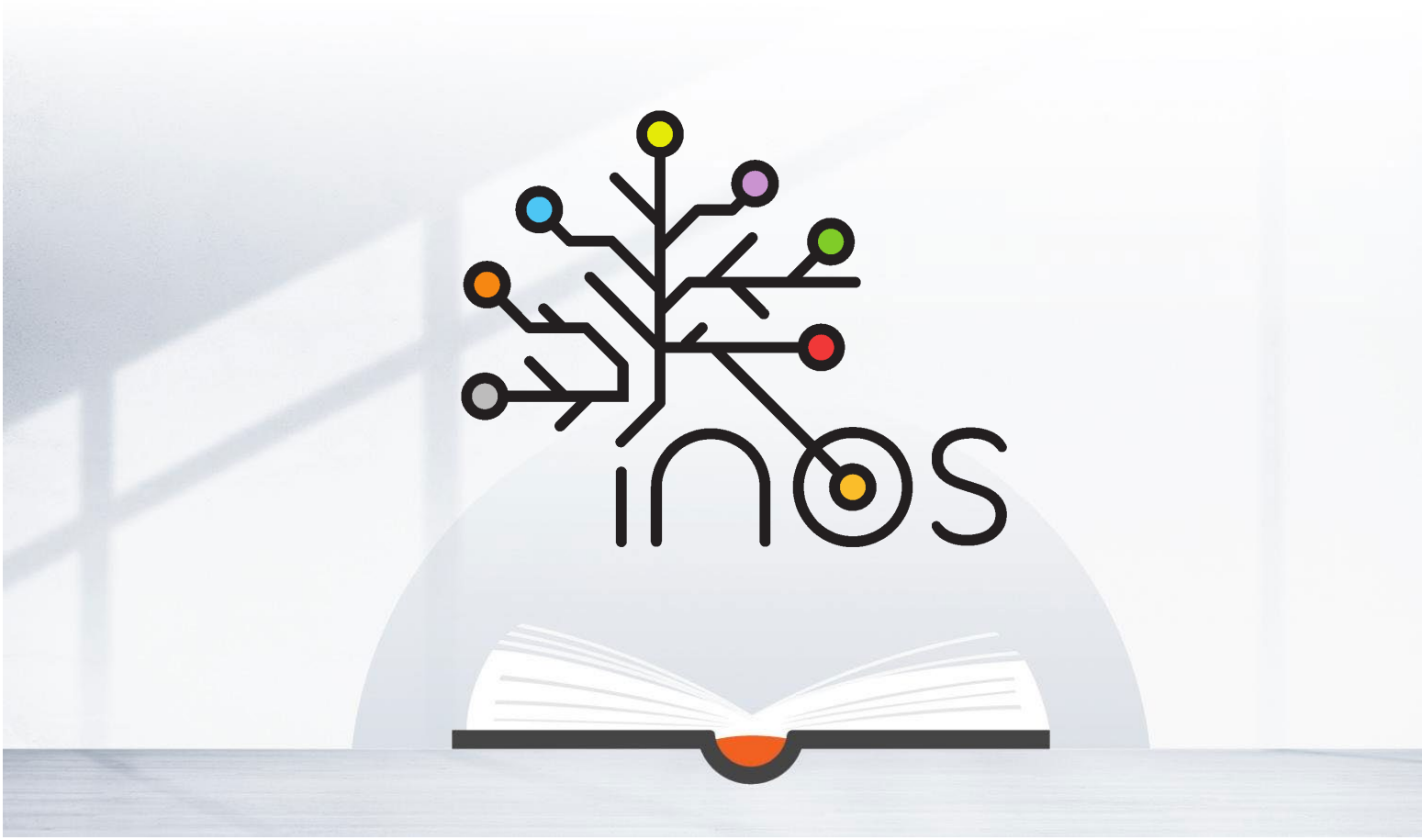
INTEGRATING OPEN AND CITIZEN SCIENCE INTO
ACTIVE LEARNING APPROACHES IN HIGHER EDUCATION



Vision and Policy Recommendations

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Consortium

	Name	Short Name	Country
1	Aalborg University	AAU	Denmark
2	Tallinn University	TU	Estonia
3	Web2Learn	W2L	Greece
4	University of Oulu	UO	Finland
5	University of Bordeaux	UBx	France
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List of Abbreviations

The following table presents the acronyms used in the deliverable in alphabetical order.

Abbreviations	Description
OS	Open Science
CS	Citizen Science
HEIs	Higher Education Institutions
HE	Higher Education
SDGs	Sustainable Development Goals
EU	European Union
EC	European Commission
SDU	University of Southern Denmark
UCL	University College London
LERU	League of European Research Universities

Executive Summary

This Vision & Policy document aims to inform the reader about the outcomes of several consultations with a range of stakeholders involved in the integration of Open Science (OS) and Citizen Science (CS) in Higher Education Institutions (HEIs).

Part A will begin by distilling interactions with key stakeholders into a coherent vision for the future of OS/CS in HE learnings and teachings. Practical examples will support these visions to illustrate how HEIs are integrating OS/CS concepts into their working activities.

Part B will offer concrete recommendations for cultural change in HEIs that aim to facilitate the integration of OS/CS practices. Four overarching recommendations will be made that HEIs can adopt in their strategic directions.

The document will be openly available and widely disseminated and aims to be used as an important resource to trigger further activities and the fruitful integration of OS (and CS) into active learning approaches in HEIs.

1. Introduction

Background

The INOS project (Integrating Open and Citizen science into active learning approaches in Higher Education curricula) has been working since 2019 to integrate and mainstream Open Science (OS) and Citizen Science (CS) in HE (Higher Education) curricula and teaching practices. Successful dissemination of project results and engagement of stakeholders plays a big role in achieving these objectives. Over three years, partners have sought to raise awareness of project goals and outputs and seek feedback from stakeholders to help facilitate the adoption and implementation of project results and contribute to policy and mindset changes in the community. INOS has strived to create a two-way interaction with key stakeholders by giving them opportunities to connect, engage and contribute to project outputs.

Work so far

Output 6 of INOS – **to engage, raise awareness and foster policy change –** has completed several stakeholder consultation events throughout the project. These consultations sought to gain the feedback, practical experiences and opinions of key stakeholders in the field of OS/CS in HEIs (Higher Education Institutes), including academic libraries. The full range of INOS stakeholders, as determined at the beginning of the project, can be seen in *Figure 1*.

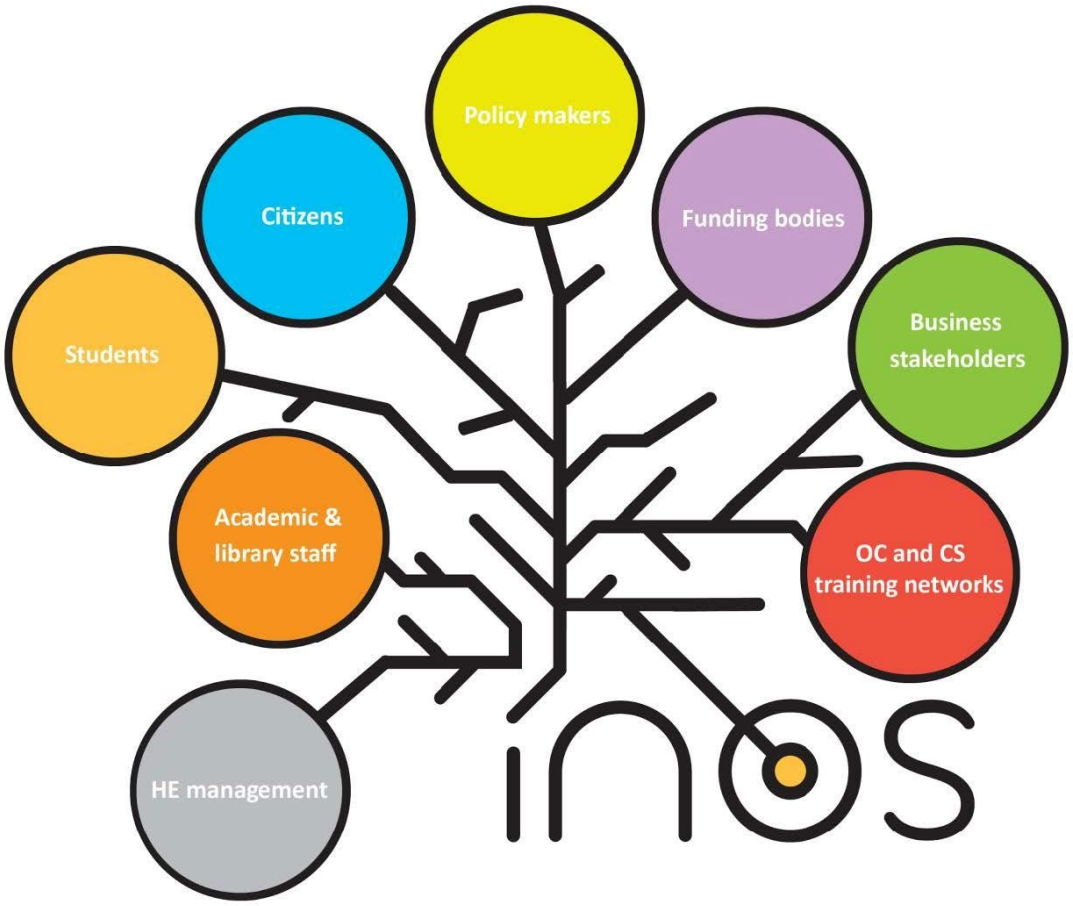

Figure 1- INOS Stakeholders

The consultations resulted in the publishing of three reports: 1) *Co-Creating a Shared Vision for Citizen Science in Higher Education: Pitfalls and Recommendations Report on two Vision-Building Workshops* (O6A1[1]), 2) *Roadmap for Capacity Building on Open Science and Citizen Science for Research Libraries*

[1] Kalaitzi, Vasso, Yankelevich, Tatsiana, & Buunk, Iris. (2021). Co-Creating a Shared Vision for Citizen Science in Higher Education: Pitfalls and Recommendations Report on two Vision-Building Workshops. Zenodo. https://doi.org/10.5281/zenodo.4837243

(O6A2)[2] and 3) *Report on Stakeholder Consultation Workshop* (O6A3[3]). All three of these reports will be considered in the current report, which aims to combine various stakeholder views into one coherent vision for the future of OS/CS in HEIs.

Scope

This Vision & Policy document builds on past results by distilling previous interactions with engaged stakeholders (O6A1 and O6A3). The document will be openly available and widely disseminated and aims to be used as an important resource to trigger further activities and integrate OS (and CS) into active learning approaches in HEIs. The recommendations aim to inspire cultural changes in the strategic direction of HEIs to facilitate the movement towards (and the sustainability of) open practices.

Audience

This report aims to offer both inspiration and concrete recommendations for the integration of OS/CS into HEIs (including academic libraries). It, therefore, targets HE staff, management, and policymakers in the field of OS. It will expand the outcomes of previous consultation activities to other stakeholder groups and the wider public.

Structure

This report will be divided into two main areas. *Part A* will raise awareness of the societal impact of OS/CS inside and outside HEIs (to encourage policy change) by outlining stakeholder visions regarding the future of open practices in academia and beyond. *Part B* will offer more concrete recommendations for actions to enable the integration of OS/CS practices into HE learning approaches through a system of cultural change.

[2] Yankelevich, Tatsiana. (2021). *Roadmap for Capacity Building on Open Science and Citizen Science for Research Libraries*. Zenodo. https://doi.org/10.5281/zenodo.5636187

[3] Allison, R., (2022). *Report on Stakeholder Consultation Workshop.* Zenodo. https://doi.org/10.5281/zenodo.7016583

Vision and Policy Recommendations

2. Part A: Visions for an Open Future

Part A will build on past Vision Building Workshops (O6A1[4]) and Stakeholder Consultations (O6A3[5]) in which key stakeholders (HEI academic and library staff, HE management, students, policymakers, funding bodies, OS/CS networks/consortia and relevant businesses) were brought together to discuss their experiences, opinions and needs regarding HE participation in OS/CS. This section aims to portray a vision for the future of OS/CS integration in HEIs, whilst providing contextual examples of real-life OS/CS practices in HEIs.

Why Open Science?

Before discussing the future of OS practices at HEIs, it is important to outline why their integration into academia is beneficial inside and outside of HEIs. OS represents a new approach to the scientific process based on cooperative work and new knowledge-sharing methods through digital technologies and collaborative tools[6]. There are several debates and schools of thought regarding why OS is desirable (see Fecher and Friesike, 2014), the general conclusion is that OS is the future of scholarly work and will become the 'new normal' of scientific production[7].

The following section summarises INOS' findings from previous interactions with practitioners in the field regarding the benefits, for academia and wider society, of integrating OS/CS activities at HEIs.

[4] Kalaitzi, Vasso, Yankelevich, Tatsiana, & Buunk, Iris. (2021). Co-Creating a Shared Vision for Citizen Science in Higher Education: Pitfalls and Recommendations Report on two Vision-Building Workshops. Zenodo. https://doi.org/10.5281/zenodo.4837243
[5] Allison, R., (2022). *Report on Stakeholder Consultation Workshop.* Zenodo. https://doi.org/10.5281/zenodo.7016583
[6] FOSTER, *What is Open Science?* https://www.fosteropenscience.eu/node/1420 Accessed: 16.08.2022
[7] Ibid

Benefits within HEIs

Mainstreaming OS/CS is instrumental in promoting decentralised, cross-border interaction in research and innovation within HEIs[8]. OS/CS activities are inherently transparent, accessible, and shareable encouraging collaboration to make "scientific research, data and dissemination accessible to all levels of an inquiring society"[9]. Within universities, the practice of OS allows for new ways to undertake research, education and innovation. It also offers new possibilities for research outputs to be archived, curated, and disseminated globally. For academics, the movement enables research to be more efficient and productive (e.g., through increased knowledge sharing) and transparent (e.g., through Open Data sets). It creates research that better responds to interdisciplinary research needs[10].

The increased trust and transparency in scientific results and the scholarly process that OS (and CS) creates can result in increased – and sustained – funding for research. The enhanced acceptance and dissemination of research produced using open principles means it is more likely to be accepted and engaged by wider society[11]. As a result, such projects are more likely to attract the attention of funding bodies looking to address societal needs with targeted research funding.

Partaking in OS/CS activities is highly beneficial for researchers themselves. For CS, in particular, researchers gain valuable collaboration, facilitation and teamwork skills that will benefit them in their future careers. Furthermore, the resulting open data can be converted to valuable training materials that enable knowledge of the positive effects of OS/CS activities to be passed on to the next generation of researchers.

[8] Teo, E. A. (2020). The INOS Learning Design Framework: Fostering the educational value of Open Science, Citizen Science and Open Innovation activities. E. Triantafyllou (Ed.). INOS Consortium. Retrieved from https://inos-project.eu/

[9] FOSTER, *What is Open Science ?* https://www.fosteropenscience.eu/foster-taxonomy/open-science. Accessed 16/08/2022

[10] Ayris, D. P., de San Román, A. L., Maes, K., & Labastida, I. (2018, May). *Open Science and its role in universities: A roadmap for cultural change* (No. 24). Retrieved from: https://www.leru.org/publications/open-science-and-its-role-in-universities-a-roadmap-for-cultural-change#

[11] Allison, R., (2022). *Report on Stakeholder Consultation Workshop.* Zenodo. https://doi.org/10.5281/zenodo.7016583

Openness can radically improve the quality of scientific and innovative outputs, especially regarding complex issues that benefit from multidisciplinary and holistic problem-solving[12]. Integrating OS/CS practices at HEIs encourages open and reproducible research practices that enable scientific reuse, thereby accelerating future projects and discoveries in all disciplines[13]. OS/CS also promotes public engagement with science and technology, openness and active citizenship, and broadly impacts wider society. The academia-higher education connection around OS/CS is highlighted through several examples in INOS publications[14].

Societal benefits outside of HEIs

The benefits for wider society of increased OS/CS integration into the scholarly process can be divided into two main areas: 1) open scholarship empowers communities with the knowledge that is accessible and relevant, and 2) open scholarship creates research more attuned to societal issues.

First, mainstreaming OS/CS principles in HEIs creates a more accessible and useful knowledge base for non-experts. Particularly regarding CS activities, research outputs are presented a more readable, understandable and interactive way. In the current climate of fake news and distrust in society, having a greater understanding of how science operates is a powerful asset for citizens. When HEIs perform CS activities, the citizens involved can enhance their scientific literacy in fields that are truly relevant to them. Consequently, communities are empowered with knowledge and can make a difference in their immediate environment, thereby raising their social well-being[15].

[12] Teo, E. A. (2020). *The INOS Learning Design Framework: Fostering the educational value of Open Science, Citizen Science and Open Innovation activities*. E. Triantafyllou (Ed.). INOS Consortium. Retrieved from https://inos-project.eu/, p. 8

[13] Chen, X., Dallmeier-Tiessen, S., Dasler, R., Feger, S., Fokianos, P., Gonzalez, J.B., & Rodriguez, D.R. (2019). *Open is not enough*. Nature Physics, 15, 113-119.

[14] Zourou, K. (2020). *Academia permeating society through Citizen Science: Use cases of engagement in Higher Education*. INOS consortium. Retrieved from: https://doi.org/10.5281/zenodo.3932216

[15] PARTHENOS project. *Benefits of Citizen Science*. https://training.parthenos-project.eu/sample-page/citizen-science-in-the-digital-arts-and-humanities/what-is-citizen-science/potentials-and-challenges-of-citizen-science/#:~:text=Citizen%20Science%20is%20a%20form,to%20scientific%20and%20research%20matters. Accessed 06.08.2022

Second, integrating OS/CS practices at HEIs produces scientific research that is more relevant to society and more likely to result in actual societal (or governmental) change. By partnering with knowledge institutions through CS activities, citizens can help address questions that are pressing to society, therefore increasing the relevance of scientific research. Research results are more likely to be adopted by local (or national) governments as they are well backed up with relevant, practical examples. By integrating OS/CS activities at a curricula level within HEIs, researchers and students are encouraged to use open practices in their studies and future careers, becoming OS/CS advocates and multiplying the positive benefits within and beyond their institutions.

The INOS Learning Design Framework*[16] report summaries the manifold benefits that OS/CS activities in HEIs often have on academic society and beyond:

''OS/CS/OI Learning Activities often have social change aspirations, such as improved inclusivity in science/innovation, improved social relevance of science/innovation, improved relationships between non-experts and experts, improved awareness of causes, and the empowerment of citizens with knowledge to encourage fact based societal change.''[17]

By integrating OS/CS activities into HEIs, institutions can ensure that their research and teaching practices are attuned to societal needs. The surrounding communities can be empowered with scientific knowledge through inclusive practices that ensure research outputs are accessible to those outside of academic circles. INOS advocates for OS/CS integration to ensure HEIs facilitate the active role of citizens in decision-making and governance.

[16] *The INOS project proposed that the impacts of OS/CS (and open innovation) activities in HEIs would be optimised if their learning components were grounded in proven pedagogical methods. The INOS Learning Design Framework aimed to expand and improve OS/CS/OI pedagogy and can be read in full on the INOS website.

[17] Teo, E. A. (2020). The INOS Learning Design Framework: Fostering the educational value of Open Science, Citizen Science and Open Innovation activities. E. Triantafyllou (Ed.). INOS Consortium. Retrieved from https://inos-project.eu/project-activities/ , p. 8

Full transparency and trust

Stakeholders in the field of OS/CS see a future where HEIs and the public are engaged in a trusting and transparent relationship, where there is a mutual understanding of the scientific process and the reasons behind scientific research. Participants noted that this effect is not only good for citizens but also for HEIs, who experience more stable funding due to the acceptance of science in society. When researchers participate in CS activities, they also gain valuable collaboration, facilitation and teamwork skills that will benefit them in their future careers. Training materials can also be created from the open data sets produced when OS/CS occurs at HEIs.

In academic libraries, their role as trusted community hubs can be solidified through OS/CS activities, bringing a wider range of citizens into the library to participate in scientific processes.[18] Academic libraries play a key role in the advancement and facilitation of OS/CS with HEIs, through their direct link to research across all departments and their knowledge-sharing capacity[19]. They can also aid in the sustainability of research outputs, collecting and collating knowledge to be easily accessible to others[20].

In practice

SDU Citizen Science Knowledge Centre

> The University of Southern Denmark (SDU) is pioneering CS integration into Higher Education.
>
> The Centre is hosted by the Library and is anchored at all university faculties, as well as Odense

[18] Ayris, P. et al., (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x
[19] Yankelevich (2021). *A 10-step guide to building open and citizen science capacity at your university and library. Roadmap for Capacity Building for HE Institution Library and Staff on Open and Citizen Science.* INOS Consortium. Retrieved from: https://inos-project.eu/
[20] Ayris, P. et al., (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x

University Hospital. The Knowledge Centres' overall goals are to bring citizens closer to science – and scientists closer to society, to encourage knowledge sharing about Citizen Science and to make scholarly processes open and accessible to citizens across all levels of education and social groups through communication, education and learning[21]. The Knowledge Centre carries out the aims of the SDU strategy of "creating value for and together with society by working with the UN's SDGs". It does this through initiating projects that create collaborations between research professionals, faculties and the other academic staff, breaking down institutional barriers. The Centre also utilises its place in the Library to initiate projects with the public and connect with new and established media. Researchers can contact the Centre to help manage research projects and conduct ethical, sound, community-based research.

The Centre actively promotes OS principles throughout all university levels, aided by its central location in the SDU Library.

Open and Citizen Science as a strategic priority

INOS project stakeholders firmly view OS/CS as strategic priorities for HEIs. Including OS as a priority within institutional strategy was a key recommendation of the INOS *Roadmap for Capacity Building for HEI Library Staff*[22] *on OS/*CS, which built on the view that research libraries could play a major role in advocating for institutional change. HE and academic library staff maintain that although bottom-up efforts can stimulate and drive OS/CS uptake, structured guidance and stable funding offered at an institutional level are

[21] SDU, *About the Citizen Science Knowledge Centre*. https://www.sdu.dk/en/forskning/forskningsformidling/citizenscience/om-videncentret Accessed 18.08.2022

[22] Yankelevich (2021). *A 10-step guide to building open and citizen science capacity at your university and library. Roadmap for Capacity Building for HE Institution Library and Staff on Open and Citizen Science.* INOS Consortium. Retrieved from: https://inos-project.eu/

necessary to sustain practices and move capacity-building practices to the next level. Making OS/CS a strategic priority would encourage open principles within academia and ensure this effect is sustained long-term.

The UCL Office for Open Science and Scholarship

> Open Science (or Open Scholarship) has been cemented as part of the strategic priorities for the UCL Library Services. Part of this was the creation of the UCL Office for Open Science and Scholarship to support the UCL community in adopting open practices and approaches. The Office oversees all UCL activities on the OS agenda, delivering leadership, advocacy and engagement in OS practice. The Office works on three main areas: 1) ensuring UCL policies and strategies reflect OS principles and practices, 2) supporting UCL colleagues across the institution as a centre for OS activities, platforms and services, and 3) building a community of OS practice amongst the UCL community.
>
> The UCL OS Office was set up as part of the strategic priorities of the UCL Library and offers a matrix management approach that links different parts of the university (depending on skills, tools and labour capacity) to deliver on the UCL Open Science Agenda[23]. This approach reframes the traditional structure of the university, ensuring specialists are working on OS implementation and making the most out of the universities' finite labour capacity.

[23]UCL Library Services, *UCL Office for Open Science and Scholarship*
https://www.ucl.ac.uk/library/open-science-research-support/ucl-office-open-science-and-scholarship
Accessed 15.08.2022

Upskilling within HEIs and beyond

OS/CS training and upskilling is an often-cited recommendation for the successful implementation of OS/CS practices at HEIs. During INOS consultations, stakeholders working in HEIs, and academic libraries advocated for increased availability of quality, pedagogically assessed training methods for upskilling staff (and students) inside universities and creating life-long learning programmes to emphasise the importance of OS principles to communities beyond HE institutes.

Training and upskilling are vital, as the move towards openness in universities and other HE institutes provides several challenges, such as working with Open Data sets, creating RDM plans and learning how to better engage with society[24]. Particularly regarding CS (as a pillar of OS), practitioners in HEIs need specialised training to effectively manage and evaluate CS projects, engage with and recruit participants, build protocols, develop data sets and communicate successfully to a wide range of diverse stakeholders[25].

Libraries (both academic and public) are recognised as the ideal location for these skills-building activities to be centralised for academic staff and the wider public. They are ideally placed due to their position as moderators across all academic disciplines and community hubs[26].

SciStarter

> SciStarter has developed a wide variety of training materials for Citizen Scientists and CS practitioners on their website, including specialised materials for integrating CS into HE learning and libraries. *Teaching in Higher Education with Citizen Science* is SciStarter's online, self-guided module that aims to provide staff in HEIs information on the benefits of including CS in

[24] Tzanova, S. (2020) *Changes in academic libraries in the era of Open Science,* Education for Information 36 *281–299, DOI 10.3233/EFI-190259,* IOS Press
[25] Ignat, T. et al. (2018) *Merry work: libraries and citizen science,* Insights – 31. Retrieved from: http://hdl.handle.net/2445/128147
[26] Ayris, P. et al., (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x

> undergraduate courses and some practical strategies for doing so[27]. The materials in the course were developed by projects at the North Carolina Agricultural and Technical State University. They were field tested by a team with expertise in instructional design, education, libraries, inclusive practices, digital design, micro accreditation, and CS. SciStarter has also recently launched a special training module for librarians interested in making their library a community hub for CS activities. The module, made possible with support from the National Library of Medicine, aims to help libraries develop best practices and identify resources to engage their users in citizen science and life-long learning. SciStarter also offers a range of other CS training modules for non-academic or library staff, such as the Foundations of Citizen Science training that is open and available to anyone interested In learning about CS and its practice. These free, pedagogically sound and easily-accessible resources are a valuable start in helping people from all walks of life engage in science and bringing CS to new communities. HEIs and libraries could utilise such resources to train staff and citizens or act as models for more in-depth, specialised courses integrated into the curriculum.

OS participation is rewarded and incentivised

A persistent message in the conversation surrounding methods to incentivise and mainstream the integration of OS/CS practices into HE learning approaches is the need for cultural change in the rewards system for scholarly work. Stakeholders such as researchers and academic staff maintain that reform is needed on research assessment to ensure quality research that is open and impactful to society is justly rewarded. Furthermore, teaching that utilises OS/CS as a methodology, or curricula that includes modules

[27] SciStarter. *Teaching in Higher Education with Citizen Science*. Retrieved from: https://scistarter.org/training-highered

teaching OS/CS skills (e.g., handling open data sets or setting up CS projects), should be recognised at an institutional level, and the benefits to students for taking part in these activities should be emphasised.

Whilst research integrity is still based on impact factors, open collaboration and knowledge sharing (key values in OS/CS) are hampered. Issues such as citation bias (researchers' willingness to publish only in subscription journals with impact factor) and publication bias (editors' selection of the works to be published based on criteria outside of research quality, e.g., political conjuncture of journals) hinder the movement towards openness. Significant parts of research data remain hidden and cannot be used as generators for further research ideas and topics[28].

Furthermore, there are few incentives for integrating OS/CS modules and using OS practices in learning activities for those involved in HE curricula development. For students, there is also little concrete incentive to choose OS/CS methods during their studies or to take modules that teach OS/CS practices.

Key stakeholders in mainstreaming OS/CS in HEIs envision institutionalised incentives for researchers and students to partake in OS/CS practices. Recruiting bodies should also recognise OS/CS activities as equal to other scientific work, motivating researchers and students to partake in such activities to improve their career prospects.

Reform in research assessment – Utrecht University

> Progress is being made in the reform of research assessment, both on an institutional and ministerial level. A multi-stakeholder initiative initiated by the European Commission to reform research assessment has recently collected input from more than 350 organisations from over 40 countries to draft an Agreement on Reforming Research Assessment. The final Agreement was made public on July 7, 2022, and 'offers a platform for piloting and experimentation, developing new assessment criteria, methods and tools, and for joint, critical reflection, exchange of good

[28] Tzanova, S., *Changes in academic libraries in the era of Open Science*

practices and mutual learning, while fully respecting the autonomy of organisations.'[29]. Organisations will now decide on the next steps to implement the commitments made in the agreement.

Following agreements to reform research assessment, such as the San Francisco Declaration on Research Assessment (DORA) and the Leiden Manifesto for Research Metrics, several HEIs are reforming their practices. Utrecht University is changing its models of Recognition and Rewards to the TRIPLE system, which emphasises rewarding research that aligns with Utrecht's OS aims. The new system ''rewards teamwork by support staff and all others involved, and it will evaluate quality, real impact on academia and society, sharing, and openness to the world.''[30] TRIPLE ensures Utrecht University staff are rewarded for all their contributions, according to OS principles. It will guide the recruitment of new staff, training and development, and employee appraisal, ensuring that OS skills and principles are incentivised and rewarded sustainably.

[29] Science Europe, *An important milestone for research assessment reform.* https://www.scienceeurope.org/news/an-important-milestone-for-research-assessment-reform/ Accessed 17.08.2022

[30] See https://www.uu.nl/sites/default/files/UU-Recognition-and-Rewards-Vision.pdf. Accessed 17.08.2022

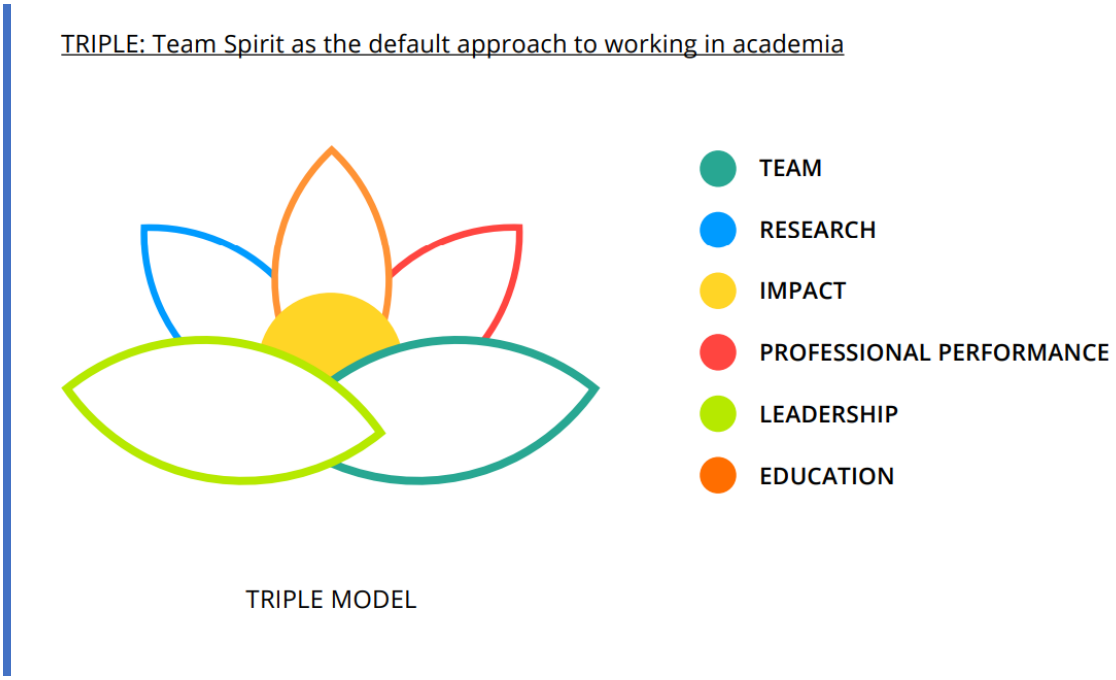

Figure 2 Utrecht University TRIPLE model of Recognition and Rewards

Seamless systems of knowledge transfer

A key pillar of the movement toward integration of OS/CS practices at HEIs is the widespread communication of the benefits of being involved, the resources available to facilitate involvement, and the effective knowledge transfer of best practices. INOS stakeholders created a vision of communicative systems that ensure full transparency and knowledge transfer so that all potential OS stakeholders are aware of the benefits of participation, are working towards the same shared goal and are fully aware of how they can facilitate their involvement.

Knowledge transfer procedures could include platforms aggregating the funding opportunities for OS/CS initiatives, reusable training resources for researchers and students, aggregated channels of knowledge transfer between all levels of expertise (starting as a junior level in high schools) and targeted and sustained communication (within and outside of HEIs) on the benefits of participation in OS/CS activities.

INOS stakeholders agreed that for OS/CS integration to be sustained, there needs to be a revamp in knowledge transfer procedures and general communication surrounding the benefits of OS/CS, both within and beyond HEIs. Therefore, the involvement of other institutions, such as academic and public libraries, is vital to ensure a wider range of stakeholders can be reached through various appropriate mediums.

CeOS_SE Project

> The practice of Open Science, particularly Citizen Science, across Europe is concentrated in central, western and northern Europe. Countries in southeastern Europe typically partake in much fewer citizen-enhanced scientific projects[31]. It is this issue that the Erasmus+ project, CeOS_SE (Citizen-enhanced Open Science in southeastern Europe), has been designed to counter. The project consortium is composed of six partners (from academic or national libraries) from south-eastern Europe (Bulgaria, Serbia, Cyprus, Greece, Italy and Croatia) and two institutes from northern Europe – LIBER (Association of European Research Libraries) and the University of Southern Denmark Library.
>
> The project is built on a knowledge transfer framework; best practices will be developed from mapping exercises within regions more developed in OS/CS practices by LIBER and SDU, which will then be transferred through training and upskilling to partners in areas less developed in these fields. A series of OS/CS piloting activities with public libraries in southeastern Europe will help raise awareness of OS/CS and its benefits not only within the academic community but also among local citizens. CeOS_SE will create networks of knowledge transfer across Europe to

[31] Vohland, K. *et al.* (2021). Citizen Science in Europe. *The Science of Citizen Science*. Springer, Cham. https://doi.org/10.1007/978-3-030-58278-4_3

> ensure that the skills acquired in central, northern and western Europe can be transferred to areas less developed in OS/CS practices.

3. Part B: Recommendations for change

Scope of recommendations

INOS has produced several guides, frameworks, and recommendation documents throughout the project to help practitioners integrate OS/CS and open knowledge/innovation activities into learning approaches and curricula design at HEIs[32]. These materials should be consulted for anyone wishing to gain advice on practically facilitating the integration of OS/CS into new curricula development. The current report aims to advocate for systematic change on an institutional level by giving four overarching recommendations for how systematic alterations in the strategic direction, institutional mindset and resource allocation within HEIs can facilitate OS/CS integration and lay the foundations for fully integrated OS curricula. Each recommendation has been drawn from consultations with key stakeholders within HEIs and OS policy makers.

Structure of recommendations

Each recommendation will be split into two sections: a) contextual background and b) practical actions. Each recommendation will be linked to the visions described in Part A, which aims to highlight practical ways to achieve these visions.

#1 Utilise the role of academic libraries

[32] See https://inos-project.eu/project-activities/

Research libraries (and other types of libraries) have been consistently identified as appropriate centres to lead the integration of OS/CS into the workings of HEIs[33]. Libraries work across faculties, making them a logical location for centring OS/CS management due to the multidisciplinary nature of OS practices. Libraries also hold the infrastructure necessary to foster knowledge sharing and data management and are natural connectors between science and society. Libraries have a unique position at the heart of the community to act as communicators, translating research findings into easy-to-digest information[34]. INOS stakeholders, therefore, recommended the utilisation of the library as a key location in the movement towards OS integration in HEIs.

Contextual background

''The Library is now more than a curator and cataloguer of knowledge. The Library has now become an active creator of knowledge''[35]. Academic libraries have been integrated at the centre of academic institutions for centuries, and they typically evolve to meet the needs of the education and research communities they serve[36]. As scholarship moves towards open practices, libraries should ensure they are well placed to facilitate this change.

The LIBER Open Science Roadmap established by LIBER (Association of European Research Libraries) broadly endorses libraries as partners in OS/CS and guides developments in the field. LIBER recommends that libraries become active partners in creating support infrastructure, such as guidelines and training that foster open scholarly practice. This movement is also reflected in projects beyond the EU. *Libraries as Community Hubs for Citizen Science* is a project based at Arizona State University that recognises the central importance of libraries in facilitating CS projects[37].

By serving as hubs, academic libraries can gather different stakeholders (e.g., researchers, technical staff, administrators, etc.), help establish strong and trusting relationships between them and provide essential

[33] Yankelevich, 2020; Ayris & Ignat, 2020.
[34] Ayris, P., & Ignat, T., "Defining the role of libraries in the Open Science landscape: a reflection on current European practice". *Open Information Science*, vol. 2, no. 1, 2018, pp. 1-22. https://doi.org/10.1515/opis-2018-0001
[35] Ayris & Ignat, 2020. P. 9
[36] Tzanova, S., *Changes in academic libraries in the era of Open Science*
[37] Arizona State University, *Libraries as community hubs*. Retrieved from: https://www.imls.gov/sites/default/files/grants/lg-95-17-0158-17/proposals/lg-95-17-0158-17-full-proposal-documents.pdf

expertise for OS and CS practice (Yankelevich, 2021). The INOS project, therefore, recommends that the research library be utilised by HEIs in the movement toward OS-integrated curricula for its central role in training, communicating and enabling openness in the scholarly process.

Recommended actions

1. Centralise all OS (and/or CS) actions within the university library.
2. Integrate the expertise of librarians in key OS skills, such as research data management, into HEI curriculums as mandatory courses for students.
3. Develop and maintain training materials and toolkits for key OS/CS skills and base them in the library where they are accessible to all.
4. Utilise the strong communicative position of the library to focus OS-related communication and strategic marketing efforts on the benefits of OS for researchers and society alike.

Libraries, particularly research libraries, can facilitate multidisciplinary collaboration, which is crucial for OS and CS implementation in HEIs[38]. However, their strong position must be recognised and utilised, and proper funding allows libraries to fully embrace this role as OS/CS facilitators within HEIs.

#2 Reform the traditional structure of the HEI

Resources and funding within HEIs are undoubtedly limited. Often, the implementation of open practices can be seen as a burden for employees whose workloads are already full. In addition, staff members within HEIs may be asked to take on tasks for which they are not trained, adding strain to the staff member and

[38]Nakata, A., (2022). Recommendations on integrating OS (and CS) in HE curricula. Zenodo. https://doi.org/10.5281/zenodo.6787302 , p. 18

hampering the effectiveness of the activity. Instead of attempting to 'fit' OS/CS principles into the traditional labour structure of HEIs, institutions need to reform the labour composition of institutions to ensure that open principles are effectively and efficiently integrated into the academic cycle.

Contextual background

The movement toward OS integration in HEI learning practices requires breaking down faculty barriers (and cross-institutional barriers) and enabling collaborative and multidisciplinary research[39]. Yet the traditional model of HEIs, with their separated faculty silos and emphasis on competition in research, does not allow for collaborative approaches to research and education[40]. Furthermore, the emphasis on research outputs as a measure of successful institutions encourages a focus on research funding rather than investment in innovative and open learning approaches. Because of competitive cultures, ideas are shaped to fit calls for projects and are sacrificed if they are unlikely to succeed[41]. Innovation and open knowledge do not have a place in this traditional culture and structure.

For OS/CS to be sustained in HEIs, academic staff should be valued and rewarded for skills other than research skills, such as collaborative and communicative abilities. They should be given the time and resources to modify their workflows to include open practices, supported by skills training and access to tools. There is a need for serious reform in the labour structure of HEIs to encourage and enable the integration of OS/CS practices in research and education. Such changes should be led by a general cultural change within the institution, beginning with strategic reform.

The most difficult change within traditional organisations such as HEIs is cultural change[42]. Furthermore, due to the large disparity in organisational structures and the development of current OS practices across institutions, there is no one-size-fits-all solution. The management of the OS transition requires real structural change, resource allocation (or reallocation) and a clear strategy led from the top. Therefore, structural change should be accompanied by a change management policy to address sustainability.

[39] Yankelevich, 2020
[40] Ayris & Ignat, 2020
[41] Ibid, p. 2
[42] Ibid, p. 2

Recommended actions

Reforming institutions' structures that have been in place for many years is no easy task. Therefore, a change management system must accompany any alterations and be led by skilled practitioners**.** INOS stakeholders were unanimous that although many OS/CS practices can be led from the bottom-up, sustained structural change must be driven from the top-down.

1. Put OS on the strategic agenda of HEIs.
2. Hire senior management representatives to lead OS approaches and develop a cultural change programme.
3. Include a communications plan to ensure the reasons for strategic and organisations changes are clear to all.
4. Provide access (and time) for staff members to receive the necessary training to implement OS/CS practices within their work.
5. Hire employees with skills necessary for OS/CS activities and close the gap between academic and administrative staff.

The restructuring of traditional workflows and structures to facilitate OS ensures that open activities are not reliant on bottom-up approaches from key advocates. Resource allocation and reallocation are fundamental, as is reform in how openness is recognised and rewarded.

#3 Reform of recognition and rewards systems

Creating fully integrated OS curricula has its challenges[43]. Therefore, creating incentives for its design and implementation is paramount. Teaching and management staff need to be on the same page regarding the *why* of integrating OS and feel the tangible benefits of integrating OS/CS into their learning activities and curricula. A system of recognition and rewards that appreciates using OS/CS principles in research and

[43] Nakata, A., (2022). *Recommendations on integrating OS (and CS) in HE curricula,* p.14

education is recommended to ensure the permanent integration of such practices. INOS recommends reform in recognition, and rewards should be for researchers within HEIs and students learning at HEIs. They represent the grassroots of future scientific work.

Contextual background

Stimulating OS/CS is inextricably tied to modernising recognition and reward systems[44]. Academics and teaching staff integrating OS/CS into their research and teaching practices need to receive adequate recognition for this practice to be sustainable. As referenced early in this report, HEIs are moving away from research assessment metrics such as impact factors and towards systems that reward quality, impact, diversity, inclusiveness and collaboration. The Agreement on Reforming Research Assessment, when implemented, goes some way to ensuring that research, researchers and research-performing organisations are rewarded for research that is impactful, ethical, diverse and open.

Recognition and reward systems are understood here to be not only the way that research itself is assessed but how HEIs reward all domains of academic work (including teaching practices). Recognition and rewards include factors such as recognising diverse skills within the academic staff, collaboration with society and innovative teaching/learning approaches. By rewarding skills and activities that help academic research to be more open (e.g., science communication skills, innovative practices, CS activities), recognition and reward systems can incentivise the integration of OS/CS into HE learning activities and beyond.

Recommended actions

HEIs looking to reform their recognition and rewards systems to incentivise OS/CS approaches, both for their researchers and teaching staff, should look for ways that their current systems could be altered to incentivise openness better.

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There are no sources in the current document.See https://www.universiteitenvannederland.nl/recognitionandrewards/wp-content/uploads/2019/11/Position-paper-Room-for-everyone%e2%80%99s-talent.pdf

1. Develop a task force or working group to analyse your institution's current recognition and rewards system.
2. Identify areas in which open principles could be incentivised further (e.g., is your system of recognition and rewards incentivising open research, but not open methods of educating students?)
3. Utilise best practices from other institutions to create a framework for a new system of recognition and rewards tailored to your institutions' needs (e.g., Utrecht Universities TRIPLE system).

When OS/CS practices are correctly and justly recognised and rewarded across all domains in HEIs, the resulting cultural and mindset shift will help to sustain open practices into the future.

#4 Advocate, communicate and collaborate

All of the above recommendations are reliant on one important concept: collaboration. Libraries must collaborate across faculties and societal groups to reach the wide range of stakeholders involved in OS processes. Academic staff must be allowed to create new workflows to move away from competitive practices and toward collaborative practices. The reformation of recognition and rewards systems requires a combined and unified effort from all HEIs to move away from unhelpful research assessment metrics and towards more collaborative approaches to scholarly processes and educative methods. Therefore, the final recommendation is increased advocacy on OS/CS, communication lines to enable knowledge sharing and understanding of OS/CS benefits, and collaborative practices.

Contextual background

OS involves a wide range of stakeholders who must clearly set out the benefits of participation before sustainable participation in OS/CS can occur. This approach requires clear lines of communication on the

benefits of OS/CS, and such communications need to be tailored to specific stakeholder groups to be effective.

The LERU advice paper, *Open Science and its role in universities: A roadmap for cultural change* highlights the importance of communication in addressing all eight pillars of OS and their integration into HEIs. They suggest that ''universities can establish advocacy programmes, which should identify the benefits of Open Science approaches, whilst being realistic about the challenges.'' To complement these plans, communication strategies should be set up to enable ''the whole university body to become familiar with Open Science practices''[45]. The different facets of OS, and the variety of stakeholders that need to be engaged to ensure true openness in HEIs, require coordinated, structured communication practices to ensure everyone is aware of why changes are necessary.

Similarly, the INOS *Roadmap for Capacity Building on Open Science and Citizen Science for research libraries* suggests that targeted OS and CS communication to foster capacity building is necessary for implementing OS/CS in research library institutions and, subsequently, their HEIs. The Roadmap argues that ''knowledge transfer is one of the cornerstones of ensuring that HE institutions embed OS practices'' and therefore recommends that research libraries move beyond their traditional role as storers of information and towards a more active role in the communication, training and advocating for OS/CS in their partner HEIs. Research libraries, as discussed, are also well placed to collaborate with public libraries or other local institutions to better reach stakeholders outside of HEIs and ensure the institution's outputs match societal needs.

Recommended Actions

In line with the LERU (League of European Research Universities) recommendations for cultural change in universities, INOS recommends that HEIs create advocacy programmes that instil the benefits of OS/CS within and beyond their institutions. These programmes should include clear communication strategies that address the diverse range of stakeholders involved in OS directly and appropriately. Crucially, advocacy programmes should not stop at the boundary of the HEI itself but extend (through collaborations with

[45] Ayris, D. P., de San Román, A. L., Maes, K., & Labastida, I. (2018, May). *Open Science and its role in universities: A roadmap for cultural change* (No. 24). Retrieved from: https://www.leru.org/publications/open-science-and-its-role-in-universities-a-roadmap-for-cultural-change# p. 22

outside institutions, potentially leading through the university library) to stakeholders outside of the institution. Furthermore, these programmes should be built to last – setting up sustainable knowledge transfer procedures to ensure that OS/CS advocacy and awareness become a permanent part of the HE workflow.

1. Develop OS/CS advocacy programmes within HEIs, including communication strategies and establishing knowledge-sharing practices to ensure the sustainability of OS/CS awareness.
2. Identify (or fund) research into why OS is better for academic work and wider society, and ensure this research is presented in a format that is easily accessible to all stakeholders involved in the move towards openness
3. Base advocacy programmes and communication strategies in the academic library and look for collaborations with local citizen groups, research funding organisations, schools or public libraries.

The movement towards OS represents a fundamental change in the way HEIs work. These changes can represent significant challenges to all involved. Therefore, advocating the benefits of these changes, and building the infrastructure to ensure their sustainability, is a crucial step in the integration of OS/CS into HE practices.

4. Conclusion

This Vision and Policy report provides an overview of stakeholder visions for OS integration in HE and some practical recommendations for encouraging the cultural change necessary to facilitate this. The driving message of this document is that sustained change is needed on a strategic level in HEIs to facilitate the integration of OS/CS practices into HE learning approaches and curricula. INOS believes that this integration will allow HEIs to situate better their role in current demands for civic engagement, societal impact and learning opportunities for all.

The recommendations given in this report are deliberately overarching and generalised, as conversations with practitioners in the field of OS/CS in HE show us that there is no 'one-size-fits-all' approach to OS integration. HEIs must determine which measures the best support their institutional mission and organisational structure. Since these vary across Europe (and beyond), it is difficult to offer concrete templates for OS integration that can transfer to any institution. Therefore, this report sought instead to advocate for why OS/CS integration into HEIs is desirable for all stakeholders involved and to outline areas of shared goals and visions.

Cultural change cannot, and will not, happen overnight. Therefore, this report recommends that HEIs embark on strategic alterations to facilitate OS/CS integration and create a clear change management plan. For this plan to succeed, clear communication and collaboration amongst all stakeholders are vital, as the LERU advice paper on OS encapsulates:

> 'Scholarship is a complex system. Open Science is even more complex. The transition to Open Science affects all stakeholders – universities, researchers, teachers, students, funders, publishers, policymakers and support organisations.'[46]

The key principle is that all these stakeholders, whether inside or outside the HEI, know why the movement towards openness is a necessary and highly beneficial transition. HEIs must become OS advocates and reflect this in all aspects of their work to act as examples for future generations entering the scholarly field. The INOS consortium encourages HEIs to embrace openness in their practices to reap its many benefits.

[46] Ayris et al., *Open Science roadmap*, LERU, p. 7.

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