EUROPEAN COMMISSION
EUROPEAN RESEARCH EXECUTIVE AGENCY

REA.C – Future Society
C.4 – Reforming European R&I and Research Infrastructures

GENERAL PROJECT REVIEW CONSOLIDATED REPORT

Grant agreement (GA) number:	824064
Project[1] Acronym:	ESCAPE
Project title:	European Science Cluster of Astronomy & Particle physics ESFRI research infrastructures
Type of action:	RIA
Start date of the project:	01/02/2019
Duration of the project:	48
Name of primary coordinator contact and organisation:	Giovanni Lamanna (CNRS)
Period covered by the report:	from 01/08/2020 to 31/01/2022
Periodic report/Reporting period number:	2
Date of first submission of the periodic report (if applicable):	22/02/2022
Amendments (latest AMD concerning description of the action)[2]	22/09/2021 (AMD-824064-32)
Date of meeting with consortium (if applicable):	02/03/2022
Name of project officer:	Christos CHATZIMICHAIL
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[1] 'Project' means the same thing as 'action'.
[2] Only amendments to the description of the action (DoA; AT21) are relevant for general project reviews since they always have to be carried out against the latest version of the DoA

1. Overall assessment

1. Overall assessment
Project has achieved most of its objectives and milestones for the period with relatively minor deviations.
2. Significant results linked to dissemination, exploitation and impact potential
Project will likely provide results with significant immediate or potential impact in the next reporting period (even if not all objectives mentioned in the Annex 1 to the GA were achieved). The project has taken a very strategic approach by putting EOSC into the centre of its activities and by integrating not only the project partners' activities, but also establishing an impactful and continuous exchange with the other ESFRI clusters, thus delivering a truly interdisciplinary approach. The project aims at aligning and further developing existing technologies and research infrastructure services, develop tools for integrating heterogeneous data sources for and from research. The articulated ambition (i.e., setting global standards) is very high, but the project is very well suited for achieving this goal. Very good work was done in several directions on scientific community engagement and also in citizen science involvement. Active participation of the ESCAPE coordinator in 2020 to the set-up of the EOSC Future work programme as well as in 2021 to establish a dedicated consortium contributed significantly to the networking objectives of the project. The dissemination strategy to on-board the ESCAPE community is very good. Massive online training events (about 1000 users/visitors) have been organized online to raise awareness and teach all the basic skills/technologies the community would need to move to Open Science (best software practices, etc.). Then the offering is completed by bespoke trainings on data management interoperability where learners pro-actively participate, joining the training with their own (mini-)projects where the services, either developed or used by the ESCAPE or other EOSC projects are exploited by learners with the help of "tutors/mentors". Such training is, of course, more demanding and a much smaller number of learners are on-boarded, but each of them can become ambassadors of the ESCAPE & EOSC services they have used during the training. A significant progress was achieved on interoperability standards of tools definition for the multi-messengers' investigation with the future advent of the ESFRI projects currently in construction. However, the service connector system that provides a standardised, plugin-based mechanism for integrating new services needs to be better advertised to providers and service developers, including SMEs: the potential for innovation is under-exploited. ESCAPE Citizen Science projects are excellent, with the very impressive participant numbers and results demonstrated. Moreover, the presentation during the project review of the approach used for ESCAPE Citizen Science has clearly demonstrated a coherent, well though-out conceptual view of citizen science potential as a valuable methodological tool of scientific investigation, complementing a more established view of outreach and educational benefits of citizen science activities. As a result, the reviewers recommend to further disseminate this conceptual methodological approach (as either an academic publication or a white paper) detailing the methodology, best practice and clearly highlighting multiple benefits of citizen science. It was also noted, that impressive results from the citizen science projects could be even more exploited and used to demonstrate the innovation potential of ESCAPE & EOSC and their portfolio of services (i.e., plugin-based service integration).
3. General comments
The European Science Cluster of Astronomy & Particle physics ESFRI research infrastructures (ESCAPE) bring together seven ESFRI facilities (CTA, ELT, EST, FAIR, HL-LHC, KM3NeT, SKA), two pan-European organisations (CERN, ESO), an ERIC (JIV-ERIC) and a French-Italian private Consortium (EGO-Virgo) in astronomy and particle physics research domains to support the EOSC implementation. The project has made significant progress and has already delivered some important results demonstrating its potential impact. The work plans were developed in close consultations with all participating project partners and most of the planned activities are progressing in full according to these implementation plans. The ESCAPE management (including adequate support team) and advisory structure were consolidated, and the ESCAPE project is well embedded into the environment of the five ESFRI cluster. The networking with these projects was intensified and long-term commitment to the implementation of the EOSC was produced. Steps have been taken in this respect and several activities started to build a European cross-border multidisciplinary environment for sharing data in research and innovation. However, this main aim of the project has, despite some progress, not been reached yet.

The approach chosen by the project is very good and aims at taking advantage of existing technologies/services to integrate heterogeneous resources and facilitate day to day research work (rather than re-inventing the wheel).
- The Data Lake has been implemented with many different storage (INFN-CNAF, INFNROMA, INFN-Napoli, DESY, SURF-SARA, IN2P3-CC, CERN, IFAE-PIC, CNRSLAPP and GSI) and integrated with commercial clouds (Swift/S3 storage endpoints).
- The work done through the collaboration with the FENIX project to enable sciences to make use of HPC resources with Data Management capabilities to be able to access data, and steer/move data the HPC facilities is very good and would be beneficial beyond the ESCAPE and FENIX projects.
- Another interesting work is the Rucio extension to connect the Data Lake Infrastructure with Jupyter Notebooks (JupyterLab extension). This work would also be beneficial for many EOSC services based on Jupyter notebooks, including EGI-Notebooks. There are lots of potential collaboration that are unexploited by the consortium.

- The work done for the introduction of a token-based authentication and fine-grained authorisation on ESCAPE Data Lake (authentication and Authorisation mechanism) has well progressed.
- The Open-Source Scientific Software and Service Repository is also a service that could be deployed/reused by other scientific domains: the guide for on-boarding new project (scientific software, container images, or repositories with full analyses environments) is very good; easy to follow and foster best software practices. What is unclear is if additional metadata are added. Also, it is recommended to put more emphasis on FAIR software practices. The search functionality is rudimentary.
- The successful development of the service connector system that provides a standardised, plugin-based mechanism for integrating new services
- Satisfying progress for connecting ESFRI projects to EOSC through VO framework.

All dissemination activities have suffered from the Covid-19 pandemic. The overall strategy used to on-board researchers is very good with a combination of massive online training about tools and foundational skills required for moving to Open Science (such as best software practices) and bespoke training dedicated to ESCAPE & EOSC services. The ESCAPE Summer School was excellent and well attended. The training material is available online with videos.
The training strategy itself could be explained to learners on the ESCAPE website (to help them defining their personalised learning path). In addition, the training material (available at https://www.euro-vo.org/scientific-tutorials/) and the outcome of the training (mini-projects/presentations delivered by the learners) could be make available online (FAIR training).
The role of ESCAPE in the construction of EOSC is key but could also be increased by taking the initiative to explain its approach to other ESFRI cluster projects. The ESCAPE science demonstrators and citizen science projects could be better highlighted/exploited (and not only though EOSC-Future).
ESCAPE could also identify more actively "EOSC" projects where large amounts of data needed to be analysed to engage with them and elaborate concrete use cases. It is important for other scientific communities to "apply" these technologies to their own use cases: this would help to engage with more users and increase the benefits of EOSC.
Outreach activities towards citizen are very good (including future plans) with the ESCAPE citizen science project Radio Galaxy Zoo.

4. Recommendations concerning the period covered by the report

Several clarifications / improvements are required in the Periodic Report:

R1. More details in the Periodic Report are required on the necessary update of the Exploitation and Dissemination Plan, particularly in relation to future sustainability and extended collaboration with other EOSC-related projects.

R2. Add to the Periodic Report details Consortium's response to the recommendations given by the External Experts Advisory Board (EEAB) – see Appendix 1 of PR_CORE_2. Such explanations were given during the review meeting – please formally record them in the PR_CORE_2.

R3. Add to the PR_CORE_2 for the WP6 progress a table of target KPIs for communication activities vs achieved KPIs. Such table was demonstrated during the review meeting – please formally record them in the PR_CORE_2. Moreover, in the dissemination activities a large number of other persons approached is reported (257000), however it is not made clear who belongs to this category, it is also not clear how were these numbers measured. Please add explanation.

R4. Parts of the report have been copy pasted from the PR_CORE_1 and it is not always obvious which progress has been achieved in the first phase, and which action shall be attributed to the second project phase (e.g. the establishment of the ESCAPE External Expert Advisory Board). This information shall be clearly distinguished.

R5. Ten data set are mentioned in the PR_CORE_2, but several are not publicly available. In addition, only one data set is reported in the project management system. Please provide necessary clarification on this in the PR_CORE_2.

R6. Add to the PR_CORE_2 a detailed financial information in a tabular form, with a breakdown per WP/per partner planned vs actual, for the reporting period 2 and in relation to the overall duration of the project. Any deviation from the planned amount, shall be explained and justified in the PR_CORE_2, together with the impact of over-spending. It has been noted, that some of the financial information presented in graphs during the review was very difficult to interpret.

5. Recommendations concerning future work, if applicable

FR1. Increase communication to better disseminate the results of the project and promote its strategic conceptual and unified vision of EOSC outside the ESCAPE community, including other ESFRI cluster projects. This would also benefit the ESCAPE community, through new collaborations/projects (for instance, exploitation of services related to the ESCAPE data lake, citizen projects and engagement with users), recognition of the ESCAPE community as a leading Open Science and actively contributing to the construction of EOSC.

FR2. Improve the way the training materials are "presented" online by i) provide an overview of the training strategy (from foundational skills for moving to Open Science to bespoke trainings on ESCAPE & EOSC services for the community) and detail the learning objectives and key concepts taught; ii) highlight the outcomes of the WP5 workshops, including addition of the (mini-)project topics of the participants and their final presentations. This could also lead to a more systematic Train the Trainer program through "ambassadors" of ESCAPE community Open Science services.

FR3. Increase effort towards the development of common standards for Virtual Research Laboratories.

FR4. Systematically disseminate your coherent, well though-out conceptual view of citizen science potential as a valuable methodological tool of scientific investigation, complementing a more established view of outreach and educational benefits of citizen science activities (as either an academic publication or a white paper) detailing the methodology, best practice and clearly highlighting multiple benefits of citizen science.

FR5. Consider more systematic approach to the continuous measurement of the effectiveness of your engagement with the user community (e.g., surveys / post-use questionnaires / resource consumption stats).

FR6. Increase visibility and widen dissemination of citizen science projects in other domains (Social Sciences and Humanities, Urban Planning and Policies etc.) in order to demonstrate the versatility of the proposed citizen science methodologies.

FR7. The ESCAPE project is very well positioned to be an amplifier of the voice of data producers and data curators in EOSC and Open Science community. Therefore, in the remaining period consider continuation of useful value-added collaborations with other EOSC-related project, even though there is no formal contractual obligation for it, as the lessons learned and requirements elucidated will help to emphasise the importance and shape the future development of the scientific clusters in Europe (i.e., strengthening the "S" in EOSC).

FR8. Although the ESFRI RIs serve as a pilot, it is currently not convincingly demonstrated that the concept can be transposed to the whole research community, and it is not fully clear, if this concept can already be presented as a consolidated service to the end user. Please consider better articulation of this wider relevance and appeal (potentially through the implementation of the recommendations FR1, FR2, FR4 and FR6 above.)

FR9. ESCAPE has the capacity to be a natural leader of the other RI related projects when it comes to the contribution to the EOSC concept evolution and the implementation of concrete EOSC services. These services must be developed according to the user needs and it is recommended for ESCAPE to continue integrating the knowledge that was accumulated by the RIs and piloted in interactions with user communities and the broader society.

2. Objectives and workplan

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

Overall, the progress reported in line with objectives and work plan as specified in the DoA. The project has made a significant progress in achieving the main planned objective for the current review period and the actions are implemented in interplay of the various work packages. There were delays during the initial part of the project and several deliverables and milestones have been delayed but the consortium has well recovered. Also, the project duration has been extended, given a very good buffer to the ESCAPE consortium.
A number of Deliverables and Milestones have been delayed due to COVID-19. These delays have been communicated and approved by the EC project office and also recorded in the relevant Amendments (AMD-824064-27 and AMD-824064-32). A detailed list is submitted in the Periodic Report.

It was also noted by the reviewers, that the timeliness of the submission of the deliverables was significantly improved in comparison with the first reporting period. This clearly demonstrates the effectiveness of the project management and the overall commitment of the team.

The huge diversity of the project consortium and the huge portfolio of the actions makes further integration of the work packages to a challenge. This will most probably be achieved only after the final goal is reached. Several of the activities (e.g. Virtual observatory) are self-standing and form “independent” components of future ESCAPE services and only several partners are providing data. Though, ESCAPE participates in the International Virtual Observatory alliance only limited progress has been made in developing common standards and on developing further the concept of virtual research laboratory.
The ESCAPE project objectives and the understanding of the EOSC ecosystem are well understood by all the key staff. Collaboration within the different work packages is very good.

WP1: Management, Innovation, Networking and Dissemination

Despite changes in personal and related difficulties that can arise in such situation, the day-to-day management of the project is very good. Internal communication is clearly very effective.
The potential for innovation is under-exploited and measures to better disseminate the project results and the strategy adopted to increase ESCAPE participation in EOSC should be taken. ESCAPE can clearly have a lead role; beyond the ESCAPE community.

WP2: ESCAPE Data Infrastructure for Open Science (DIOS)

Two deliverables have been produced. The work in this work package is very good and could be reused in many other fields where scientific data lake is beneficial. ESCAPE can clearly lead the development of a “common” and standardised approach for scientific data lake in EOSC. To this regard, the reviewers recommend to intensify their dissemination and communication towards other ESFRI cluster projects. The development on token-based authentication is also very good with large potential impact. The DAC21 exercises to illustrate the different functionalities/aspects of the system are not sufficiently highlighted, for instance on the ESCAPE website.

WP3: E-OSSR

The ESCAPE Open-source Scientific Software and Service Repository (OSSR) is now fully operational but has started to be populated with software and services. The last part of the project will be critical as a significant increase in the number of scientific software and services are expected to be added: some adjustments are expected, in particular the documentation on how to contribute. Advanced search (beyond zenodo search) to exploit the metadata and facilitate the reusage of software and services would be beneficial. Training material and online training event have been very successful.

WP4: Connecting ESFRI projects to EOSC through the VO framework

The work done in this work package has well progressed. The interoperable data school requires considerable effort (tutors, learners need to be selected with valid and valuable mini.projects, etc.) and the outcomes of this training are not very well highlighted and exploited. A second edition will take place in March 2022. Overall on-boarding is good.
During the last part of the project, the work could focus on the development of common standards for Virtual Research Laboratories.

WP5: ESFRI Science Analysis Platform

The progress is very good. The API gateway and the service connector system that provides a standardized, plugin-based mechanism for integrating new services are full ready but need to be better advertised to external providers and service developers. The ESAP "shopping basket" could also potentially become central to EOSC for the creation of "bundle services". Showcases/highlights need to be better communicated. This is also important to go beyond the ESCAPE community and seek for additional collaboration for the development of concrete use cases demonstrating data orchestration, data lake as a service, OSSR integration and Virtual Laboratory. WP6: Engagement and Communication Citizen Science projects are exemplary. The reviewers recommend to publish a white paper on the methodology and process for effective Citizen Science projects.

2. Are the objectives of the project still scientifically and /or technologically relevant?	Yes
The objectives of the project are still scientifically and technologically relevant, and the methodology is appropriate. The ESCAPE project is contributing linking the ESFRI research infrastructures in astrophysics and particle physics to EOSC through the multi-messenger approach and the data lake concept. The ESFRI RIs serve as a pilot, however, it is not convincingly demonstrated that the concept can be transposed to the whole research community, and it is not fully clear, if this concept can already be presented as a consolidated service to the end user. ESCAPE contribution to EOSC goes beyond the astrophysics and particle physics communities. However, ESCAPE could also enhance its role within EOSC and take the lead for generic services such as data lake, training and on-boarding communities to EOSC.	

3. Are the critical implementation risks and mitigation actions described in the DoA still relevant?	Yes
The critical implementation risks and mitigation actions described in the DoA are still relevant. Risks related to staff shortage have materialized but mitigations have been put in place. The Covid-19 pandemic has also impacted the project but mitigation actions towards communication and dissemination have been successful; for instance, online training events were very effective and successful, reaching far more users than in-person training events.	

4. Have the pilots/case studies started to showcase innovative results as described in the DoA?	Yes
Pilots/use cases/demonstrators have started and already showcase innovative results. More results are expected during the last part of the project. For example, the implementation of the data lake pilot has just started and it includes storage endpoints from the majority of the ESCAPE partners. Very promising is also the file transfer concept and the VO developed on the IVOA standards. Although these services are developed as scientific domain specific by ESCAPE, strong overlap exists to other domains, which is very useful.	

5. Have the ethics deliverables due for the current period been adequately addressed and approved?	Not applicable
The ethics requirements (D7.1) were delivered during the First reporting period, no updates were required during the Second reporting period.	

6. Have the comments and recommendations from previous project reviews been taken into account?	Not applicable
This is the first formal review of the project, no formal recommendations were given to the consortium before.	

3. Impact

1. Does the work carried out contribute to the expected impacts detailed in the DoA?	Yes
The work carried out contribute to the expected impacts detailed in the DoA. This is due to its strategic understanding of the EOSC ecosystem and its ability to successfully coordinating all the ESCAPE RIs. However, to fully realize all the expected impacts, the ESCAPE projects should better disseminate its strategic vision to other ESFRI cluster projects and other EOSC projects (please see Future Recommendations section). The impact of ESCAPE is strongly linked to other EOSC-related projects, as it forms a part of a long chain of projects addressing various aspects of EOSC. These projects are often intimately interlinked and all contribute collectively to the ESOC implementation. In particular, the advanced cooperation among the ESFRI clusters and the related communities shall be utilised to a maximum extent to amplify the benefits of the generalised schemes and solutions to be subsequently embedded within the EOSC. ESCAPE has made significant progress not only in the project implementation, but it has the capacity to be a natural leader of the other RI related projects when it comes to the contribution to the EOSC concept evolution and the implementation of concrete EOSC services. These services must be developed according to the user needs and ESCAPE has made significant work in integrating the knowledge that was accumulated by the RIs and piloted in interactions with user communities and the broader society (see FR9).	
2. Does the work carried out follow the plan detailed in the DoA to enhance innovation capacity, create new markets opportunities, strengthen competitiveness and growth of companies, address issues related to climate change or the environment, address industrial and/or societal needs at regional level or bring other important benefits for society? Give information on the relevant innovation activities carried out (prototypes, testing activities, standards, clinical trials) and/or new product, service, reference materials, process or method (to be) launched to the market, if any.	Partially
Although the project does not create immediate market opportunities, currently the consortium also does not make any particular effort to communicate the innovation potential of its services (data lake as a service, etc.) while these innovations could potentially create new market opportunities.	
3. Does the work carried out contribute towards European policy objectives and strategies and have an impact on policy making?	Yes
The work carried out clearly contributes towards European policy objectives and strategies, including the EOSC strategic implementation and the European Open science policy. It pilots the data management practices and designs dedicated tools for interoperable data sets based on ESFRI RIs in astrophysics and particle physics, but transferable to other research domains. These tools must be preserved and implemented into EOSC. In particular the applicability of the Data Lake concept, i.e., a distributed data infrastructure for manipulating, managing and deliver on demand data at exa-scale level. It is worth to note that several RIs (e.g., CTA & SKA) have already implemented sizeable parts of these services making them to community standards. Also, the file transfer services developed / co-designed together with the Data Lake shall flow directly into the EOSC core services. However, the impact on policy making could be increased with better communication of the project results to the relevant stakeholders and resolving identified bottlenecks towards Open Science (sustainability, funding issues, rewarding researchers, etc.) (please see the Future Recommendations section).	
4. Does (or will) the work carried out have an impact on SMEs?	Partially
No specific effort towards SMEs has been done by the project. The service connector system that provides a standardised, plugin-based mechanism for integrating new services needs to be better advertised to providers and service developers, including SMEs (data lake as a service, etc.): the potential for innovation is under-exploited. (see also R1).	
5. Have the beneficiaries reached gender balance at all levels of personnel assigned to the action? If not, have the reasons been explained in the periodic report?	Partially
The gender balance is not reached and there is no clear justification/explanation provided in the periodic report whether any attempts were made to improve the situation.	

4. Implementation

1. Has the project been efficiently and effectively managed?	Yes
Delays at the beginning of the project have been successfully mitigated. The project is well managed. The vision and objectives of the projects are well communicated internally and the overall internal communication is very good.	
2. Is the management of the project in line with the obligations of beneficiaries (including ethics and security requirements, risk and innovation management if applicable)?	Yes
The management of the project is in line with the obligations of beneficiaries. The project management reflects properly the complexity of the project consortium and serves the purpose in all the aspects.	
3. Is the contribution of each beneficiary in line with the work committed in the DoA? (applicable only to multibeneficiary projects)	Yes
The contribution of each beneficiary is, overall, in line with the work committed in the DoA. The project faced a number of challenges related to staffing which induced delays. The project has been extended in duration due to the Covid-19 pandemic. There are deviations in the usage of resources, they are, overall, explained (although please see R6) and not related to any lack of commitment of a partner. The partners demonstrate very strong commitment to the project.	
4. Have the beneficiaries disseminated project results (foreground) in scientific publications as planned in the DoA (including the deposition of publications in open access repositories)? Do they include a reference to EU funding?	Yes
Scientific dissemination activities (workshop and conference presentations etc.) are generally in line with the initial dissemination strategy. The project's main focus is not the dissemination in scientific publications, nevertheless, a number of publications has been produced with reference to EU funding (and open access repositories). The number of publications reported (9) is rather modest for such a large and research-active consortium, therefore it is not clear what is the reason for it, as the project has produced very impressive results to report on. Moreover, the dissemination activities are somewhat unbalanced. Emphasis is put on their own website and the presence in Social media (647 posts). Several conference (13) and workshop (37) participations are reported, but no conference or workshop has been organised. This propagates in the estimates of persons reached.	
5. Have the beneficiaries disseminated and communicated project activities and results by other means than scientific publications (social media, press-release, the project web site, video/film, etc) as planned in the DoA? Do they include a reference to EU funding?	Yes
A lot of emphasis is put onto the social media communication and dissemination to the scientific community. Reference to the EU funding is included. Despite the Covid-19 pandemic, the project activities have been disseminated by other means than scientific publications, e.g., the citizen science project and other online training events. While the scientific community (91000), and the general public (2000) are well covered, the remaining stakeholder groups are either hardly reached (industry 11) or even not considered (Media, policy makers, etc.). A large number of other persons approached is reported (257 000), but it is not made clear who belongs to this category. It is also not clear how these numbers were measured (please see FR5). Outreach activities are achieved indirectly via the large-scale citizen science projects, with very impressive results. However, the multi-channel engagement with the wider society and general public is not the strongest point of the project and shall be improved after the COVID based restrictions are lifted. (see the Future Recommendations section).	
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? Is it appropriate?	Partially
The update is mostly related to the Covid-19 pandemic, with the appropriate relevant adjustments implemented. However, more details are required on the necessary update of the Exploitation and Dissemination Plan in relation to future sustainability and extended collaboration with other EOSC-related projects (please see R1).	
7. Has the data management plan (DMP) (if required) been updated and implemented? Is it appropriate?	Yes
DMP has been produced and is up to date and is very well elaborated. However, the transferability of the data lake concept for mastering large amounts of data to other scientific domains shall be further explored within the collaborations with the other ESFRI clusters projects and the EOSC AISBL task forces (please see FR9).	
8. Have the proposed institutional changes been appropriately promoted?	Not applicable

N/A

5. Resources

1. Were the resources used as described in the DoA and were they necessary to achieve its objectives? If there are deviations from planned budget, have they been satisfactorily explained? Have they been used in a manner consistent with the principle of sound financial management (in particular economy, efficiency and effectiveness)?	Partially
The financial resources were spent according to the planning, and are proportional to the tasks and the work done, which is in line with the DoA. The changes in allocation of resources are projected to the GA amendment. Larger overspending in the area of personal costs is observed, while due to COVID the other costs are not used. The project faced staffing difficulties and there are some deviations in the resources. The cost and usage of resources per work package and per partners should be provided, and any significant deviations should be justified. In particular, over-spending of some partners and for some tasks should be better explained, together with their potential impact on the project. Most of this over-spending has been sufficiently justified during the review, but it should be properly reported in the Periodic Report (please see R6).	

Annex 1

Expert opinion on deliverables

Deliverable number	Deliverable name	Status	Comments
D2.2	Assessment and analysis of performance of the first pilot data lake	Accepted	
D3.4	Establishing of innovation competence group (all hands meeting)	Accepted	
D3.5	Thematic training event - first school for software development and deployment in the EOSC	Accepted	
D3.6	Mid-term technology WP3 project progress report	Accepted	
D3.7	License and provenance model for the software and service repository	Accepted	
D4.3	First Science with interoperable data school	Accepted	The established concepts shall be further promoted
D4.5	Release of prototype machine learning enabled archive services providing value-added content to archives	Accepted	
D5.3	Performance assessment of initial Science Platform prototype	Accepted	
D6.4	Citizen science experiments with embedded educational resources (midterm)	Accepted	Excellent work, shall be better promoted
D6.5	Promotional education animation videos	Accepted	

Annex 2

Expert opinion on milestones

Milestone number	Milestone name	Achieved	Comments
MS1	Project Kick-Off meeting	Yes	Achieved on time
MS2	1st E-GA meeting. Governance entities (e.g. E-EB, E-EAB) and E-MST fully appointed	Yes	Achieved with a delay
MS3	1st E-EAB evaluation	Yes	Achieved with a delay
MS4	Mid-Term Review + E-EAB evaluation + Acceptance of periodic report 1	Yes	Achieved on time
MS5	E-EAB evaluation + Acceptance of periodic report 2	Partially	Periodic review is successfully passed, the revision of the Periodic Report 2 is requested.
MS7	First WP2 workshop on the initial design and goals of the first pilot data lake, prepare D2.1	Yes	Achieved on time
MS8	Initial pilot data lake with at least 3 core data centres	Yes	Achieved on time
MS9	Second WP2 workshop to analyse the performance of the pilot, prepare D2.2	Yes	Achieved on time
MS10	Expanded prototype – more data centres including 3rd party centres, demonstrate integrated data management tools, verify RI data accessibility from compute platforms including commercial clouds	Yes	Achieved on time
MS11	Extension of the data lake to efficiently serve data to external compute resources providers	Yes	Achieved on time
MS14	List of software and services	Yes	Achieved on time
MS15	Establishment of innovation competence group	Yes	Achieved on time
MS16	Software and service repository demonstrator	Yes	Achieved on time
MS17	Progress of common software and service proposition	Yes	Achieved on time
MS20	Presentation of progress and results and discussion of priorities at IVOA (1)	Yes	Achieved on time
MS21	Progress and priorities at IVOA (2)	Yes	Achieved on time
MS22	Progress and priorities at IVOA (3)	Yes	Achieved on time
MS23	Progress and priorities at IVOA (4)	Yes	Achieved with a delay
MS24	Hands-on workshop for data providers	Yes	Achieved on time
MS25	Progress and priorities at IVOA (5)	Yes	Achieved on time
MS26	Progress and priorities at IVOA (6)	Yes	Achieved on time

Milestone number	Milestone name	Achieved	Comments
MS27	First WP5 workshop on Science Platform design and requirements	Yes	Achieved on time
MS28	Review of preliminary report on requirements for ESFRI science analysis use cases by WP5 task leader and ESFRI representatives	Yes	Achieved on time
MS29	Initial science platform prototype with discovery and data staging	Yes	Achieved on time
MS30	Deployment of initial set of ESFRI software on prototype platform	Yes	Achieved with a delay
MS31	Second WP5 workshop to analyse prototype performance	Yes	Achieved on time
MS32	Integration of Science Platform with OSSR repository	Yes	Achieved on time
MS33	Integration of Science Platform with Data Lake expanded prototype	Yes	Achieved on time
MS36	First Citizen Science workshop	Yes	Achieved on time
MS37	Second Citizen Science workshop	Yes	Achieved on time
MS38	First periodic report	Yes	Achieved on time
MS39	Second periodic report	Partially	Report is submitted for the second periodic review, the revision is requested.