Amsterdam, 8 November 2018

Dear editor,

In the name of all co-authors, I thank you for the opportunity to submit a revised version of our manuscript. We took into account all the comments from the reviewers as explained point-by-point below. We believe that the revised version is improved due to the constructive reviewers' comments and suggestions. The changes are marked in red in the manuscript.

Looking forward to your decision, yours truly,

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Comments from the editors and reviewers:
-**Reviewer 1**

This is a timely paper that will be of interest not only to practitioners in the field, but to funding agencies/government, and researchers in general.
This was a clean and well-organized manuscript. I offer the following suggestions which may help to improve it in a few places.

1. Starting on page 4 you use the term "community of practice." Although it is defined in the reference, the term is used a few more times in the paper, so perhaps a succinct definition?

We thank the reviewer for this suggestion.
We added the following definition in page 4:
> A community of practice is a group of people who share some expertise in a specific field or common interest, and who learn from each other through information sharing [1].
> [1] J. Lave, E. Wenger, Situated Learning: Legitimate Peripheral Participation, Cambridge University Press, 1991.

2. Pg 7: Suggest you define XSEDE as NSF-funded HPC infrastructure. With all the acronyms, every bit helps.

Thanks for the suggestion – we now introduce d XSEDE and added a reference to the project as follows:

XSEDE (a high performance computing infrastructure project funded by the US National Science Foundation [1])
[1] Extreme Science and Engineering Discovery Environment, n.d. URL: https://www.xsede.org/, [Accessed: 28 Oct 2018].

3. Pg 9: In the paragraph starting on line 208 you mention the benefits of globally distributed, internet-accessible infrastructure, including for Africa. Does not *have to* be addressed here, but internet accessibility in Sub-Saharan Africa (excepting perhaps SA) is still a challenge. I think groups like H3 Africa BioNet have opted for different, local solutions. Maybe a mention?

We thank the reviewer for this comment. We have introduced a minor change referring to the accessibility issue in Africa:
> Building on information and communication technology investments over many years, Sci-GaIA supports today a virtual collaborative community through the African Pharmacology Science Gateway and the Community Health Portal for health professionals and patients.

Furthermore, we agree with the reviewer that looking into alternatives would be interesting and useful. We however consider this topic outside of the ambition of our current work, and we will take in into account in a follow-up paper.

4. From page 8-14 it seems like many of the paragraphs could be grouped into subheadings in this section (e.g. 'Open source', 'Linking infrastructure', 'Standards', etc.). May help readability, and i don't know if it may prompt authors to tweak how the content is organized.

Thanks for the suggestion. We sorted the text into paragraphs for the following themes: lowering barriers to e-infrastructures, enabling collaboration between (remote) researchers, sharing and linking infrastructure resources, driving standards and open science, and supporting teaching and new career developments. The text itself has not been changed.

5. Pg 11: Line 261 - COS should be the American English Center for Open Science

We thank the reviewer for this remark. We mean to refer to the Center for Open Science (https://cos.io/), and fixed the spelling into 'Center'.

6. It occurs to me that section 5 (Pg 14) might actually open with the content in the paragraph starting on Pg 15 line 373. I think most people close to the subject find measuring impact to be one of more difficult challenges. For less familiar readers, presenting this more explicitly might better frame the content in this section.

Thanks for this suggestion. We have included this sentence to introduce section 5:
> Science gateways have diverse goals, diverse user communities and diverse measures of success. But in all cases, measurement and characterization of impact is of fundamental importance.

-**Reviewer 2**

- Overall a good overview of recent efforts, although it does make me wonder if a more comprehensive list of key platforms/initiatives would be feasible as a follow-up?

We agree with the reviewer that a more comprehensive list would be interesting, and could be part of follow-up research.

1. Section 3 discusses existing programs, and provides funding for some, but not all. If feasible I would suggest adding information on funding levels for all. Likewise, if the user activity listed for Nectar was available for the others that would also be useful.

We agree with the reviewer that such information would be valuable, however this would require additional research. We have however added details where they were available, and also added the following paragraph to section 3.1:

Note that these programs are very diverse in organization and level of funding. This hampers their comparison, so the examples above should be taken as illustrations rather than a complete and systematic overview. In addition to these coordinated programs, there are also many gateways being developed and sustained with direct funding through their own research grants. Although it is difficult at the moment to estimate the actual budgets of these initiatives, the 400+ entries in the SGCI gateway catalog (400+) can serve as an indication of the impressive amount of investments taking place in this way.

2. Line 150, replace "form" with "provide".
3. Line 222 - delete 2nd "Apache".
4. Line 240 - add hyphen before "related".
5. Line 248 - delete "open".
6. Line 270 - replace "develop" with "tailor".
7. Line 417 - replace "to rely" with "a reliance".

Thanks for the suggestions, all changes have been applied in the revised manuscript.

-**Reviewer 3**

- This manuscript provides a comprehensive overview of current Virtual Research Environment and Science Gateway infrastructure.

The article is deliberately broad to encompass all aspects of the Science Gateways. In future articles, it would be useful to contrast this analysis to other research and development activities occurring outside of publicly funded research institutes and organisations. Are, VRE's used in commercial companies with large research and development operations (e.g. pharmaceutical, manufacturing. material design, information technology development).

We thank the reviewer for this suggestion, which could be indeed approached in a follow-up article.

Additional analysis on outcomes and impact areas from an international perspective would also be useful. The article references some initiatives designed to increase adoption, utilisation and sharing of research infrastructure global but does not reference the Global Impact of these infrastructures. Further discussion on implicit or explicit impact would be useful.

Impact work in this field has not evolved in a way that enables the impact of national and international programs to be collated into global figures.
We have amended the abstract, introduction, and starts of section 3 and 5, to specify that this paper documents national and international programs in this field to illustrate the global impact achieved by the sum effects of these national and international initiatives in collectively facilitating more efficient, open, and reproducible research worldwide. Section 5 already contains more detailed explanation of why it is difficult to collate the various measures being used into global indicators, and goes on to detail the different types of indicators that programs use.

Some specific comments regarding the article include:

- Figure 1 - Utilisation Graph - would be useful to have some explanation to why there was an increase in mention of VRE's in 2008 and then a fall.
- Also, is it unclear what has caused the decrease in presentations in Australia. Is this funding or no accurate reporting for those periods?

Thanks for pointing out your observations. We unfortunately do not have evidence to explain the reasons for oscillations in the number of presented papers, so we prefer to avoid speculation.   Note that 2012 there was no workshop in the USA, and in 2018 no workshop was run in Australia, therefore the decrease in presentations.

- VRE in open source environments with active code development - [33] and Galaxy [34], Drupal [35] and Django [36]. Suggest removing Drupal and Django due to their common usage outside of the VRE.

Thanks for the suggestion. We changed the text to

Many frameworks used to build science gateways are available on GitHub, for example Apache Airavata …