final
Date of the latest version of DoA against which the assessment is performed:	7/6/2022
Date of meeting with consortium (if applicable):	Not applicable
Name of project officer:	Enrico PELLIZZARI
Name(s) of monitors:	Not applicable

1. OVERALL ASSESSMENT

1. Overall assessment
<p><input checked="" type="radio"/> The project has fully achieved its objectives and milestones for the period.</p> <p><input type="radio"/> The project has achieved most of its objectives and milestones for the period, with relatively minor deviations.</p> <p><input type="radio"/> The project has achieved some of its objectives and milestones. However, corrective action will be required.</p> <p><input type="radio"/> The project has failed to achieve critical objectives and/or milestones and/or is severely delayed.</p>
2. General comments (executive summary)
<p>The project EuroScienceGateway is lasted 36 months period. It is composed of 5 work packages, 22 tasks, 11 deliverables and 12 milestones.</p> <p>The main goal of the EuroScienceGateway is to achieve an open collaborative digital space for European scientists. The Project has fully achieved its objectives according DoW for the reporting period 2. It follow FAIR principles. The open Galaxy platform, the Pulsar Network and FAIR workflow services as WorkflowHub and RO-Crate create an accessible e-Infrastructure for European scientists to enable data-driven research across scientific domains. Bring Your Own Compute and Bring Your Own Storage support a broad variety of analysis types in EuroScienceGateway. Strong progress has been made in the implementation of all the work packages in line with the Description of Work. In the reporting period all WPs fully achieved their specific objectives.</p> <p>The recommendations from previous review have been adequately addressed.</p> <p>All deliverables have been provided on time.</p> <p>All milestones have been successfully achieved.</p> <p>The project goes on doing an excellent work regarding the relationship with standards bodies.</p> <p>The project management has been professional and has shown high level of maturity, with all the procedures very clearly defined.</p> <p>The project is being implemented according to the work plan. The quality of results achieved so far is good.</p> <p>The consortium executed a good communications strategy and plan, detailing the key communication goals and methods. The marketing and communications activities continued to address the project's different users and their requirements in an integrated and consistent way. A set of key performance indicators (KPIs) was well defined and monitored regularly via real-time KPI dashboard.</p> <p>The project held every week meetings - leaders meetings and meetings for some sub-tasks forces.</p> <p>The website (https://galaxyproject.org/projects/esg/)was professionally designed and continuously maintained.</p>
3. Recommendations
<p>This is final report, due to this fact the recommendations are not applicable. It is recommended to approve the report.</p>
4. EIC follow up actions (for EIC actions)
<p>Not applicable for the final report.</p>
5. Does the project meet the necessary conditions for receiving additional grants under the EIC? (for EIC actions)
<p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input checked="" type="radio"/> Not applicable</p>

2. OBJECTIVES AND WORK PLAN

1. Is the progress reported in line with objectives and work plan as specified in the DoA? If there are significant deviations, please comment.

- Yes
- No
- Partially
- Not applicable

The progress reported is in line with the objectives and the work plan specified in the DoA with no significant deviations. The progress reported shows a detailed description of the activities done per WP and task together with the KPIs showing the progress. ESGs objectives are addressed in the project's five work packages. All planned work has been achieved in this last period in objectives related to all WPs.

WP1 "Project Management, Coordination, Dissemination" has 7 objectives. It proved highly valuable for project partners, allowing them to show their technological developments and receive insights from external experts and current and future adopters in EOSC of the solutions developed in this ESG project. Decision-making processes, along with dissemination, implementation, and exploitation issues, have been documented within a consortium agreement that underwent updates throughout the project's duration. The dissemination and communication of results with all project partners have been made with good quality through various channels, including the project website, social media posts, participation in conferences, online workshops, and training sessions. All 6 tasks under WP1 done in time with professional communications among partners.

All deliverables (D1.1, D1.2 and D1.3) in this period were successfully submitted, were of good quality and thus they were all accepted.

MS1.1 and MS1.2 have been fully achieved.

WP2 "Stimulate FAIR and Reusable Research" has 4 objectives. The project makes project data FAIR, keeping in mind the need to balance openness and protection of scientific information, commercialisation and IPR, as well as data management issues. Encapsulated as RO-Crate, these FDOs contain linked resources, logs, and metadata, so qualifying them for findability, reusability, and long-term archiving. Published via EOSC services and registries like OpenAIRE, these items promote by means of focused outreach to both current and new user communities, therefore improving visibility and adoption. The project partners contributed to integration of WorkflowHub with EOSC infrastructure, and they contributed to the RO-Crate specification, the Workflow RO-Crate and Workflow Run Crate profiles, and their integration into WorkflowHub, Galaxy, and WfExS. The FAIR Computational Workflows guidelines were developed by EuroScienceGateway joining the Workflows Community Initiative. In cooperation with international organizations including the FAIR Digital Object Forum, the RDA Data Fabric Interest Group, and EOSC Core, the combination of RO-Crate with FAIR Signposting has been demonstrated to meet the formal FAIR Digital Object specification and WorkflowHub prove it. All 4 tasks under WP2 done well.

All deliverables (D2.1 and D2.2) in this period were successfully submitted, were of good quality and thus they were all accepted.

MS2.1, MS2.2, MS2.3 and MS2.4 have been fully achieved.

WP3 "Pulsar Network: Distributed heterogeneous compute" has 3 objectives. WP3 relied on three core technologies: the Galaxy workflow manager, to provide access to data, tools, workflows, and compute resources; Pulsar, to fetch jobs to remote cluster and build the distributed computing network; and the CERN-VM FS, to share reference datasets and tools across all infrastructures. Open infrastructure has been tested with commercial cloud providers and well-integrated with OpenStack, the usage of tools like Ansible, Packer, and Terraform automate deployment and the compatibility with different platforms. A fully functional deployment has been validated on Oracle Cloud Infrastructure (OCI). Using a test configuration including a standalone TESP server, backend database, FTP service, and a Pulsar instance, deployment has been confirmed on the Czech Galaxy Node. The European Pulsar Network encompasses 13 endpoints. Every pulsar site is monitored via the public dashboard (monitor.usegalaxy.it). WfExS expanded as part of ESG to function as a pluggable compute backend, therefore enabling workflows to run across the European Pulsar Network. WfExS-backend delegates workflow executions to the most appropriate supported workflow engine (Nextflow or cwltool). The project has a common catalogue of tools and workflows, which has been made discoverable via EOSC registries including bio.tools and WorkflowHub. All 5 tasks under WP3 done in time with good coordination among partners.

All deliverables (D3.1 and D3.2) in this period were successfully submitted, were of good quality and thus they were all accepted.

MS3.1, MS3.2, MS3.3 have been fully achieved.

WP4 "Building blocks for a sustainable operating model" has 4 objectives. All 3 tasks under WP4 done well. The WP4 developed the required improvements of Galaxy and Pulsar, to automate and simplify the integration of user-contributed storage infrastructure and computing. A smart scheduling system has been implemented to maximize the distribution of tasks over the available systems as the Pulsar Network grows with more resource providers, therefore guaranteeing efficient and balanced use of computing resources. The integration of Galaxy with EGI Check-in brings eduGAIN and other popular authentication sources (e.g. ORCID). A mapping system between datasets and storage endpoints has been created to assist with data locality, a fundamental need for efficient job scheduling under BYOS. It is created a smart job scheduling system that best directs jobs sent to ESG to suitable compute resources, taking into account the user-provided computing and storage allocations. The TPV Broker is a new API endpoint that extends Galaxy's TPV and it gathers live usage metrics from Pulsar endpoints thanks to producer/consumer scripts publicly available in the ansible-pulsar-utils repository. Galaxy Job Radar is a web application and dashboard developed to visualize computational traffic across the Galaxy system. It provides v the number of jobs across the network, the state of these jobs, the location of computational nodes and the evaluation of scheduling within these nodes.

All deliverables (D4.1 and D4.2) in this period were successfully submitted, were of good quality and thus they were all accepted.

MS4.1 and MS4.2 have been fully achieved.

WP5"Community engagement, adoption and onboarding" has 3 objectives. All 4 tasks under WP5 done well. In biodiversity and climate science (Task 5.1), the project integrated advanced genome annotation and climate science modelling workflows into Galaxy and the IWC. The new tools and GTN tutorials and containerised HPC-enabled climate models are promoted at major scientific meetings. In materials science the project proposed Galaxy workflows for XAS, muon spectroscopy, and neutron diffraction, deploying a dedicated Materials Galaxy instance. Tools such as mudirac, muspinsim, and GSAS-II were added to the Galaxy tool set. In astrophysics, the project developed workflows such as CRBeam and PhotoZ and integrating Galaxy with different platforms. WP5 also liaised with EOSC4Cancer to demonstrate the interoperability between Galaxy and cBioPortal for clinical image analysis.

All deliverables (D5.1 and D5.2) in this period were successfully submitted, were of good quality and thus they were all accepted.

MS5.1 has been fully achieved.

2. Are the objectives of the project still scientifically, technologically and economically relevant?

- Yes
- No
- Partially
- Not applicable

The objectives of the project are relevant scientifically, technologically and economically.

3. Critical risks

- Yes
- No
- Partially
- Not applicable

Risks have been appropriately managed overall. Risk mitigation measures were applied for all the foreseen and unforeseen risks.

In the first period two critical risks have occurred and have been adequately mitigated (risk 3) or suitable plans put in place for mitigation as required (risk 1).

In the second period only one risk have occurred and have been adequately mitigated (risk 2). The change of the main project manager does not reflect on the tasks schedule or quality of communication among partners.

The project has finished. Risk management was very good during the course of the project.

4. Does the project respect the 'do no significant harm' principle?

- Yes
- No
- Partially

<input type="radio"/> Not applicable
<p>The project does respect the do no significant harm principle.</p>
<p>5. Is the gender dimension appropriately taken into account?</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The project team confirmed that there are a number of women on the project. The facilities being developed are not gender-specific.</p>
<p>6. Does the project respect the commitments concerning open science as described in the DoA? Is it undertaking additional open science practices?</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>Galaxy is a free, open-source system for analyzing data, authoring workflows, training and education, publishing tools, managing infrastructure. The ESG project packaged workflows and their run provenance as machine-actionable RO-Crates, assigned PIDs, and published them to WorkflowHub for discovery, reuse, and citation. This provides a consistent, standards-based way for others to find, repeat, and adapt ESG methods. WP2 is introducing FAIR workflows onto the EOSC. WP5 showed the influence of the project, promoting broader community uptake and supporting Open Science best practices. Its impacts are visible in scientific uptake and reuse, in infrastructure readiness and security, and in the diffusion of FAIR and open-science practices across communities. There are 47 training materials which aligned to released workflows and more than 565 TIIaaS-supported sessions, the project ESG apply FAIR in practice for researchers and Research Institutes, including outside life sciences.</p> <p>The project delivered 128 open-access publications (deposited with complete metadata), open-source code (GitHub/GitLab), and formal registration/archiving of workflows and related research objects in EOSC-recognised repositories (e.g., Zenodo, OpenAIRE, WorkflowHub).</p>
<p>7. Is the project adequately integrating social sciences or/and humanities? (for SSH topics)</p>
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
<p>There is no specific requirement to integrate social sciences and/or humanities.</p>
<p>8. Have the ethics/security deliverables due for the current period been adequately addressed and approved?</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The partners focus on comprehensive understanding of the ethics considerations throughout the project's duration.</p>
<p>9. Did the fellows/staff members demonstrate sufficient knowledge of the research project? (for Marie Skłodowska Curie actions)</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially

<input type="radio"/> Not applicable
The project staff participating in the meeting were highly knowledgeable and enthusiastic about their work.
10. Were the fellows aware of their rights and obligations as a Marie Skłodowska Curie fellow? (for Marie Skłodowska Curie actions)
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
Not applicable
11. Did any issues requiring REA follow-up arise during the meeting? (for Marie Skłodowska Curie actions)
<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
12. Has the project effectively addressed the relevant standardisation aspects in R&I activities?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
Project claims 5 standards. In addition, it follows EOSC-wide interoperability guidelines and standards, such as FAIR-IMPACT. For example, GTN and WorkflowHub records used shared standards. The project representatives have participated in technical committees.
13. Did the EIC beneficiaries prioritise IP protection over dissemination when applicable, particularly with regards to results with market potential?
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
Not applicable
14. Have the comments and recommendations from previous project reviews been taken into account?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The comments and recommendations from the previous project review have been taken into account..</p> <p>4 recommendations were provided in the second project's assessment report. They were all taken into account from consortium, namely:</p> <p>1)attention to security and IPR -the team was constantly hardening the infrastructure during the project, responding to CVEs and streamlining the process in the ISO 27001 framework</p> <p>2)to promote the website and introduce the work to a wider set of stakeholders -The ESG project and the Galaxy platform have been actively promoted across a variety of research communities and more than 25 events. During the ESG project, the GTN expanded its resources by developing additional tutorials, forming new learning pathways for new scientific</p>

communities, which attracted over 1.7 million visitors to the platform during this project, there are 128 publications. User engagement reached over 142,000 registered users.

3) to make a training needs analysis, training plan for each of the use cases, a user requirements survey - Training needs were assessed through multiple channels (surveys, EOSC OA5, collaboration with Skills4EOSC project).

4) to develop further the integration of existing data repositories beyond EOSC, such as the EHDS, into the Galaxy - The project has actively engaged with other initiatives such as EOSC4Cancer, there is access to 38 external data repositories (Zenodo, BERD). The project introduced a “Bring Your Own Data” (BYOD) concept.

3. IMPACT

1. Is the proposed pathway to achieve the expected outcomes and impacts still credible?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
The work carried out in the third reporting period contributed to the expected impacts detailed in the DoA. The project will have a wide impact on the European research and EOSC community, especially among users of Galaxy (researchers, educators, and citizen scientists). The project has a number of positive impacts reaching out to society in general with some selected important impact areas, such as, science (Biodiversity and Climate Science for human health, Materials Science, and Astrophysics), innovation in ICT area.
2. How will the project have an impact on policy making (if any)?
<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
There is no specific policy.
3. Please indicate the EU headline priorities to which the project has contributed or will contribute to.
<input checked="" type="checkbox"/> European Green Deal <input type="checkbox"/> Economy that works for people <input checked="" type="checkbox"/> Europe for the digital age <input type="checkbox"/> Promoting the European way of life <input type="checkbox"/> A stronger Europe in the world <input type="checkbox"/> A new push for democracy
These are the priorities highlighted by the project.
4. Are the measures to maximise impact still suitable? (n/a for EIC Pathfinder)
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
The measures to maximise impact are suitable. The marketing communications strategy in the ESG project raises awareness of the project, its activities, and ambitions, as well as the network and services, and highlight the impact these have on the community. The project has effectively identified stakeholders, composes clear messaging and positions statements to address the scientists, innovators, and investors to advance the transition towards a open science and FAIR using of data. The project had publications on conferences, a web site, blog posts, social media and tutorials.
5. Are the measures for public/stakeholder engagement properly implemented? (for EIC Pathfinder)
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially

<input type="radio"/> Not applicable
<p>The ESG's communication strategy enhances visibility, inclusivity, and coherence of ESG's messaging. It is directed to the internal and external communications with end users. In the end of the project there are actively collaborations with a wide array of institutions, research infrastructures, and strategic initiatives. This is a significant advancement in both scale and impact according to recommendation from first period.</p>
<p>6. Translation into innovation (for EIC Pathfinder)</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>This project promotes reproducibility, innovation, and successful reuse of scientific findings by supporting Open Science. It developed WorkflowHub toward TRL-9 operational standards, the WorkflowHub knowledge graph, the FAIR Computational Workflows guidelines, a Snakemake workflow with 5 stages, the TESP microservice (TESSAP), the OI framework for deploying and managing usegalaxy national instances.</p> <p>The project has concentrated on creating workflows as academic outputs by means of cross-system direction, technical innovation, and cooperation with the larger research community. A prototype tool to extract workflow references from scientific papers and turn them into structured, verifiable RO-Crate objects (GitHub) was developed.</p>
<p>7. Empowering key actors (for EIC Pathfinder)</p>
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The project is empowering the use case participants to take advantage of new compute facilities. Multiple subdomains developed to serve specific research communities.</p>

4. IMPLEMENTATION

1. Has the project been efficiently and effectively managed (including risk management)?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The project has been efficiently and effectively managed. Communication within the consortium was efficient. All the project outputs have appropriately been completed, within the available budget. Overall, all deliverables have been submitted on time.</p> <p>The weekly meetings were to provide a coherent management framework to enable the project to deliver results efficiently and effectively, applying quality control and optimizing costs, time and effort. There was a very good coordination management in many dimensions, such as the management of the project finances, the ICT tools and systems used with the project, the prototypes lifecycle Management.</p> <p>Risks have been monitored effectively and critical risks occurring have suitable mitigations.</p>
2. Have all the obligations described in the grant agreement (contract) been respected by the participants (including ethics and security requirements, if applicable)?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>The management of the project was in line with the obligations of beneficiaries. The consortium has fulfilled all its obligations including ethics requirements. Risk and innovation management were applicable and have been properly implemented.</p> <p>All the obligations described in the grant agreement have been respected by the participants.</p> <p>All deliverables (11) have been provided by the consortium with good quality.</p> <p>All the milestones (12) have been achieved.</p>
3. Have all participants contributed to the project according to the work-plan described in the DoA?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
<p>All participants have contributed to the project according to the work-plan described in the DoA. The final period fully implemented all project deliverables and objectives, on time and within budget.</p>
4. Have the EIC beneficiaries protected the IPR of the results with market potential (foreground) as planned in the DoA (including patents filing or any other formal IPR protection)? How do the beneficiaries plan to get return on investment over the generated IP? (for EIC Pathfinder)
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
<p>The project does not generated new IP.</p>
5. Have the participants disseminated project results (foreground) and have they communicated project activities and results as planned in the DoA (e.g. through publications, a page for the project on social media, press-releases, a website, video/film, etc.) and have they included a reference to EU funding?

- Yes
- No
- Partially
- Not applicable

A good dissemination plan has been developed and executed by the project in this last period. The project produced and published its useful results and addressed the key stakeholders through the corresponding channels. The members of the consortium have published a total of 128 articles. Project's support of partner activities and more than 25 events represents valuable dissemination channels. The communications plan provided details on each objective, actions to be taken to achieve it, audiences targeted by the actions, channels used to reach the audiences and frequency of the actions to be executed.

6. Has the plan for the exploitation and dissemination of the results (if required) been updated and implemented as described in the DoA, in particular as regards intellectual property rights? Give details if a (further) update is needed. How effective were the measures planned? (only for final report)

- Yes
- No
- Partially
- Not applicable

The plan for exploitation and dissemination of the results has been implemented as described in the DoA. The project does not generated new IP.

7. If the plan for exploitation and dissemination provides for exploitation primarily in non-associated third countries, have the participants explained how that exploitation is still in the EU interest? Is it acceptable?

- Yes
- No
- Partially
- Not applicable

There is no exploitation planned in non-associated third countries.

8. Are the critical implementation risks and mitigation actions described in the DoA still relevant?

- Yes
- No
- Partially
- Not applicable

The project has finished. Risk management was very good during the course of the project. Risks have been appropriately managed overall. Risk mitigation measures were applied for all the foreseen and unforeseen risks. In the first period two critical risks have occurred and have been adequately mitigated (risk 3) or suitable plans put in place for mitigation as required (risk 1). In the second period only one risk have occurred and have been adequately mitigated (risk 2). The change of the main project manager does not reflect on the tasks schedule or quality of communication among partners.

5. RESOURCES (N/A FOR LUMP SUM AND UNIT GRANTS)

1. Were the resources used as described in the DoA and were they necessary to achieve the project objectives?
<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
The project is 36-month project with a budget of 3998009 Euros (grant is 3531124 Euros) . The resources used in the ESG project align with the Description of Action (DoA). The resources have been used as planned and they are necessary for the achievement of the project objectives.
2. If there are significant deviations from planned budget, have they been satisfactorily justified?
<input type="radio"/> Yes <input checked="" type="radio"/> No <input type="radio"/> Partially <input type="radio"/> Not applicable
There are no significant deviations from planned budget and partners adequately justified them with relocation of some personal and material costs.
3. If unforeseen subcontracting costs are declared, do you agree with them?
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
No unforeseen subcontracting costs.
4. If unforeseen in-kind contributions costs are declared, do you agree with them?
<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> Partially <input checked="" type="radio"/> Not applicable
No unforeseen in-kind contributions.