Centrality of researchers in reforming research assessment

Routes to improve research by aligning rewards with Open Science practices

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Initiative for Science in Europe ise:

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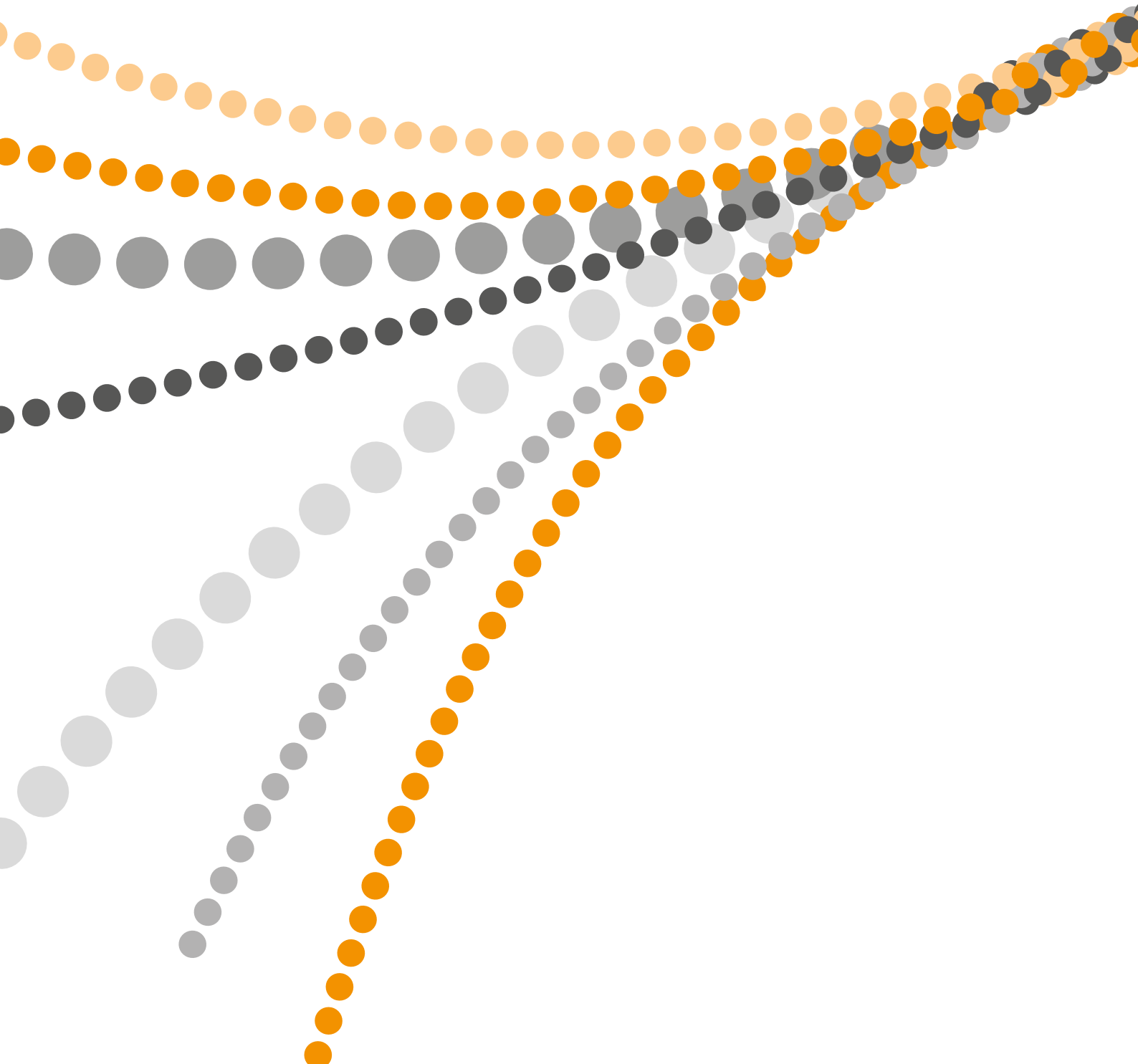

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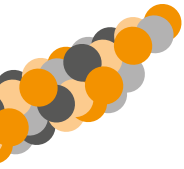

Summary

Open Science is a broad approach to improve the reproducibility, transparency, and robustness of research. By enabling broader access to data, code, methods and publications, it has the potential to increase the efficiency and impact of public funding of research, and societal engagement. Although some aspects are being implemented by specific funders and organisations as well as many individual researchers, Open Science overall is still far from being fully embraced by the research community. At the same time, the ways in which research assessment is carried out at present have become an acute issue both for researchers and organisations. A key factor for overcoming these systemic challenges is to reform academic evaluation and reward systems to include Open Science practices.

This report explores how and at which levels change can happen, and which routes can be taken to reach a comprehensive change that could be applied across the research system while respecting valid disciplinary or other relevant sectoral differences. Several policy options for each stakeholder are proposed. Overall, the pressure by the European Commission and other actors should be welcomed to drive much-needed changes, but this approach may risk neglecting the quality of research in favour of how it is performed. This is why we feel it is crucial for researchers to drive the transition to Open Science and is the main motivation for this work.

We believe that all stakeholders must recognise four essential principles for the successful reform of research assessment, and these require coordination both within and between stakeholder groups:

- Engage researchers in all decisions regarding changes to research assessment: all stakeholders should liaise more with researchers and researcher organisations and include them from the beginning in their decision making processes.
- End the use of inappropriate metrics: all stakeholders should abide by the principles previously outlined in the San Francisco Declaration on Research Assessment and the Leiden Manifesto.
- Agree on appropriate ways of assessing research and researchers: identify suitable discipline-specific means of evaluation; establish an appropriate balance between qualitative and quantitative evaluation; evaluate which metrics or indicators, if any, are suitable.
- Recognise that reforming assessment requires resources: to facilitate Open Science practices, funders, governments, and universities should provide additional targeted funding.

For research communities, it is urgent and vital to concretely consider how they wish evaluation systems to be adapted to eliminate pernicious incentives and to reward pertinent Open Science practices in their diverse circumstances. There is a serious risk that if they cannot make concrete proposals on how to replace currently prevalent prestige indicators such as journal impact factors and quartile ranks, these will either continue to be (mis)used or new indicators will be imposed without the communities' participation.

Similarly important and critical is the engagement of all concerned parties in the larger discussion of how to move towards new forms of research assessment, with an appropriate balance of qualitative and quantitative evaluation. This engagement requires the involvement of researchers themselves and their community representatives, such as learned societies. By positively articulating what the goals of research assessment should be, research communities can help build better systems of assessment and credit reflecting those goals.

Summary of options

All options are in the context of four framing questions to be kept in mind:

- Which practices should be rewarded?
- What should evaluation be based on?
- How can a change in evaluation culture be achieved?
- Who should be responsible for driving change?

The options are in service of key policy goals for an improved research assessment and reward system:

- Evaluate and reward people and institutions based on their achievements and competencies rather than based on prestige or inappropriate indicators.
- Identify suitable discipline-specific means of evaluation, emphasising transparency, reproducibility and robustness of the research outcomes and of the research process.
- Incentivise Open Science practices at each career stage in a coordinated reform of academic evaluation and reward systems.

The options are in the context of four essential principles:

- Engage researchers in all decisions regarding changes to research assessment.
- End the use of inappropriate metrics.
- Agree on appropriate ways of assessing research and researchers.
- Recognise that reforming assessment requires resources.

Centrality of researchers in reforming research assessment

Routes to improve research by aligning rewards with Open Science practices

I. Introduction

Open Science is gaining increasing support across research communities, political actors, funding bodies, and other stakeholders. Developments proceed on several fronts but at highly variable rates across different practices, research fields, geographical regions, and demographic groups.

The ultimate purpose of incentivising Open Science practices is to catalyse a transition to improved ways of doing research.

Open Science (Box 1) is a broad concept for improving research by enabling greater accessibility, transparency, and reproducibility of research and scholarship. Thus, the ultimate purpose of incentivising Open Science practices is to catalyse a transition to improved ways of doing research, rather than promoting a set of technical practices to be pursued for their own sake. One effective way of ensuring that best practices are followed is to make this part of the reward system for scientists and scholars.

Unfortunately, the ways in which research assessment is carried out at present has become an acute issue both for researchers and research organisations. Research assessment in principle should foster "good research", but the current assessment systems place disproportionate emphasis on criteria and measures that do not necessarily support this aim: quantity, where research is published, perceived impact, and grant income. Instead, focusing on the intrinsic quality and relevance of the work, person or institution that is being evaluated would help align incentives to improve research outcomes and integrity.

Many individual researchers and organisations have called for the reform of current research assessment practices, which would, at least in part, include Open Science practices in the constellation of research outputs and activities to be rewarded. "Open" is not in itself a synonym for excellence but is part of a package of practices leading to improved quality, integrity and relevance of research by enhancing its transparency, reproducibility and reusability. Although it is only one aspect of an academic reward system, the recognition of these practices has the potential to improve research outcomes.

Thus, Open Science practices should be part of any research assessment and reward system. They will undoubtedly lead to improved access to research results and data, reproducibility, and transparency, all of which are part of good and impactful research. What the adoption of Open Science means practically for researchers and research organisations particularly in terms of research assessment practices is, however, yet to be determined.

BOX 1: Framing Open Science practices

'Open Science' is an umbrella term for various practices across the whole research cycle, including Open Access to scientific publications and Open Data as its two main pillars. Today, Open Source code for software can be considered a third pillar, followed by Open Peer Review and Open Methodology.

1. **Open Access:** free, unrestricted online access to research outputs such as journal articles, and increasingly research-level books (monographs, treatises).

2. **Open Data:** free access to research data, collections, and cultural heritage archives, including metadata, preferably according to the FAIR principles (findability, accessibility, interoperability, and reusability) and responsibly managed.

3. **Open Source:** documenting and free sharing of software used for research activities, including the source code, and potentially of hardware designs.

4. **Open Peer Review:** scholarly review mechanism that discloses peer review reports and/or referee identities at some point during the review or publication process.

5. **Open Methodology:** sharing of full methodological details of studies and any tools used for data collection and analysis, including pre-registering studies and so-called open notebook science.

An overarching goal is to open the processes of scientific knowledge creation, evaluation and communication to any interested individual. These definitions or statements of "openness" are evolving (UNESCO, 2021), and even where agreed in principle, the level of support for any one of them may vary, even within fields of research, and certainly between them. We note them here as the basis for considering the question of how their adoption can or should be evaluated and rewarded.

Since our focus is on research assessment, we have included neither Open Education (education without academic admission requirements, typically offered online to broaden access to learning and training) nor Citizen Science (societal participation in the design and implementation of research processes, as part of the democratisation of research and for broadening the engagement of citizens in science). While these are of importance in the widest adoption of Open Science (UNESCO, 2021), here we have chosen to focus explicitly on those areas relevant to researchers working and being evaluated in institutional settings (research performing organisations).

As an independent association of learned societies and research organisations representing a diversity of academic disciplines across Europe, the Initiative for Science in Europe (ISE) is well placed to understand researchers' views of and concerns about Open Science. ISE can, where appropriate, help assure that researchers can take the lead in introducing and integrating those views into research organisations' assessment procedures.

To coordinate these efforts, in April 2020 ISE formed a task force on Open Science. This report describes its work to help research communities integrate Open Science into day-to-day research by making it an integral part of research evaluation. It was immediately apparent that without any "carrots" (direct career rewards for those practices that policy-makers wish to see enacted), researchers are only faced with "sticks" (e.g. threat of penalties for non-compliance by their funders or institutions). We find that, at best, such threats may cause resentment and delays, and at worst, derail progress toward Open Science.

Although there is increasing recognition of the need and desire to move away from the use of inappropriate metrics (particularly problematic are biased journal-level metrics such as impact factors or quartile ranks that constitute a prestige hierarchy; Heckman, 2020), there is little consensus on what should replace them. Considering the increasingly strong drive from policy-makers, it is vital that diverse research communities urgently and concretely consider how they wish evaluation systems to be reformed to eliminate pernicious incentives and reward Open Science practices in each of their individual circumstances.

It is vital that diverse research communities urgently and concretely consider how they wish evaluation systems to be reformed.

In this report, our focus is on the change in research culture and related reward systems, whether directed toward evaluation, promotion or hiring researchers, evaluation of research institutions, or awarding grants and projects. Our work presupposes that the resources to fund research are limited, and prioritisation and selection are inevitably needed. We however assume that all parties involved in evaluation should prefer to commit no more resources than are strictly needed to conduct research assessment thoroughly and responsibly.

The development of Open Science in Europe

In 2012, the European Commission (EC) issued a communication to optimise the circulation and transfer of scientific knowledge among key stakeholders in Europe, with the goal to boost economic growth and to address the societal challenges of the 21st century. Later in 2015, the EC proposed the European Open Science Cloud (EOSC) to develop an infrastructure with services that support Open Science practices.

In 2016, the EC further introduced a new Open Science vision for Europe (European Commission, 2016a) and set up the Open Science Policy Platform (OSPP) to provide expert advice to the Commission on Open Science including EOSC. The final report from the first mandate (European Commission, 2018) emphasised that "all stakeholders in research and its communication need to take responsibility for supporting Open Science activities". Open Science will be the "standard method of working under [European Commission's] research and innovation funding programmes as it improves the quality, efficiency and responsiveness of research" (European Commission, 2019).

To date, there are large differences between geographic regions in the degree of adoption and acceptance of Open Science ideas and practices, with western and northern Europe furthest along. Nonetheless, the transition to Open Access publication, as a prerequisite Open Science, has been advancing steadily over many years. However, differences between academic disciplines are important, both in Open Science in general, and for Open Access in particular.

The related concept of Open Data, particularly in the framework of FAIR: Findable, Accessible, Interoperable, Reusable (GO FAIR, 2016) is being increasingly considered in many research fields. Open Access and Open Data are both based on the principle that publicly funded research should be publicly available; however, distribution mechanisms for FAIR data may be complicated, and require significant effort from researchers and academic institutions, which should provide infrastructure and support to implement. Many funding agencies already require data management plans; although FAIR and Open Data mandates are gaining traction, they have still remained opt-out in most cases.

Through access to research methods, data and results via digital technologies and collaborative tools, Open Science induces systemic changes to conducting, publishing and evaluating scholarly research, while maintaining the standard of peer review. Although it became possible to open and share scientific data several decades ago, the internet and technological developments in the 21st century have changed how we work, and this has also affected how research is done and shared.

Challenges to engaging in Open Science practices

For researchers to participate in a broad transition to Open Science practices, in addition to the generally accepted benefit for the entire research community and the public, a major consideration will, realistically, be the direct professional benefits it brings them. These will determine to what extent researchers will be motivated to expend any additional efforts required by Open Science.

Leaving aside here the complex but crucial issues of licensing and payment barriers, the move towards **Open Access (OA) publishing** for an individual researcher is in principle straightforward: one can choose to submit a manuscript to a publishing venue that offers OA (if funds are available) or deposit the author-accepted manuscript in an open repository (if this is permitted). However, researchers are currently subject to conflicting pressures: on the one hand to publish OA; on the other hand, to publish in journals considered to be 'prestigious'. In the past these journals may not have offered an option for OA, and this is still the case for some key journals for many researchers, and occasionally complicated by funder mandates. At the same time the perceived – and often institutionally enforced – status of the journal still tends to be the hardest career currency. In case of publishing results from collaborations with colleagues in countries or institutions where OA is not mandated, this tension becomes more problematic.

In those fields of social sciences and humanities, however, where monographs are often the most highly valued scholarly output, the scarcity of OA monograph venues (no clear economic model, the tradition of lengthy reading on paper rather than on screen, even fewer prestigious OA publishers) disadvantages scholars. In a growing OA scientific environment, books risk becoming invisible: they are more difficult to find and quote, as they have seldom been retrospectively digitised and made available, unlike past issues of many or most journals. For the time being, scholars in the social sciences and humanities arguably pay a price for the unfinished OA transition.

Open Data recognises that access to research data should be as open as possible. The issue is complex, however, because data take different forms in various disciplines of scholarship, and research data need to be responsibly managed. Access cannot be mandated to be completely open without qualifications: restrictions are justified for example in cases involving security, confidentiality, privacy or the protection of intellectual property rights. Some research data can be openly available, accessible and reusable only to specific users according to defined access criteria, or once the data are anonymised. The need for justified restrictions may also change over time, allowing the data to be made accessible at a later point.

The arguments for Open Data are strong and the ongoing privatisation of increasingly important big data is a real concern, but the chances for successful implementation are greater if incentives and proxy technical support for individual researchers are developed. Hurdles for Open Data currently need to be cleared by each individual researcher, who might justifiably perceive that there is not enough reward or support for the effort. The most acute example of this is in the realm of data management and adhering to FAIR principles, which can be in practice too laborious and time-consuming for researchers to handle themselves. This can change as Open Data becomes more widely used as a way of recording research outputs.

The concept of **Open Source software** has long existed among programmers and developers, and is therefore nearly as familiar to scientists as the concept of Open Access. Many important details of published research reside within software that is developed to produce or analyse the results. And like other research outputs, Open Source code and software are publicly financed research outputs that should be openly available (OECD, 2021). Various licenses are used for Open Source software, but the formats are less complex than those for open data, and therefore it should be easier to develop guidelines and procedures. Similar benefits would apply for Open Source hardware designs, though these are not yet widely shared. Generally, Open Source practices do not currently receive sufficient tangible rewards considering their increasing importance for research.

The term **Open Peer Review**, which primarily refers to the disclosure of the review reports and, optionally, reviewers' identities, represents another mechanism to improve transparency. Most common is the practice of publishing anonymous reviews together with a published paper, often referred to as Open Reports, ideally including the author responses and the editorial correspondence. To supplement this, in Open Identities, not only the names of the authors but also those of the reviewers including their affiliations can be made open. Yet another component is Open Participation or Open Interaction, by which a wider research community contributes to the review process; this may require that pre-published manuscripts and final publications, in addition to preprints, are available Open Access.

More studies are needed on the effects of various forms of Open Peer Review. Arguments in favour focus on the added value of the reviews themselves, which might contribute to subsequent research and also citation; making them public brings a wider benefit from the reviewers' efforts. Credit can also be given more transparently for review work, which today is mostly carried out anonymously and despite its central importance is insufficiently acknowledged. Furthermore, reviewers might be fairer and more constructive if they were not anonymous – it is argued that conflicts of interest and bias will be brought out in the open and thereby can be controlled.

Some drawbacks of Open Identities have also been acknowledged. It might be risky for a reviewer to write a critical review openly. Specifically, early-career researchers could fear for their professional perspectives, and established researchers might not want to compromise good relations with their colleagues. Thus, the quality of the review process could be compromised, and sharp criticism could be replaced by lukewarm statements. Reviewers might overall hesitate to carry out open reviews, which would counteract the potential incentives.

Implications of Open Science for stakeholders

Open Science practices can improve the robustness of research and quality of the research system. Not least because of the potential of high-quality research for economic and societal impact, practising Open Science is in the interest of the larger community. However individual researchers or research institutions are rarely rewarded for it.

The journal impact factor (JIF) has become a widely misused proxy for research quality because it is so easy to use and gives an illusion of predictive power.

One of the unfortunate developments in the assessment of researchers for career progression, funding or awards, is the emphasis often placed on the journals in which their results are published, rather than how they have contributed to progress in the field. The journal impact factor (JIF) has become a widely misused proxy for research quality because it is so easy to use and gives an illusion of predictive power. Therefore, most researchers and institutions aim to publish in prestigious journals (i.e. usually with high JIFs) because this is believed to be an "objective" measure of quality and embedded in existing reward systems.

Such shortcuts have been widely criticised, and several research performing organisations have endorsed declarations such as the San Francisco Declaration on Research Assessment (DORA, 2013) and the Leiden principles (Hicks et al., 2015) that advise against their use. However, despite some progress, journal-level metrics remain ubiquitous. We recognise that in some cases, even flawed metrics are thought to be preferable to systems where nepotistic or similarly corrupt mechanisms prevail. We do not discount these concerns but rather note that these systems themselves must be challenged, and while they will not be solved by assessment reform per se, those reforms may contribute to a systemic improvement.

Open Science then represents a new challenge: current metrics for research assessment, in addition to being flawed, also fail to measure the impact of sharing research, data or code. Solely rewarding prestigious publications means that a large part of what makes research valuable – such as robustness, transparency or accessibility of results – is not taken into account. We miss out on other contributions that may be at least as valuable (Hicks et al., 2015), and the current academic reward system hampers the move towards Open Science.

Overall, the pressure by the European Commission and other actors should be welcomed to drive much-needed changes, but this approach may risk neglecting the quality of research in favour of how it is performed. This is why we feel it is crucial for researchers to drive the transition to Open Science and is the main motivation for this work.

The increasing emphasis placed on Open Science by policy-makers and research funders creates a risk that the reform of research assessment, including a transition to Open Science, will be perceived as an unwelcome and unwanted "top-down" imposition that further increases the workload of already overburdened scholars. Since the realisation and implementation of Open Science practices may not be equally relevant to all researchers, are likely to be discipline-dependent, and may encounter resistance for structural or historical reasons, the uptake of these practices by the research community may be fragmented and slow.

This fragmentation could simply be an expression of genuine differences between research communities, but may also point to a rejection of those practices for reasons unrelated to the nature of the discipline. It is not necessarily straightforward to determine where these differences come from, but as Open Science becomes more an inherent part of research, reasons for why individuals, institutions or communities might resist these reforms will become clearer.

Overall, the pressure by the European Commission, as well as by some national governments and individual research performing organisations, should be welcomed to drive much-needed changes, but this approach may risk neglecting the quality of research in favour of how it is performed. This is why we feel it is crucial for researchers to drive the transition to Open Science, and this is the main motivation for this work.

Questions to be addressed

In this report, our focus is on change at various levels of research evaluation and reward systems. If something is to be rewarded, it first needs to be evaluated. What should be rewarded, how, and based on what? Thus, we consider evaluation of, and rewards for, individual researchers, individual and collective grant proposals, and research institutions. For individual researchers this may bring important changes in the system of evaluating who gets hired, promoted and funded.

There are four main aspects that should be considered

1. **Which practices should be rewarded?**
2. **What should evaluation be based on?**
3. **How can a change in evaluation culture be achieved?**
4. **Who should be responsible for driving change?**

1. What Open Science practices does a scientific community wish to reward, and how should these rewards be weighted and embedded within the existing evaluation system? What is the correct balance of rewards, and how can tendencies to 'game' any system be avoided or mitigated?

2. Once suitable forms of Open Science practices have been identified, how is their implementation in the various fields and regions equitably and accurately assessed? How do we evaluate the quality of Open Science practices? Should metrics be de-emphasised in favour of more qualitative forms of peer assessment? Can this scale across the research system?

3. Provided that suitable practices can be agreed upon and assessed, how can it be ensured they are rewarded in practice? How can the way that recruitment committees, funding panels, or research performing organisations handle research assessment be changed? How can cultural inertia be overcome to ensure that Open Science practices will be rewarded, and not remain on the level of idealistic statements?

4. Which academic or research institutions, stakeholder groups, and individuals should drive the change and how should those who take on this responsibility work together for an optimal outcome? Who should decide about the requirements and implementation of Open Science within the research system? There is no single solution that can be superimposed on the current system to fit all disciplines. Shifting towards Open Science practices may require that the participants in this evolving system, with their own diverse needs, adapt the way they work.

Those involved in developing Open Science systems and policies know well the divergence in approaches to it in different fields of research. Even if much of the solution will come from the funders (national states, EU, private and philanthropic funders), the path towards Open Science should be led by the research communities taking field-specific and other differences into account.

Researchers need not act as individuals while participating in these activities. Often overlooked is the option of engaging with learned societies. In fact, learned societies are run by and for researchers: a learned society is its members, with secretariats working to provide the platforms that researchers need. These include advocacy platforms, where the learned society may function as an amplifier of researchers' views, but not separate from those views. The impact of advocacy could be further strengthened by combining efforts between societies. For this, an organisation like ISE has an important role to play.

BOX 2: ISE Open Science Task Force and Study Methodology

"Opening" research has been one of the main interests of ISE from its inception. ISE carries out its work through the voluntary efforts of its members, in some cases formalised in the use of a task force. The ISE Open Science Task Force was initiated in April 2020.

Through discussions with ISE member organisations, the task force found that while there are many areas of Open Science that are relevant to ISE, the particular concerns around the relationship between enabling "better" research (more reproducible, more transparent, etc.) and the still-evolving concept of Open Science surfaced as a key query of interest. More specifically, reforming the research evaluation and reward system appeared to be both highly timely and important.

The task force explored this area through a combination of expert elicitation, interviews, and discussions with ISE member organisations. The task force was chaired by Toma Susi.

To conduct the expert elicitations, a closed workshop was held as an online meeting on 25 – 26 March 2021. The agenda and participant list are found in Appendix A. Additional interviewees are listed in Appendix B.

The authors of this report, along with other members of ISE's Open Science task force, structured the workshop and interview questions to elicit information from the expert group, and to begin to analyse the shared information. Further analysis was done by the members of the task force, and the conclusions are reflected in the report.

The workshop and interviews included participants from, or with knowledge of, the areas of research (including representative organisations such as learned societies and university networks), scholarly publishing, industry, open science practice, research administration, funding, and research assessment.

The workshop was held under the Chatham House Rule. Structured discussions facilitated the group's ability to look at specific questions of concern or measures of interest in detail, while allowing at the same time for comparative analyses. In addition to the members of the ISE task force who were organisers and thus participants, other members of the task force attended as observers who contributed during the last session.

We additionally interviewed other stakeholders to further increase our understanding of specific potential measures; or to understand better how specific organisations are approaching reward systems. We also directly addressed concerns about the treatment of Open Science as an approach to enable greater reproducibility, transparency and robustness of scholarly work, rather than as separated technical practices.

Many participants were in agreement on these goals, and hence, incentivising such practices should be aimed at catalysing the transition to an improved way of performing research. However, there is much less consensus on how this should be done, and different types of indicators or practices may still be relevant for different actors within the research system.

Overall, we observed some hesitancy to name specific practices that should be rewarded. There are grounds for being careful: practices vary greatly across disciplines and different geographic regions are at different stages of development. Furthermore, anything that becomes a target of evaluation is always in danger of becoming a target of gaming. A secondary interpretation of this observation is that, if it is the case that Open Science practices make for "good" research, they would be indirectly rewarded. How far to separate practices of Open Science from practices of research is likely to be a tension point for researchers and evaluators for some time to come.

II. Key policy goals

We note here specific policy goals that, when achieved, will contribute to the reform of research assessment, which is a part of broader academic reward systems. In section III, we will then focus on options that address these policy goals.

In our view, a prerequisite for a successful reform is to increase the involvement of researchers in designing reward and evaluation systems.

The overarching aim of these policy goals is to enable a positive change in research culture that helps improve the transparency, reproducibility and reliability of research, and also de-emphasises those forms of evaluation that contribute to toxic competition (Brazil, 2021). In our view, a prerequisite for a successful reform is to increase the involvement of researchers in designing reward and evaluation systems (see 'essential principles' below).

The key policy goals for an improved research assessment and reward system are:

- Evaluate and reward people and institutions based on their achievements and competencies rather than based on prestige or inappropriate indicators.
- Identify suitable discipline-specific means of evaluation, emphasising transparency, reproducibility and robustness of the research outcomes and of the research process.
- Incentivise Open Science practices at each career stage in a coordinated reform of academic evaluation and reward systems.

III. Routes to implementation

Several important initiatives, including DORA (2013) and the Leiden Manifesto (Hicks et al., 2015), have already pointed to important features of Open Science that lead to more transparent and reproducible research, and by implication, should be part of a reward system for researchers. Amongst others, DORA has explicitly pointed out the importance of community engagement in driving reforms.

We agree with those views, and to amplify them here, we point to the importance not only of stakeholders not only understanding each other's views, but in talking with each other about them as they are developing. Particularly, it is critical that researchers' views are taken into account in the development of evaluation and reward systems, and this can be best accomplished through ongoing discussions. Learned societies, stable organisations representing researchers, are particularly well-placed to promulgate these discussions over time.

Below we first outline the broad routes along which reform of research assessment could be implemented, highlighting examples of recent actions at different levels – top-down, intermediate, and bottom-up – and then move on to propose options that each stakeholder group could take.

Taking into account earlier initiatives and extending their analyses through the workshop and interviews we have conducted, we identify several routes by which rewards and incentives for Open Science practices could be applied:

1. Top-down

Policy-makers and funders would need to consider Open Science practices as core part of a robust research system. Their policies and funding requirements could incentivise research institutions and researchers to broadly adopt these practices. However, any top-down measures should be implemented in cooperation and coordination with those research communities that they affect, lest those incentives be perceived as unwelcome mandates.

Any top-down measures should be implemented in cooperation and coordination with those research communities that they affect.

Recent examples of such interventions include:

a. **Transnational:** The drive of the European Commission as a key policy-maker and research funder towards implementing Open Science[1] and national Open Science coordination in all Member States. A concern with this approach is that the disconnect between policy-makers and those whom their policies affect may bring undesired effects, such as increasing the workload of researchers in ways that are disproportionate to the benefits. As a positive development, the European Commission has and will continue to consult research funders, research performers, policy-makers, and other stakeholders including researcher associations, on how to advance in reforming the research assessment system, with a proposal to reach an agreement in 2022 (for example, an MoU amongst those willing to participate; EC, 2021c)

b. **National:** After several years of policy efforts by the Dutch Research Council (NWO) including a FAIR Open Data mandate introduced in 2016, the Dutch government and university leaders are now making a common effort towards embedding Open Science in the academic reward system across the Netherlands (VSNU et al., 2019).

c. **Funder:**

i. The Wellcome Trust has recently introduced "culture" assessment and as an experiment, research culture was given equal consideration to scientific project consideration in one call ("Basic Science PhD"). They had determined that a top-down approach is needed in order to move universities in the desired direction, but that bottom-up feedback is fundamental to learn what adds value to the research system (particularly considering the needs of researchers at different career stages and disciplines). This approach is currently being assessed by the Wellcome Trust including through a project on research cultures.

ii. The European Research Council (ERC) has signed DORA, and explicitly asks applicants not to include journal impact factors. The Scientific Council of the ERC stated that they are convinced that the implementation of research assessment procedures integrating the DORA principles is the key to an equitable transition to Open Science (European Research Council, 2021).

1 As the funder of Horizon Europe, the EC wants to cover both upstream and downstream facets: (1) work programmes will include support to Open Science practices (for the clusters, but also for the missions, partnerships, etc., to adopt Open Science); (2) the EC will support enabling infrastructures (e.g. EOSC, or the Open Research Europe publishing platform); (3) cultural change towards Open Science will be incentivised through the MSCA work programmes part; (4) there will be full policy support in the ERA part of the work programmes; (5) evaluation criteria will take into account the quality and appropriateness of the Open Science practices in the submitted proposals: Open Science practices in the proposals will be evaluated as part of the project's methodology, under the excellence award criterion, considering a diverse set of outputs and practices and in line with DORA principles; (6) evaluations will include evaluators familiar with Open Science practices and briefed about how to assess them; (7) contractual obligations will be included in the grant agreements and will require immediate Open Access to all peer-reviewed scientific publications, Data Management Plans so that data are FAIR (Findable, Accessible, Interoperable and Re-usable), and data 'as open as possible, and as closed as necessary'; (8) Open Science practices will be reported at project level, and the impact at Programme level will be monitored through nine Key Impact Pathways, of which two specifically address Open Science practices (the pathway 'Fostering diffusion of knowledge and Open Science' towards scientific impact, and the pathway 'Strengthening the uptake of R&I in society' towards societal impact).

iii. The French National Research Agency (ANR) has issued calls for funds directed towards the structuring of each disciplinary field as open, thus letting researchers and staff find the concrete means discipline by discipline. Such funds are available for a range of actions, from inside consultations and networking to the creation of data platforms, from the search for economic models for making journals OA to the creation of new forms of scientific publications that are both sound and transparent (ANR, 2019).

2. Intermediate layer

Universities and other research performing organisations have the resources and capabilities to drive change from within by encouraging their faculty, researchers and staff including librarians to find solutions for rewarding Open Science practices. Universities and other research institutions, with their proximity to researchers, would want to explore different forms of rewards to find an optimum. This optimum, though, is steered by policies that allocate funding to these institutions – it is thus important that these institutions feed the learning back to governments and funders, and that policies are aligned and consistent across the research system.

It is important that universities feed their learning back to governments and funders, and that policies are aligned and consistent across the research system.

Both the potential and the difficulties of these types of changes is seen also in the results of a members' survey conducted by the European University Association (2021). The survey focused on attitudes about possible policy changes and on practicalities when translating policy to practice. While the self-selected respondents demonstrate an enthusiasm for many aspects of Open Science and have made progress in particular areas (such as Open Access), fully one-third of the institutes included no elements of Open Science in academic assessments.

There are examples of early ambitious reforms, which include:

a. University College London (UCL) ran a 3-year program of consultations within all academic departments. This resulted in a co-creation process to understand how to implement assessment of Open Science practices in the university (and others are following the lead of UCL to change their current systems; LERU, 2020). One important lesson learned from UCL is that different research communities develop different approaches to weighting contributions to Open Science in their evaluations. In general, they base their assessment on a combination of qualitative and quantitative criteria to assure scalability of the process (DORA, 2020).

b. Utrecht University announced that they will be embedding "Open Science fellows" within every department or institute to drive a comprehensive staff assessment reform, aimed at transforming hiring, promotion and performance review across the university. The scheme explicitly acknowledges that the requirement for Open Science practices can become an additional burden on researchers unless evaluation processes are revised to emphasise transparency, reproducibility and public engagement. The University also explicitly states that there is no place for journal impact factors in recognition and reward policies (Utrecht University, no date; Woolston, 2021).

c. The French National Centre for Scientific Research published the CNRS Roadmap Open Science (CNRS, 2019), which aims to render all publications open in the next few years (involving the redirection of some publications from traditional publishers to OA platforms). It also proposes to change the individual evaluation of its researchers in relation to their Open Science practices, and through debates with national committees, discipline by discipline, to open research data. An Open Research Data Directorate had already been created in 2020 to assure the coordination between the different scales of decision making regarding data, thus linking local disciplinary needs to European directives.

3. Bottom-up

The academic community, i.e. faculty, researchers, and staff including librarians are best-placed to advocate for abandoning prestige-based metrics and to be included in the design and adoption of new reward systems at different levels. As ISE is a platform representing researchers, we would like to see this type of advocacy by researchers as broadly as possible, down to the most local levels.

Some research communities have already adopted and now informally reward certain Open Science practices, which could be used as examples to be formalised into policy at higher levels of the research system.

Existing examples include:

a. Pre-prints are already widely read and cited by researchers working in several fields, with the notable example of the now 30-year-old preprint archive arXiv, whose use has spread from high-energy physics to other branches of physics and then mathematics and computer science (Ginsparg, 2021). In many cases, preprints are accepted on resumes and in grant applications. A similar change that was underway in biomedical sciences and medicine has been greatly accelerated by the COVID-19 pandemic (Fraser, 2021). The tacit acceptance of the importance of preprints was highlighted when the Australian Research Council (ARC) initially disallowed fellowship applications that included preprints or other non-peer reviewed contributions (Watson, 2021). The immediate negative response to this, and ARC's rapid change of its policy (Australian Research Council, 2021) speak to how research assessors now want to take information from pre- or non-peer reviewed outputs into account.

b. A handful of academies, including the Royal Netherlands Academy of Arts and Sciences (KNAW); the Austrian, Australian and Lithuanian Academies of Sciences; and multiple Swiss academies of arts and sciences, as well as several researcher associations, including the European Council of Doctoral Candidates and Junior Researchers (Eurodoc), the Global Young Academy (GYA), and the Young Academy of Europe (YAE) have signed DORA, thereby committing to not evaluate candidates for membership based on inappropriate metrics.

It is clear that there are many actors driving the transition to Open Science and that their approaches will be different. Such a major cultural shift will not take the form of a "system reset" but rather of a slow process that might take an entire generation to complete. Praising and rewarding first movers will increase their visibility and will nudge others to follow these role models. The challenge is to bring these different groups together and find common ground.

Aspects to consider include:

- What is the appropriate balance between qualitative and quantitative evaluation for different disciplines and in different evaluation settings, and which indicators are fit for purpose?
- What changes to the assessment of grant applications, academic recruitments and promotions would be needed?
- What resources, including time, would be needed and by whom? Who provides those resources?
- Will any given option need ubiquitous acceptance, or can it be implemented locally?

We are concerned that unless the research community itself makes concrete proposals, the shape of the reforms and transitions to Open Science will be largely driven top-down by policy-makers, or indeed entirely by outside commercial and other interests. If research communities cannot agree on how to replace currently prevalent prestige indicators such as journal impact factors and quartile ranks, these will either continue to be (mis)used or new indicators will be imposed without the communities' participation. Beyond that immediate concern, even better will be for researchers and their communities or representatives to contribute to outcome- or goal-driven systems for assessment: what do we want to reward and why?

IV. Essential principles for reform

We believe that all stakeholders must recognise four essential principles for the successful reform of research assessment, and these require coordination both within and between stakeholder groups:

- **Engage researchers in all decisions regarding changes to research assessment**
  All stakeholders should liaise more with researchers and researcher organisations and include them from the beginning in their decision making processes. Using an appreciative inquiry approach (Cooperrider, 2012) might be a good way to achieve this. In this way, stakeholders would be able to craft better policies that will be accepted by the research community. This stakeholder engagement (or co-creation) process would drive the uptake of new practices and accelerate the cultural change, and reduce unintended effects to the research community.

- **End the use of inappropriate metrics**
  In all instances where policies for research assessment are determined and in the conduct of research assessment itself, all stakeholders should abide by the principles previously outlined in the San Francisco Declaration on Research Assessment (DORA) and the Leiden Manifesto. Where appropriate, stakeholders should sign DORA, implement the appropriate measures, and ensure that these are communicated and followed.

- **Agree on appropriate ways of assessing research and researchers**
  Identify suitable discipline-specific means of evaluation for the transparency, reproducibility and robustness of the research outcomes and of the research process. Establish an appropriate balance between qualitative and quantitative evaluation for different disciplines and in different evaluation settings. Evaluate which metrics or indicators, if any, are suitable in what settings.

- **Recognise that reforming assessment requires resources**
  Changing how we evaluate and reward science will require resources, but these should not come from existing research budgets or be reliant on volunteer labour. To facilitate Open Science practices, funders, governments, and universities should agree to finance additional personnel such as data stewards and curators or designated experts within research-conducting units (laboratory, department, or institute), and allocate funding to libraries as an integral part of the process. In addition to the personnel needed for assessment reform, the stakeholders could finance the policy work needed for implementation.

V. Options for action

In this section, we consider the options for action by any of the stakeholders in the research system. We look at the following types of actions, which do not necessarily apply equally for each group:

- **Setting policy**
- **Advocacy and training**
- **Rewarding**

In addition, we identified "Tool creation" as an option specifically for publishers.

Options for researchers

Researchers play a key role in the research assessment system. They conduct research and are evaluated, but are also evaluators and involved in decision making. Thus, researchers need to have a central role in any discussions about, creation of, and implementation of policies for Open Science. This may be most obvious in the area of research assessment reform, where changes to reward structures affect researchers most, but are also best understood by them.

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Researchers need not act as individuals while participating in these activities, but could engage through their learned societies. This takes effort on the part of researchers, but leads to much more robust outcomes for their advocacy.

Setting policy

1. Researchers could prioritise venues with robust Open Science policies

When choosing where to publish their work or to dedicate their time for performing peer review, researchers could prioritise those journals or publishing platforms that have robust Open Science policies including Open Data, Methods and Software, pre-registration of studies, and transparent review processes.

Examples of publishing platforms with progressive policies and modern technical features include Open Research Europe, Wellcome Open Research, or SciPost. A number of initiatives cover other aspects of the research process, including Review Commons, GitHub, and Protocols.io. During the COVID-19 pandemic, Outbreak Science Rapid PREreview has been an important collective effort.

Advocacy and training

2. Researchers could strategically advocate for the adoption of specific Open Science practices as part of designing, conducting, and sharing good research

Researchers at all career stages who are knowledgeable about Open Science practices and the problems of the current system could help raise awareness in their institutions and other forums. They could also act as role models or champions to help drive change and offer support to their peers in implementing these in practice.

Early-career researchers who generally support Open Science can be particularly good advocates for it. Many have the know-how, as some have had access to Open Science training from the start of their careers. They are also more mobile, and may choose to move to research institutions with a culture of excellence where their Open Science experience will be valued. Finally, early-career research-

ers have the critical mass for successful advocacy and are the researchers and decision makers of the future. They should be better included in decision making and assessment, but the responsibility for changing the system cannot be theirs alone.

Communities of researchers could work towards the implementation of novel assessment and reward systems in their domains (Armeni et al., 2021). Here, the role of learned societies representing researchers is important as they have access to different demographics within various disciplines (see also Option 4). They can encourage their communities to use assessment criteria that embrace Open Science and responsible conduct of research as well as equity, diversity and inclusion, for the activities they run, from electing members (if applicable) to providing awards and prizes, or organising meetings.

3. Established researchers could model good practices and support their trainees, postdoctoral researchers and other personnel

While Open Science practices and rewards are still not widespread, established researchers whose careers are more secure and who have more influence could already incorporate these practices into their work as first adopters. Further, they could avoid advertising personal indicators such as the h-index on their web pages. This means also supporting doctoral candidates and postdoctoral researchers for whom these practices may seem natural, but who are in a precarious position and concerned about their careers (de Herde, 2021). In addition, they should help early-career researchers to not feel intimidated by the status quo, and to actively improve their research processes through Open Science.

4. Learned societies could raise awareness within their membership of the benefits of Open Science, and convey their communities' views to decision makers

Learned societies could play a key role in raising awareness and educating their members and the wider community about the issues with the current evaluation system. They could help promote Open Science practices by pointing to, for example, ambassadors or Open Science champions (i.e. first adopters).

Generally, the learned societies to which researchers belong may have both organisational and moral powers to engage decision makers. Some of them, conscious of their members' concerns with respect to Open Science and research assessment, already have embraced many aspects of it and promoted them to their membership. Nonetheless, not all learned societies have the motivation to do this or are not aware of their members' concerns and difficulties, and some may have potential conflicts of interest if they also publish journals.

Considering that learned societies want to be responsive to their members, researchers could actively engage them in the conversation about Open Science to achieve a critical mass for a more extended adoption (and assessment/reward) of these practices.

Rewarding

5. Researchers serving on hiring, promotion or funding evaluation panels could call out the improper use of metrics

Many researchers might not realise how unquestioning they have become towards traditional metrics and how often they make an improper use of them to assess others or to promote themselves. They should be mindful about this and distance themselves and their peers from bad practices; a particular responsibility here lies on panel chairs, who could, for example, they could point out improper uses of metrics both in formal and informal conversations with colleagues or other stakeholders.

Options for other stakeholders

Funders

Because of their central role in financing research, funders have the most direct power to change the way how research outputs are disseminated and how Open Science practices are taken into account in the evaluation of grant proposals.

Setting policy

6. Funders could provide a set of field-specific criteria, including Open Science practices, that should be taken into account in the evaluation process

For example, based on a narrative CV with only a few important publications, they could ask to ascertain that data were available in the recent publications, if they adhere to FAIR principles, and if these publications are available openly. Description of Open Science practices in the project proposal could be evaluated as an integral part of the proposed methodology. Plans for research data management (RDM) in line with the FAIR principles could be requested by funders as part of the grant proposal and updated during the project lifetime.

Advocacy and training

7. Funders could train grant proposal reviewers in evaluating Open Science

In addition to setting appropriate policies, a reform of the process of grant evaluation also requires the training of staff and evaluators, as well as monitoring their adherence to the policies. Funders should train the evaluators of grant proposals and give them clear guidance on the evaluation procedure. For example, evaluators should be trained on how to assess the relevance of different Open Science practices and plans for RDM; a good indicator for the latter would be whether they contain some discussion of FAIR data.

Rewarding

8. Funders could explicitly reward Open Science practices as part of normalising their use in research

While funders want to fund excellent research, they have significant latitude to place conditions on their grants. While researchers themselves have been clear that merely adding Open Science practices will not save a poor proposal, it is clear that following these practices will make any research more transparent, robust and reproducible.

The goal would be for these practices not to have to be called out at all. But until that is the case, prominent funders may show others what these possibilities are. As an example, the EC (2021a, 2021b) as a funding body is requiring Open Science as an integral part of projects by default within the Horizon Europe programme, where these practices should be described in the project proposal and will be part of the evaluation process. Thus, projects with a strong Open Science focus may be more readily funded.

Governments

Governments and decision makers that distribute public funds to research performing organisations are responsible for how this money is spent and have an interest in making the results publicly available when possible. They may also strive to promote greater transparency and cost-effectiveness of the invested money. However, the governments of many countries currently distribute funding based on inappropriate metrics, which may hold back the necessary reforms at institutions.

Setting policy

9. Governments that fund research institutions based on research performance could cease using biased and subjective ranking tables and other inappropriate metrics to allocate funding

It is widely recognised that university rankings or league tables are subjective, often based on intransparent criteria and data sources, and over-emphasise prestige and entrench inequities (Gadd, 2020). As with other proxy factors that use inappropriate metrics to judge individuals, the use of league tables to assess a very specific factor, research performance, will always give irrelevant results.

Further, in many countries, at least part of government funding is distributed based on prestige-based metrics such as the number of publications in so-called Q1 journals, which may discourage universities from reforming their own evaluation practices.

Better methods can be developed and adopted. Governments generally have at their disposal experts in metrics and statistics in many different areas of government interest. Applying their skills to help evaluate performance appropriately would be a significant contribution to research assessment generally.

Rewarding

10. Governments providing financial support to research institutions could include rewards for the use of Open Science practices at an institutional level

Governments could reward research performing organisations for their commitment to implementing Open Science practices including Data Management Plans, and especially institutional policies for hiring and rewarding researchers based on them. In addition to direct funding, such incentives for research institutions could include support structures that would benefit researchers who want to include more extensive Open Science practices in their work.

Crucially, institutions should take care that changes in hiring and rewarding are done without adversely impacting research quality, while keeping in mind that Open Science activities in many cases can reflect quality directly (e.g. improving the transparency and impact of research by making data openly available).

Universities and research performing organisations

Universities and other research-performing organisations play a critical role in the research system by hiring and promoting researchers and scholars, and thus their participation is vital for a successful reform of research assessment.

Setting policy

11. Institutions could set policies for hiring and promotion that evaluate research on its own merits

Instead of misusing journal quartile rank or journal impact factors as easy but inappropriate proxies for evaluating individuals for hiring and promotion, research institutions could modernise their evaluation and reward systems to evaluate candidates on their own merits. Clear guidance should be given on what constitutes high-quality research, and sufficient time and resources should be provided to allow evaluators to resist taking easy but flawed shortcuts.

Archivists, librarians and other supporting staff, who are at the forefront of the transition to Open Science, and who provide training and support to researchers and perform other forms of work on data, could be key in establishing new measures and rewards for the work necessary to prepare data for open publication.

Advocacy and training

12. Institutions that award doctoral degrees could incentivise doctoral candidates to practice Open Science

Where applicable, institutions could explicitly reward Open Science during the doctorate progress evaluation, and practices such as maintaining a data management plan could be already included in with doctoral research projects. As part of their PhDs, doctoral candidates validate a number of credits in addition to those awarded for their thesis manuscripts. Institutions could decide that a number of these credits (e.g. ECTS) could be awarded for attending Open Science training or for the publication in OA journals. All doctoral theses and reviews from their defence could be made openly available.

Rewarding

13. Institutions could explicitly reward Open Science practices in coordination with each other

Institutions could explicitly reward Open Science practices including the deposition of all research articles and data in the institutional or other repositories. Even if these practices would be rewarded by a researcher's current institution, they perhaps would not be recognised by the next institution. Thus, universities that have relationships with each other (or through organisations representing universities such as European Universities Alliance) could agree to recognise a common set of measures for evaluating and rewarding researchers, and engage in exchange of good practices and mutual learning.

Publishers

In the context of research evaluation and rewards, publishers should be seen as service providers that implement those features and metrics that research communities choose to use. Any publisher policies that give preference to their own interests over those of their customers should be questioned and revised. Further, private ownership of critical components of the data and infrastructures used for assessment and metrics should be questioned, or full transparency in terms of data collection, algorithms and processes should at least be required.

Private ownership of critical components of the data and infrastructures used for assessment and metrics should be questioned.

Setting policy

14. Publishers could develop policies to support Open Science practices

This includes allowing open licenses, requiring data availability statements and data deposition in trusted repositories, providing guidelines and assistance to authors to help them with FAIR Data, using the CRediT system to indicate the contribution of each author, requiring an ORCID for authors, and making available article-level metrics to help measure the impact of individual outputs.

15. Publishers could adhere to Open Science standards to be indexed in Open Research Central

A non-profit organisation, the Open Research Central, has recently launched a set of five core principles drafted by representatives of the global scholarly system to foster the re-imagination of the research dissemination system and to facilitate trust, collaboration and transparency through setting norms and standards (ORC, no date). Any publication venue adhering to these principles could apply to be indexed on ORC.

Advocacy and training

16. Publishers could train journal editorial boards and staff on Open Science practices

An increasing number of publishers support Open Science practices including pre-prints, Open Data, and Open Peer Review, but not all editorial board members – especially those who are volunteers – or journal editorial staff may be fully up to date on what policies and possibilities are in place at each

journal. Providing continuous training could be helpful in promoting and facilitating the transition to Open Science.

Tool creation

17. Publishers could provide options for Open Peer Review and other practices

More research is needed to find the optimal balance of openness without compromising the rigour of peer review, and publishers are best placed to do this. In the meantime, providing the technical means to enable Open Peer Review as a voluntary option and allow Open Reports to be citable would help prepare publishers for changes that prove beneficial.

In addition, publishers could also better support measures for improving research such as study preregistration or registered reports and the review of code, images and statistics (Center for Open Science, no date).

18. Publishers could help develop tools to accurately highlight research contributions, both for journal articles and more generally

Several organisations (notably, the CRediT system pioneered by CASRAI) have developed standards for describing detailed contributorship, but implementing their use in a way that is easy for researchers, funders, infrastructures, and institutes has not yet been achieved. Linking these to, for example, ORCID records, will require a level of automation.

Summary of options

Numbers in the table correspond to the option number in the report.

All options are in the context of four framing questions to be kept in mind:

- Which practices should be rewarded?
- What should evaluation be based on?
- How can a change in evaluation culture be achieved?
- Who should be responsible for driving change?

The options are in service of key policy goals for an improved research assessment and reward system:

- Evaluate and reward people and institutions based on their achievements and competencies rather than based on prestige or inappropriate indicators.
- Identify suitable discipline-specific means of evaluation, emphasising transparency, reproducibility and robustness of the research outcomes and of the research process.
- Incentivise Open Science practices at each career stage in a coordinated reform of academic evaluation and reward systems.

The options are in the context of four essential principles:

- Engage researchers in all decisions regarding changes to research assessment.
- End the use of inappropriate metrics.
- Agree on appropriate ways of assessing research and researchers.
- Recognise that reforming assessment requires resources.

	Actions			
	Setting policy	Advocacy and training	Rewarding	Tool creation
Stakeholders				
Researchers	Researchers could prioritise venues with robust Open Science policies (1)	Researchers could strategically advocate for the adoption of specific Open Science practices as part of designing, conducting, and sharing good research (2) Established researchers could model good practices and support their trainees, postdoctoral researchers and other personnel (3) Learned societies could raise awareness within their membership of the benefits of Open Science, and convey their communities' views to decision makers (4)	Researchers serving on hiring, promotion or funding evaluation panels could call out the improper use of metrics (5)	

	Actions			
	Setting policy	Advocacy and training	Rewarding	Tool creation
Stakeholders				
Funders	Funders could provide a set of field-specific criteria, including Open Science practices, that should be taken into account in the evaluation process (6)	Funders could train grant proposal reviewers in evaluating Open Science (7)	Funders could explicitly reward Open Science practices as part of normalising their use in research (8)	
Governments	Governments that fund research institutions based on research performance could cease using biased and subjective ranking tables and other inappropriate metrics to allocate funding (9)	Governments providing financial support to research institutions could include rewards for the use of Open Science practices at an institutional level (10)		
Universities and Research Performing Organisations	Institutions could set policies for hiring and promotion that evaluate research on its own merits (11)	Institutions that award doctoral degrees could incentivise doctoral candidates to practice Open Science (12)	Institutions could explicitly reward Open Science practices in coordination with each other (13)	
Publishers	Publishers could develop policies to support Open Science practices (14) Publishers could adhere to Open Science standards to be indexed in Open Research Central (15)	Publishers could train journal editorial boards and staff on Open Science practices (16)		Publishers could provide options for Open Peer Review and other practices (17) Publishers could help develop tools to accurately highlight research contributions, both for journal articles and more generally (18)

Parenthetical numbers in Table correspond to numbered Options described in main text.

VI. Conclusions

It is becoming increasingly clear that Open Science is the future of research and scholarship, but a crucial question remains: how will academic evaluation and reward systems be reformed to support this transition? We argue that research communities themselves should shape the much-needed reforms, but for this to happen, they must now take on a more active role.

Research communities themselves should shape the much-needed reforms, but for this to happen, they must now take on a more active role.

This report is the contribution of the ISE to current discussions that include governments, research organizations, learned societies, funders, publishers and many others – not least, the researchers themselves – particularly at the intersection of Open Science and research assessment. Both from our work and that of others (most recently, the European Commission's recent scoping report on research assessment reform; 2021c), we begin to see how stakeholders' roles, responsibilities, and own agendas may begin to amplify each other, potentially resulting in new and improved mechanisms for assessment and academic credit.

We will survey ISE member societies and other learned societies for proposals of what they believe should be rewarded in their own disciplines. With exhaustive lists of possible indicators already established (see, for example, European Commission, 2016b), it is urgent to start working towards a consensus that acknowledges that different fields have justifiably different views on what should be rewarded. Such a consensus must be built from the bottom up and adapted to the needs of each discipline and research culture, including the appropriate balance of qualitative and quantitative evaluation. However, regardless of disciplinary or geographical differences, good, reproducible and transparent science should be similarly valued globally.

For such a systemic transition to be possible, coordinated action from a range of stakeholders is needed. Effective enforcement tools are in the hands of policy-makers and research funders, who can and increasingly do require that publicly funded research be open. However, ultimately, researchers will be the real actuators of the transition to Open Science. Hence, funders, research agencies, and research institutions must recognise their contribution and adequately reward it.

To this end, it is urgent and vital that diverse research communities concretely consider how they wish evaluation systems to be adapted to eliminate pernicious incentives and to reward Open Science practices, and that decision makers engage with such communities in planning the much-needed reforms.

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Appendices

Appendix A.
Workshop agenda, participant list, interviewees

ISE workshop Defining a reward system within the Open Science framework
Thursday-Friday, 25–26 March 2021 (online)

	Day one Thursday, 25 March 2021, 9.00–16.00
9.00 – 10.15	**Session I: Introductions** • Welcome from the ISE President Martin Andler • Ground rules and work plan: Michele Garfinkel, EMBO • Overview of the project: Toma Susi, University of Vienna • Introductions: initial 2-minute contribution from each participant
10:15 – 10:30	Break
10.30 – 12.00	**Session II: Overview** • Rebecca Lawrence Open discussion
12.00 – 13.00	Break
13.00 – 14.15	**Session III: Describing a reward system, first look** Structured discussion
14.15 – 14.30	Break
14.30 – 16.00	**Session IV: Defining a reward system, specification** • What should be rewarded? • Where to get data for evaluation? • How to change evaluation culture? Structured discussion: options

ISE workshop Defining a reward system within the Open Science framework

Thursday-Friday, 25–26 March 2021 (online)

	Day two Friday, 26 March 2021, 09:00 – 16:00
9.00 – 10.30	**Session V: Challenges and opportunities for stakeholders** • Overview: Eva Hnatkova • Stakeholder analysis • Learned society roles Structured discussion: tradeoffs per stakeholder
10.30 – 10.45	**Break**
10.45 – 12.15	**Session VI: Implementation 1** Structured discussion
12.15 – 13.00	**Break**
13.00 – 14.15	**Session VII: Implementation 2** Structured discussion: options
14.15 – 14.30	**Break**
14.30 – 15.45	**Session VIII: State of our work** • Last look at options/tradeoffs • Possible recommendations • Outputs • Follow-up
15.45 – 16.00	**Conclusions and workshop end**

Workshop participants

Luke Drury
Professor Emeritus
Dublin Institute for Advanced Studies
Dublin, IE

Jean-Emmanuel Faure
Policy Officer for Open Science
European Commission
Brussels, BE

Vinciane Gaillard
Deputy Director for Research and Innovation
European University Association
Brussels, BE

Michele Garfinkel
Organiser
Head, Policy Programme
EMBO
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Senior Data Scientist
British Geological Survey
President EGU
Nottinghamshire, UK

Carlos Härtel
Chief Technology Officer
Climeworks, and
Special Advisor to Science|Business
Zurich, CH

Eva Hnatkova
Open Science Coordinator
National Library of Technology, and Eurodoc
Prague, CZ
(for session "Challenges and Opportunities for Stakeholders")

Rebecca Lawrence
Managing Director
F1000
London, UK

Gabi Lombardo
Director
European Alliance of Social Sciences and Humanities
Brussels, BE

Priya Madina
Director of External Affairs and Policy
Taylor & Francis Group
London, UK

Marco Masia
Organiser
Executive Coordinator
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Bernd Pulverer
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Kenneth Ruud
Professor
Theoretical and Computational Chemistry, and EuChemS
The Arctic University of Norway, NO

Toma Susi
Organiser
Associate Professor
Faculty of Physics
Universität Wien, and Young Academy of Europe
Vienna, AT

Pablo Garcia Tello
Section Head, New Projects and Initiatives
CERN EU Office
Geneva, CH

Nicolas Walter
Chief Executive Officer
European Science Foundation
Strasbourg, FR

Workshop observers from the ISE Open Science Task Force

Martin Andler
President, Initiative for Science in Europe

Monica Heintz
European Association of Social Anthropologists (EASA)

Eva Hnatkova
European Council of Doctoral Candidates and Junior Researchers (Eurodoc)

Wolfram Koch
European Chemical Society (EuChemS)

Maria Leptin
European Molecular Biology Organization (EMBO)

MariLuz Martínez Marco
European Physical Society (EPS)

Helge Pfeiffer
European Aeronautics Science Network (EASN)

Enrique Sanchez
European Physical Society (EPS)

Interviewees (interviews conducted following the workshop)

Paul Ayris
Pro-Vice-Provost
UCL Library Services, and
UCL Office for Open Science and Scholarship
London, UK

Mattias Björnmalm
Advisor for Research and Innovation
CESAER
Leuven, BE
(at time of interview)

Jean-Pierre Bourguignon
President
European Research Council
Brussels, BE
(at time of interview)

Anne-Marie Coriat
Head, UK and Europe Research Landscape
Wellcome Trust
London, UK
(at time of interview)

Marin Dacos
French Coordinator for Open Science
Ministry of Higher Education, Research and Innovation
Paris, FR

Appendix B.
Author biographies

Toma Susi is an Associate Professor of Physics at the University of Vienna in Austria, where he leads an ERC Starting Grant team in discovering new ways to manipulate materials at the atomic level. Having advocated for Open Science for over a decade, he served as the Vice-Chair of the Young Academy of Europe in 2018 – 2020, coordinating the organization's efforts in science policy, especially around Plan S. He is a member of the Scientific Advisory Board of Open Research Europe and the Editorial Board of Scientific Data, and has in his personal work contributed open data and code as well as an open grant application.

Monica Heintz is Professor of Anthropology at the University of Paris Nanterre and codirector of the Laboratoire d'Ethnologie et de Sociologie Comparative (CNRS/UPN). She has done field research in Eastern Europe and France and has published books and articles on ethics, work, citizenship and transitional environments more generally. In the frame of several collective projects, her current research is on the transition to Open Science in anthropology and on the implications of the open data movement on the practice of anthropology at the global scale. Since 2019 she is the Secretary of the European Association of Social Anthropologists.

Eva Hnatkova is an Open Science Coordinator at National Library of Technology and University of Chemistry and Technology in Prague. She has been active for many years in the area of research and higher education policy at the local, national and European level. Eva is an Advisory Board Member and former President of Eurodoc. She has been involved in various European projects like ORE or as a member of the Advisory Board (DIOSI, DocEnhance, Edulia, SAF21). Eva is an external Policy Advisor at ISE. She also serves on the Board of Directors at ORC and as a member of the EOSC Task Force for Researcher Engagement & Adoption. Eva obtained her PhD in Process Engineering at Tomas Bata University in Zlín, Czech Republic.

Wolfram Koch studied chemistry in Darmstadt and Berlin and obtained his PhD in 1986. He then worked for IBM Research in San Jose, CA (USA) and Heidelberg (Germany). In 1992 Wolfram was appointed Professor of Theoretical Organic Chemistry at TU Berlin. Since 2002 he is Executive Director of the German Chemical Society in Frankfurt. Wolfram authored some 190 scientific papers and a textbook on density functional theory. He is a member of the Executive Board of the European Chemical Society, is Treasurer of the International Union of Pure and Applied Chemistry and was a member of the Open Science Policy Platform of the European Commission. Wolfram is a Fellow of the Royal Society of Chemistry and holds honorary memberships of the Czech, Israel and Slovenian Chemical Societies.

Maria Leptin is the President of the European Research Council (ERC). After her PhD in Basel, Switzerland, postdoctoral research in Cambridge, UK, and leading a research group at the Max-Planck-Institute in Tübingen, she became professor at the Institute of Genetics, Cologne. She spent research visits at UCSF, the École Normale Supérieure in Paris, and the Sanger Institute, Hinxton, UK. From 2010 to 2021, Leptin was the Director of EMBO. Leptin is an elected member of EMBO, the Academia Europaea, the German National Academy, Leopoldina, an Honorary Fellow of the UK Academy of Medical Sciences, and holds an Honorary Doctorate from the EPFL, Lausanne.

Martin Andler is a mathematician and historian of science, professor emeritus at the Université de Versailles St-Quentin. His main domains of interest are Lie theory and the development of mathematics in France since 1870. A graduate of École normale supérieure in Paris, he obtained his PhD (doctorat d'État) from Université Paris-Diderot in 1983. He has held positions as a CNRS researcher, before joining Versailles-St-Quentin, and has been a visiting professor at MIT, Rutgers, and a visitor at IAS-Princeton. He was vice-president of

the Société mathématique de France (1997-1999) and the founding president of Animath, the main mathematics outreach organisation in France (1998-2017). His interest in European policy issues led him to be vice-president of EuroScience (2012-2018). Since 2017, he is the president of the Initiative for Science in Europe.

Marco Masia is the executive coordinator of ISE, where he is responsible for running the organisation, coordinating the work of different task forces, and liaising with policymakers and other relevant stakeholders. He works closely with the President and reports to the General Assembly of ISE. Earlier he worked as assistant professor of Theoretical Chemistry at the University of Sassari, Italy. He has also been board member and chaired the policy working group of the Marie Curie Alumni Association. He holds a PhD in Physics (Polytechnic University of Catalonia, Spain) and an executive MBA (Frankfurt School for Finance & Management, Germany).

Michele Garfinkel is head of the EMBO Policy Programme, where she is responsible for addressing policy concerns of researchers, policymakers, and the public in biotechnology, Open Science, and research integrity. The work she directs at EMBO comprises analytic policy research and practical applications of the results of that research. Earlier she worked as a policy analyst at the J. Craig Venter Institute and at Columbia University's Center for Science, Policy, and Outcomes. She holds a PhD in Microbiology (University of Washington) and an MA in Science, Technology, and Public Policy (George Washington University). She is an elected fellow of AAAS.

About ISE

The Initiative for Science in Europe (ISE) is an independent platform of 16 European Learned Societies and Research Organisations operating within different disciplines and across sectors. ISE supports all fields of research at a European level, involves researchers in the design and implementation of European science policies, and advocates strong independent scientific advice in European policy-making.

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