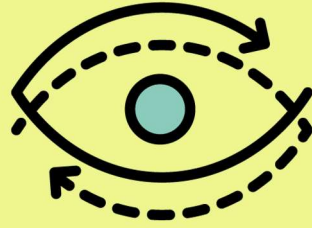


REPORT



TRUSTparency

Deliverable 1.2

A map of disparities across stakeholders, institutions, and national regulations

Project title: Increasing reproducibility through the co-creation of interventions that support a transparent and trustworthy ecosystem

Project acronym: TRUSTparency

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ABSTRACT:	<p>This report presents the outcomes of Task 1.3, focusing on the landscape of stakeholders and institutional disparities relevant to reproducibility and the TRUSTparenity project. The report provides an overview of the central stakeholders involved in research reproducibility and highlights differences in the interest they have in reproducibility, as well as their influence on and power to change reproducibility practices. The report builds on a literature study and a co-creation exercise with representatives from national Reproducibility Networks (RNs). By highlighting the diversity and complexity of the stakeholder landscape, this report can help TRUSTparenity select the most appropriate practices and guide the development of key outputs – including training materials, reproducibility policy guidelines, and monitoring mechanisms – for Research Performing Organisations (RPOs), Research Funding Organisations (RFOs), and publishers.</p>
Keyword List:	Stakeholders, Reproducibility, Stakeholder mapping, Institutions, Disparities

Consortium

	<i>Role</i>	<i>Name</i>	<i>Short Name</i>	<i>Country</i>
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2.	BEN	Aarhus Universitet	AU	DK
3.	BEN	Science of Science Limited	SoS	UK
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Under review by the European Commission

Introduction

A key objective of **TRUSTparenacy** is to develop institutional procedures that support Research Performing Organisations (RPOs), Research Funding Organisations (RFOs), learned societies, and publishers in promoting reproducibility. These institutional procedures will take the form of Reproducibility Promotion Plans (RPPs), i.e. policy guidelines that can be tailored to different institutional contexts. RPPs are intended to outline concrete steps that embed reproducibility enhancing practices into the daily operations of the aforementioned stakeholders, accompanied by monitoring mechanisms that reflect their specific needs and capacities.

Work Package 1 contributes to this objective by establishing a state-of-the-art knowledge base on existing reproducibility interventions and by mapping disparities across stakeholder types, institutional categories, national regulations, and disciplinary or epistemological contexts. Within this work package, **Task 1.3** plays a central role by:

- Identifying relevant stakeholders;
- Identifying relevant types of institutions;
- Mapping disparities related to reproducibility across stakeholder groups, institutional types, and national regulatory environments.

To carry out these activities, Task 1.3 drew on a range of sources and collaborative inputs (see Methods section below). The initial identification of relevant stakeholders and institutions was based on input from the project team, a literature study, and publications and findings from the three reproducibility-related Research and Innovation Actions, specifically [TIER2](#), [IRISE](#), and [OSIRIS](#).

To validate and enrich this preliminary mapping, members of National RNs were invited to participate in an online co-creation workshop on November 3rd, 2025. During this workshop, RN members engaged in a structured co-creation and validation exercise to review the initial stakeholder list and identify any additional relevant actors or institutions. Participants also conducted two mapping exercises aimed at uncovering disparities between stakeholders and institutions in relation to reproducibility.

This report (**Deliverable 1.2**) presents the outcomes of Task 1.3, focusing on the landscape of stakeholders and institutional disparities relevant to reproducibility and the TRUSTparenacy project. The report provides an overview of the central actors involved in reproducibility and highlights differences in the interest these stakeholders have in reproducibility, as well as their influence on and power to change practices that promote reproducibility. By highlighting the diversity and complexity of the stakeholder landscape, this report can help TRUSTparenacy select the most appropriate practices and guide the development of key outputs – including training materials, RPPs, and monitoring mechanisms – for RPOs, RFOs, learned societies, and publishers.

Methods

This chapter is divided into two sections. The first introduces the overarching concept of stakeholder mapping. The second explains the methodology applied in Task 1.3, highlighting how traditional stakeholder mapping approaches were adapted and used during the co-creation workshop to meet the objectives of Task 1.3 and Deliverable 1.2.

Stakeholder mapping

The idea of “stakeholders” has been around since the 1960s, originally referring to groups without whose support an organisation could not survive (Freeman, 2010). Since then, the concept has been used in different ways to include anyone who can affect or be affected by an organisation’s objectives. For instance, stakeholders may be defined as those who depend on a given organisation for the realisation of some of their goals, and in turn, the organisation also depends on them in some way for the full realisation of its goals (Mitroff & Mason, 1980 in Mendelow, 1981).

Stakeholder mapping is a practical tool, typically used to identify and analyse the individuals, groups, or organisations that have an interest in or influence over a project, policy, or strategic initiative. It helps teams or managers understand the key players in a given context, what they care about, and how much power they have. Related to the research ecosystem and research integrity, ALLEA, for example, defines its relevant stakeholders as: “... individual researchers, research teams, and research support staff. It also includes the institutions and organisations that enable research, such as research performing organisations, research funders, academies, learned societies, editors and publishers, and other relevant bodies” (ALLEA, 2023, p. 3). As shown below, these stakeholders largely overlap with those most relevant to reproducibility.

Mapping stakeholders may be useful in a wide range of settings, from designing policy and managing change to delivering complex projects, because it provides a structured way to visualise relationships and plan engagement (Ackermann & Eden, 2011; Mendelow, 1981). It can also help organisations anticipate resistance, build support, and align strategies with stakeholder expectations. To summarise, identifying and mapping stakeholders provides organisations with an understanding of how to manage and engage with different stakeholders in order to achieve their organisational goals.

According to Freeman (2010), the purpose of stakeholder mapping is to enable organisations to manage and engage stakeholders in an action-oriented manner. However, the focus of this report is not primarily on developing engagement plans or managing stakeholders, although the insights generated will support dissemination and communication activities by TRUSTparency. Instead, the report concentrates on identifying and mapping the most relevant stakeholders related to reproducibility.

Our aim is to provide an overview of key stakeholders, describe their characteristics and roles in relation to reproducibility, and determine whom to involve and co-create activities and policies with. Before presenting our approach, we first outline the most common methods and tools used in stakeholder mapping. This serves both to introduce the origins and evolution of the practice and to provide methodological context for the stakeholder mapping approach developed for this

report.

When discussing stakeholder mapping, it is essential to return to Aubrey Mendelow's (1981, 1991) work. Mendelow responded to calls for a systematic process to collect, analyse, and act upon information about the environment in which stakeholders are located by creating what she first referred to as the Power-Dynamism Matrix (Mendelow, 1981). This matrix can be seen in **Figure 1** below. In this matrix, **power** is defined as coming from four sources: possession of resources, ability to dictate alternatives, authority, and influence. Here, *resources* may refer to money or labour; the *ability to dictate alternative resources* refers to an organisation's access to alternative resources in case of money or labour being withheld; *authority* is the right to enforce obedience; and lastly, *influence* may be used to derive power, for instance by appointing executives to positions benefiting the specific organisation. **Dynamism**, on the other hand, refers to the impact of the stakeholder's environment on the stakeholder's basis of power. According to Mendelow's model, the environment can be static, meaning that changes occur

slowly and with little to no impact, or it can be dynamic, meaning changes are occurring which lead to alteration of the bases from which stakeholders derive their power. As **Figure 1** shows, the combination of a stakeholder's power and dynamism dictates how often they should be considered, or to use Mendelow's terminology, scanned, either in order to make adaptations within an organisation to better accommodate the stakeholder, or to engage with the stakeholder.

D y n a m i s m

		Dynamic	Static
P o w e r	HIGH	Continuous Scanning	Irregular Scanning
	LOW	Periodic Scanning	NIL

Figure 1: Power-Dynamism Matrix (source: Mendelow, 1981).

In 1991, Mendelow further developed this matrix, resulting in the well-known Power-Interest Matrix. Here, **power** refers to the ability of a stakeholder to influence an organisation's strategy or project resources, and **interest** describes the degree to which a stakeholder cares about an organisation or a project succeeding. Interest can be positive or negative, as a stakeholder can be interested in either supporting or hindering the work of an organisation.

This Power-Interest Matrix has since become the focal point of many stakeholder mapping methods, as well as the starting point of many further adaptations (see e.g. Ackermann & Eden, 2011; Bourne, 2005; Freeman, 2010; Johnson et al., 2008; Mitchell et al., 1997). Ackermann and Eden's (2011) adaptation of this model can be seen in **Figure 2** below. They have further defined each of the four segments of the grid, as well as described the characteristics yielded by the interaction between different levels of power and interest. Furthermore, Ackermann and Eden's matrix focuses on the dynamic nature of stakeholders and their location on the Matrix, as they emphasise

In 1991, Mendelow further developed this matrix, resulting

the possibility for stakeholders to change positions in terms of both power and interest, which was also included in Mendelow's (1981) original Power-Dynamism Matrix.

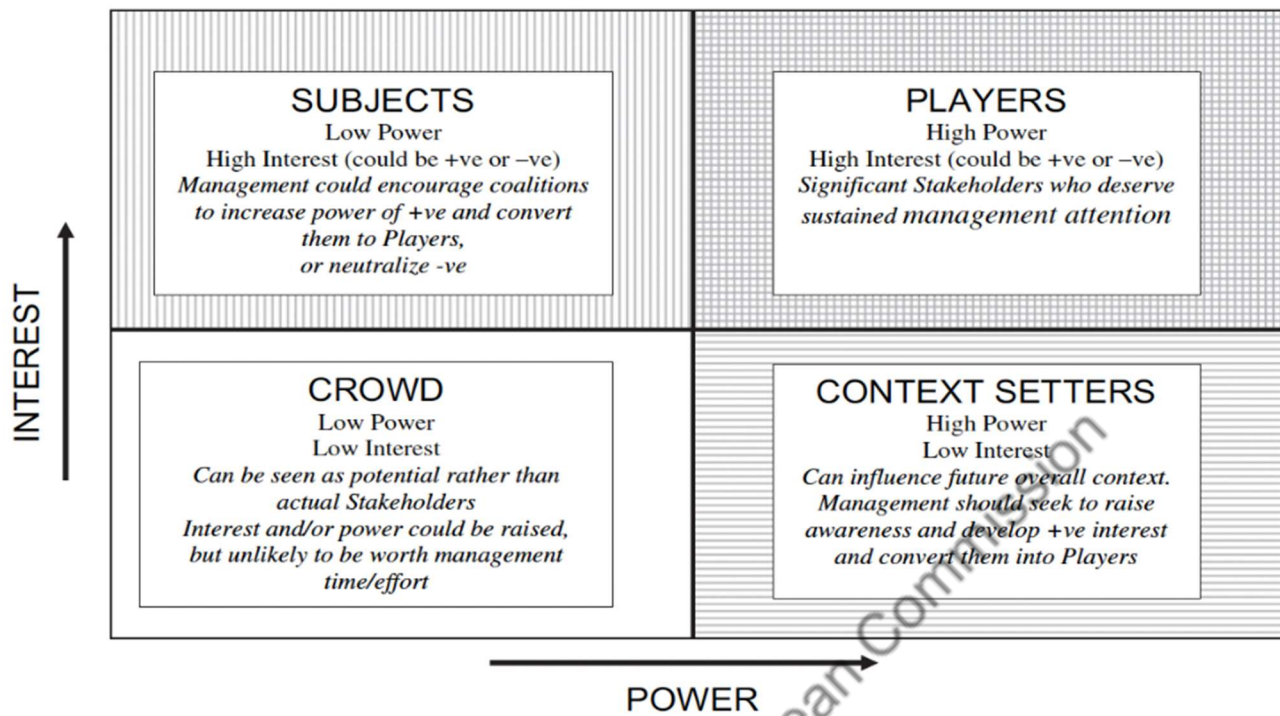


Figure 2: Power-Interest Matrix (source: Ackermann & Eden, 2011).

As this brief introduction to stakeholder mapping tools and methods illustrates, stakeholder mapping is a practice that can serve many purposes. Some, like us, may seek an overview of stakeholders related to an organisation, project, or activity (such as reproducibility). Others may aim to identify which stakeholders require greater attention, more active engagement, or to understand areas where their organisation, project, or activity may be vulnerable. The purpose of outlining these tools and methods has been to trace the development of stakeholder mapping and to introduce key elements considered in the methodology for this report. The following section describes the methodology developed for Task 1.3 and the present report.

Our methodology

As described in the introduction to this report, the goals of Task 1.3 of the TRUSTparenacy project consists of the following three elements: 1) identifying relevant stakeholders, 2) identifying relevant types of institutions, and 3) create an overview of the disparities related to reproducibility between stakeholder groups, types of institutions, and national regulations. The following will describe the methodology used to achieve these goals.

The first part of the methodology consisted of a comprehensive desk study. Publications from three EU-funded projects – TIER2, iRISE, and OSIRIS – were reviewed, and relevant stakeholders and institutions were identified by the authors. These were then discussed with colleagues from WP1 of the TRUSTparenacy project (the ‘contributors’ to this report, see p. 2). Similarly, TIER2, iRISE, and OSIRIS publications and additional relevant literature were consulted to identify disparities between stakeholder groups, types of institutions, and national regulations.

The second part of the methodology consisted of an exercise carried out at the first of two Mutual Learning Exercises (MLE) conducted during the TRUSTparenacy project. The MLE's functions as a mutual learning space between TRUSTparenacy and National RNs. This first MLE was carried out as an online workshop on 3 November 2025 with 12 participants from nine National RNs and 10 participants from the TRUSTparenacy project. We used the workshop to validate our initial identification of stakeholders and institutions within this core stakeholder group. In addition to the inputs from this workshop and stakeholder group, we will conduct three similar stakeholder-mapping exercises in connection with the three expert workshops organised under Task 3.4. These additional stakeholder mapping exercises with RPOs, RFOs, and publishers will be reported in Deliverable 3.4 and are intended to further enrich our understanding of the stakeholder landscape and to provide additional evidence to inform the development of policy recommendations.

In the workshop carried out on 3 November 2025 with National RNs, workshop participants were asked to conduct two separate mapping exercises of stakeholders on an adapted Power-Interest Matrix to identify disparities between stakeholders regarding their perceived interest in reproducibility and their influence on and power to change practices. Lastly, the workshop was used to consult the participating National Reproducibility Network representatives about important disparities in national regulations on reproducibility that TRUSTparenacy should be aware of.

In preparation for the stakeholder mapping exercise with the National RNs, the authors created an adapted version of Mendelow's (1991) Power-Interest Matrix, focused on reproducibility. This resulted in a matrix with the following axes: interest and influence/power. Both axes range from -5 to 5, with -5 indicating 'No interest in increased focus on reproducibility' and 'Not very influential - doesn't have the power to change practices to increase reproducibility', and 5 indicating 'High interest in increased focus on reproducibility' and 'Very influential - has the power to change practices to increase reproducibility'. In the co-creation workshop, participants were divided into four breakout groups and asked to map stakeholders using this matrix. More details on the implementation of this exercise in the co-creation workshop and the results are presented below in the chapter: "Stakeholder mapping in relation to reproducibility".

The mapping exercise was inspired by Ackermann and Eden (2011) who conducted a similar mapping exercise with members of top management teams, asking them to place stakeholders in their organisation on a power-interest grid (see Appendix II).

Finally, the last activity of the co-creation workshop asked participants to reflect on and discuss national disparities in reproducibility focus, policies, and regulations. The rationale behind this exercise was to make use of the participants' knowledge about the national contexts in which they are located. Results of this and the other exercises are discussed in detail in the following sections.

Stakeholder mapping/analysis

Identification of stakeholders

An initial list of key stakeholders relevant to reproducibility was compiled based on publications from the European reproducibility projects TIER2, iRISE, and OSIRIS. This list was further refined through exercises and discussions held during the kick-off meeting of Task 1.3 with TRUSTparenacy partners. The resulting list includes the following stakeholders, and is ordered according to how frequently each stakeholder is discussed in the reviewed literature:

- Journals
- Publishers
- RFOs
- RPOs
- Policymakers
- Researchers
- Research integrity officers
- Learned/Scientific/Scholarly societies
- Reproducibility networks
- Infrastructure providers

Below, we provide descriptions of each stakeholder. These descriptions outline both how stakeholders can contribute to improving reproducibility and the specific considerations they need to keep in mind. They are based on the reviewed literature and reflect the perspectives found there regarding the roles different stakeholders can play in reproducibility. Consequently, these descriptions do not necessarily reflect the views of the TRUSTparenacy project.

Stakeholder descriptions

For the purpose of this deliverable, we will be looking at institutions and stakeholders collectively, as our stakeholder analysis is on the level of institutions and stakeholder groups (e.g. RPOs, RFOs and publishers) and *not* individuals and specific institutions (e.g. Aarhus University, Wellcome Trust, and Elsevier). In the following, the text will refer only to stakeholders, but by stakeholders we refer to both stakeholders *and* institutions.

The following section will present a brief description of the stakeholders identified in the literature, including what they are doing or can do to promote reproducibility, and which challenges they face in relation to this. The goal of this is to introduce and describe each stakeholder category in relation to reproducibility, as well as to address disparities identified within and across these stakeholders.

Although the following sections outline what each stakeholder category can do to enhance reproducibility, much of the literature (Horbach et al., 2025; González & Colom, 2023; Kousta et al., 2019; Munafò et al., 2022) emphasises that supporting reproducible research practices requires cooperation among stakeholder groups. As the descriptions below will show, many actions recommended in the literature – and the challenges in implementing them – are shared across groups.

This overlap underlines the importance of coordinated action amongst stakeholders, both in adopting these actions and in addressing common obstacles. As Munafò et al. (2022) note, “no one actor in the research ecosystem can bring about meaningful change on their own” (p. 2).

Journals

Journals have historically been one of the primary means of communication, recognition, and validation of science, with published articles serving as a record of discovery and as the foundation for academic careers (González & Colom, 2023). Furthermore, most researchers have a vested interest in their research being published (Horbach et al., 2025). This confers on journals significant influence, a responsibility to uphold scientific integrity, and an interest in ensuring that the research they disseminate is reliable. Reproducibility lies at the core of this responsibility, since it allows independent researchers to verify results and identify inaccuracies. Journals, therefore, can play a decisive role in fostering practices that promote transparency and reproducibility, not only by authors but also across the broader research ecosystem.

The role of journals in enhancing reproducibility

The literature describes a variety of policy mechanisms and other initiatives that journals can implement in order to enhance reproducibility. Some of these are briefly outlined below.

Data sharing and transparency policies. Journal submission guidelines, as well as editorial checklists, can strongly influence author practices and should therefore be considered a crucial tool to combat irreproducibility in journal articles and the tendency amongst researchers of withholding important details in the used methods to improve their own ability to compete for publications (Collins, 1974; Hrynaszkiewicz, 2019; Nature, 2013). Stronger open data policies that mandate and verify data sharing, alongside data availability statements, are effective in ensuring long-term accessibility of relevant data. Yet a survey of 318 biomedical journals found that only 11.9% explicitly required data sharing, while 31.8% made no mention of it at all (Vasilevsky et al., 2017). Hence, such policies could be implemented more rigorously. Data sharing policies may suggest formal data-use agreements and controlled-access repositories to provide structured alternatives where public data sharing is not possible (Hrynaszkiewicz, 2019).

One example of such guidelines is the Transparency and Openness Promotion (TOP) guidelines, originally from 2015 but recently updated in 2025. These 2025 guidelines define research and verification practices that journals can choose to require researchers to meet as a condition of publication. These include study registration, study protocol, analysis plan, reporting transparency, materials transparency, data transparency, analytic code transparency, results transparency, and computational reproducibility (Grant et al., 2025). Furthermore, the guidelines also define different types of verification studies that may be submitted for publication (Grant et al., 2025; Nosek et al., 2015). The updated guidelines include a conceptual framework to clarify their primary objective – promoting the verifiability of empirical research claims – and to guide the reorganisation, revisions, and recommended applications of the TOP Guidelines for use across its broad range of stakeholders. The guidelines describe three levels of implementation: Level 1 is designed to have little to no barriers to adoption, simply requiring journals to disclose whether or not a specific standard was met by authors. Level 2 has higher expectations for authors as journals require standards to be met as a condition of publication. Level 3 is the highest standard, requiring

journals to verify that standards are implemented well.

It should be mentioned that not all journals find these standards helpful or appropriate. For example, the journal *Epidemiology* declined to support the TOP Guidelines for three central reasons (Lash, 2022). First, the editors would like to prioritize research quality and clarity over adherence to uniform, one-size-fits-all requirements, which they see as potentially counterproductive. Second, the guidelines offered no concrete plan for evaluating their effectiveness or updating them over time – an expectation the editors apply to any intervention meant to improve scientific practice. Third, they rest on what the editors view as a flawed premise: that a study's validity can be judged by whether its results are reproducible in a simple binary sense, often reduced to agreement in statistical significance.

Peer review and editorial practices. Peer review can be expanded to include reproducibility checks where this is meaningful, for example, in computational research, where code and workflows can be directly validated (Lu & Daugherty, 2022; Willis & Stodden, 2020). These reproducibility checks can be guided by a journal's data sharing and transparency policy. For multidisciplinary journals, enforcing relevant reporting guidelines is inherently complex and time-consuming. One way of doing this is the approach taken by *Nature*. Here, a standardised editorial checklist was introduced, which could be applied to many different study designs and research disciplines. It was developed by the journal in collaboration with researchers and funding agencies and is implemented by professional editors, who require that all authors complete it (Hrynaszkiewicz, 2019).

Publication of negative results. Null or negative results are published less frequently than statistically significant results (Franco et al., 2014; Hrynaszkiewicz, 2019). To counter publication bias, some journals have adopted policies that accept all methodologically sound work, regardless of outcome. The BioMed Central (BMC) series adopted this approach in 2000, with a mission to assess scientific accuracy rather than impact or importance, and to promote the publication of negative results and single experiments (Hrynaszkiewicz, 2019). It is worth noting here, that one such journal resulting from this approach, the Journal of Negative Results in Biomedicine, has since ceased publishing.

Incentives and rewards. Some journals and publishers have experimented with reproducibility badges, discounts, or free access for authors who adopt transparent practices (González & Colom, 2023). Transparency and reproducibility badges, such as those promoted by the Center for Open Science, have been shown to significantly increase data sharing rates in psychology and related disciplines (Hrynaszkiewicz, 2019).

Caveats for journals in enhancing reproducibility

While journals have significant influence on scientific practices, implementing reproducibility initiatives presents several challenges.

Infrastructure limitations. Many journals lack the technological infrastructure to handle supplementary materials such as datasets, code, or detailed protocols (Peng, 2009). Unlike data repositories, editorial systems are not always designed to store or check large or complex research artifacts. Willis and Stodden (2020) note that gaps in editorial software and reproducibility platforms remain a challenge, making it difficult for journals to integrate reproducibility reviews into

standard workflows.

Lack of consensus and standardisation. There is no universal “instruction manual” for reproducibility (Peng, 2009). Journals must decide which materials are required, in which formats, and which repositories or metadata standards are acceptable. For policies on data and code sharing, inconsistencies across journals create confusion for authors and add to editorial workload (Stodden et al., 2018; González & Colom, 2023).

Resource and cost constraints. Checking the reproducibility of manuscripts can be resource intensive. Large or multidisciplinary journals face particular challenges in verifying compliance with diverse reporting guidelines across fields (Hrynaszkiewicz, 2019). Implementing technical reviews or reproducibility checks often requires specialist expertise and additional editorial time, costs that many journals are unable or unwilling to absorb (González & Colom, 2023).

Limitations of enforcement. Sharing data might not be possible or beneficial for all projects. As the ALLEA code of conduct states: “Researchers, research institutions, and organisations ensure that access to data is as open as possible, as closed as necessary, and where appropriate in line with the FAIR Principles (Findable, Accessible, Interoperable and Reusable) for data management.” (ALLEA, 2023, p. 7). However, in cases where it is appropriate and where journals adopt data sharing or transparency policies, enforcement is uneven. For example, Vasilevsky et al. (2017) found that many journals encouraged data sharing without requiring it, and only a small minority made it a condition for publication. Journals often lack the staff or mechanisms to verify compliance, leading to gaps between policy and practice.

Publishers

Publishers shape how scientific knowledge is communicated and validated. By managing journals and conferences, they provide the main venues for recognition, socialisation, and evaluation within the scientific community (González & Colom, 2023). This central role brings with it a responsibility, as publishers must safeguard the integrity of the research they disseminate.

The role of publishers in enhancing reproducibility

According to the literature considered here, publishers are well-positioned to promote reproducibility by setting policies, incentivising good practices, and supporting the implementation of reproducibility interventions.

Establishing clear policies and guidelines. Publishers can – for journals and research areas where this is appropriate – create and implement policies and guidelines encouraging reproducibility, for instance relating to submission requirements that emphasise transparency, data sharing, and reproducibility in their journals. There have been a number of calls for publishers to take on the responsibility to facilitate reproducibility of research findings reported in their journal papers (Hrynaszkiewicz et al., 2018). Some publishers have started to address these issues by enforcing requirements for source code availability with manuscript submissions. Scholarly publishers play an important role in encouraging and mandating the availability of data and code, as well as developing innovative mechanisms and platforms for sharing and publishing products of research, that goes beyond papers in journals.

Incentives and recognition. To encourage openness, publishers may offer additional publishing opportunities, citation benefits, or digital badges to researchers submitting reproducible work. This initiative was also described above in relation to journals, and hence, publishers may implement such initiatives across all their associated journals to contribute to this incentivisation (Hrynaszkiewicz, 2019).

Supporting workflow changes. Implementing reproducibility requires changes to author and reviewer workflows, new editorial roles, and robust repository services. Publisher support is essential for coordinating these transitions and ensuring alignment across stakeholders (Willis & Stodden, 2020). In general, it is crucial for publishers to support the initiatives taken by journals to encourage the submission of reproducible research. This is especially the case when it comes to implementing policy concerning open data and sharing of methods.

Caveats for publishers in enhancing reproducibility

Despite their central role, publishers face obstacles in embedding reproducibility into their platforms and policies.

Policy diversity and enforcement. Publishers establish high-level policies for their journals. The enforcement of such policies typically occurs at the journal level. As was also described above in relation to journals, there is no universal way to work with reproducibility. Different journals and research areas might need different policies. This naturally makes it challenging for publishers to draft meaningful policy guidelines to be implemented by several different journals. On the other hand, for researchers, variability between publishers, and even across journals within the same publishing house, can create confusion and dilute the impact of reproducibility initiatives (Horbach et al., 2025).

Infrastructure limitations. Although technically straightforward, creating consistent, functional, and standardised links between published articles and datasets across multiple repositories is procedurally difficult. Ensuring interoperability across publishing platforms remains a significant challenge (Hrynaszkiewicz, 2019). Furthermore, publisher initiatives often rely on external repositories and services. If repository infrastructure is not mature, domain-specific, or sustainable, reproducibility policies may falter despite publishers' efforts (Willis & Stodden, 2020).

Collective action. Acting individually can create "first mover risks," as stricter requirements may discourage submissions from researchers. As Horbach et al. (2025) argue, collective actions taken by associations of publishers offers a more effective way to enforce reproducibility norms, reducing risks for both researchers and publishers. Hence, to avoid this first mover risk, it would be beneficial for publishers to coordinate the implementation of guidelines and policies. This does not necessarily have to do with the content of these policies and guidelines, simply the existence of them.

Research funding organisations (RFOs)

Similarly to journals and publishers, research funding organisations (RFOs) can play a decisive role in shaping reproducible research practices. Because researchers rely on RFOs for financial

resources, funders have significant influence not only through the distribution of financial support but also through the standards and evaluation criteria on which this funding depends (Horbach et al., 2025; Neylon, 2017). These mechanisms determine which practices are rewarded and which are discouraged, thereby shaping the broader culture of research. As a result, RFOs -are uniquely positioned to ensure that reproducibility is treated as an integral part of the research process. This is the case for both private and public funders, and they are not separated in the following.

The role of funders in enhancing reproducibility

Funders can support reproducible practices through a variety of strategies. The most frequently discussed in the literature are outlined here.

Establishing policies and standards. Funders can implement a number of different policies and instruments to further reproducible research. For example, many funders require data management plans (DMPs) as part of grant applications. These are intended to ensure that researchers address data handling, sharing, and archiving early in the research process. One of the studies considered here found that reproducibility practices are currently not systematically rewarded or recognised within funding streams and processes (Horbach et al., 2025). Furthermore, funders may consider placing compliance requirements on institutions rather than researchers. Hence, if research institutions do not live up to funders' policies and guidelines concerning reproducibility, researchers from these research institutions will not receive funding. This has been implemented by the Engineering and Physical Sciences Research Council in the UK, resulting in rapid changes within UK institutions (Neylon, 2017).

Embedding reproducibility in funding assessments. By rewarding reproducibility practices in funding evaluations, RFOs can influence research norms to engage in reproducible research practices. This has been described in the literature as a way of embedding reproducibility within standard evaluation and assessment procedures (Horbach et al., 2025; Neylon, 2017).

Targeted funding for reproducibility. Another way for RFOs to further reproducibility in areas where this is relevant is by creating dedicated funding streams to support reproduction and replication studies, which often struggle to attract resources (Horbach et al., 2025). An example of this can be seen in the Netherlands in 2017, where the Dutch science funding organization NWO designated three million euros for replication projects in the social sciences, medical sciences and humanities (Netherlands Organization for Scientific Research, n.d.) Replication studies have been described as providing "exceptional value for money" and could form part of a systematic funding model (Macleod, 2022). Funders can also support "research on research" to identify and test effective reproducibility strategies (Macleod, 2022). Derksen et al. (2024) argue that replication and reproduction studies are important in corroborating earlier findings, but they can also have a key role in exploring and developing the methodology in a field of research. In practice, replications are not just duplicates of earlier studies, they can improve the original study, for example with a larger sample size, better instrumentation, and a more transparent research process. Hence, Derksen and colleagues argue that funders should give replicators the opportunity and freedom to improve the original research protocol where needed, as well as be aware that replication studies tend to cost more and take more time than the original study.

Building capacity and awareness. Training and mentorship are important enablers of reproducibility. Funders can provide dedicated schemes or embed reproducibility requirements into existing training frameworks (Horbach et al., 2025). Funding larger projects focused on reproducibility, such as EU-level initiatives like TIER2, iRISE, and OSIRIS, also helps generate the “critical mass” of knowledge on existing reproducibility interventions/practices needed to establish reproducibility as a shared cultural norm. A local example of this can be found in Germany in 2020, where the German Research Foundation established a programme entitled *META-REP: A Meta-scientific Programme to Analyse and Optimise Replicability in the Behavioural, Social and Cognitive Sciences* (Deutsche Forschungsgemeinschaft, 2023). This programme specifically supports meta-scientific research projects that address replicability and reproducibility, including work on defining and measuring replicability, robustness, and generalisability, as well as analyses of causes for varying replication rates.

Caveats for funders in enhancing reproducibility

Despite their substantial influence, RFOs encounter a number of obstacles when trying to embed reproducibility in research systems.

Balancing compliance with cultural change. While requirements such as data management plans may be essential tools, they are also criticised for becoming box ticking exercises with little intrinsic value. Some argue that such requirements can even hinder genuine cultural change if they are viewed primarily as administrative burdens (Neylon, 2017; Vincent & Hooper, 2025). Increasingly stringent policies, such as mandatory audits, can accelerate institutional change but also risk entrenching a compliance culture that undermines genuine engagement with reproducibility (Neylon, 2017). Similarly, Vincent and Hopper (2025) argue that cultural change will only be successful and sustainable if the rules, responsibilities, and metrics used to communicate, enforce and assess research and integrity are continuously reflected upon. This is also the case when it comes to engagement with reproducibility. If data management plans and policies are created and implemented without continuous reflection, they will become empty box ticking exercises. The way in which such data management plans and policies are communicated, enforced, and assessed, should be aligned with deeply ingrained notions of ethics.

Vincent and Hopper (2025) describe this work towards lasting cultural change as having to do with so-called “thin values” and “thick ethos”. They describe means of communication, enforcement, and assessment (in this case of data management plans and policies regarding reproducibility) as thin values. These thin values can be beliefs in rules and moral obligations, and hence, communication, enforcement, and assessment should address these beliefs. An example of this could be to praise a research group’s focus on reproducibility in their project planning, to incentivise further engagement with such practices. Furthermore, the ingrained notions of research ethics that data management plans and policies should speak to are the so-called thick ethos of researchers. According to Vincent and Hopper, these refer to the internalisation of complex schemes of values, knowledge, heuristics, and skills. This could also be a deeply internalised commitment to good research practices. Hence, Vincent and Hopper’s argument goes, that in order to achieve lasting cultural change, in this case relating to engagement with reproducibility, thin values should be used to address the thick ethos of researchers.

Monitoring and disciplinary diversity. Even with strong policies in place, monitoring compliance is challenging. Funders often lack effective systems and resources to track progress

and check implementation. Furthermore, enforcement across diverse research communities can be inadequate or inconsistent. Data practices and expectations differ greatly across disciplines. What counts as essential data in one field may not be considered relevant in another. This diversity makes it difficult for RFOs to design policies that are both effective and fair across the research spectrum (Neylon, 2017). Other literature (de Rijcke & Penders, 2018; Guttinger, 2020; Penders et al., 2019) raise the question of whether policies regarding reproducibility should be implemented across different research fields. As de Rijcke and Penders (2018) point out, in the humanities the goal is often not just to develop single factual statements, but to generate insight into questions of meaning or style by considering historical and social contexts. This means that there can be multiple valid answers to the same question. This type of research does not lead to a single answer that can be arrived at with a highly standardised protocol, and hence, imposing a strict replicability criterion would therefore be irrelevant (de Rijcke and Penders 2018; Penders et al. 2019).

Resource demands. More supportive approaches, such as treating DMPs as evolving, collaborative documents that guide projects from start to finish, require sustained investment in infrastructure, training, and expertise. Funders may struggle to balance these demands against limited budgets (Neylon, 2017).

Policy makers

Governments and policymakers may perhaps play a less visible role in enhancing reproducibility than journals, funders, or some of the other stakeholders discussed here, but their influence is nonetheless significant. This has to do with their ability to set the broader framework in which other actors operate. When governments design science policy, they establish key performance indicators (KPIs) and expectations that set the overarching framework and incentives for funders, institutions, and other stakeholders (Horbach et al., 2025).

The role of policymakers in enhancing reproducibility

The following outlines initiatives that policymakers and governments are able to implement to further the production of reproducible research, as identified by the literature.

Setting key performance indicators (KPIs). As mentioned above, governments have the ability to influence reproducibility indirectly by defining KPIs for funders and other stakeholders. These indicators shape assessment frameworks and determine whether reproducibility practices are incentivised or overlooked (Horbach et al., 2025). By including reproducibility in such metrics, policymakers can support funding and evaluation systems that incentivise and reward reproducible research.

Establishing national committees on research integrity. Macleod (2022) notes that it would be surprising if governments did not seek to ensure that research councils and agencies (in this case mentioning the UKRI as an example) worked to maximise the reproducibility of the work they support. One approach to this may be to establish national committees on research integrity. Macleod (2022) outlines a proposal to establish such a network which was under discussion in the UK. This body could:

1. Conduct annual audits of research councils and agencies' support for research integrity.
2. Fund projects that test and pilot research integrity improvement projects.

3. Develop proposals for how an institution's support for research improvement, including reproducibility, can be recognised in funding decisions and evaluation exercises.

The creation of such committees could not only support research integrity but also strengthen systemic support for reproducible research practices in academic fields where this is appropriate, while acknowledging that reproducibility is not a universal quality marker across all research areas and disciplines.

Creating dedicated national offices. Similarly, Balas et al. (2025) suggest the creation of national offices focused on research quality in nationally funded research. According to Balas et al. (2025), such an office would:

- Present annual reports on value, reproducibility, and effectiveness of federally/nationally funded research.
- Develop recommendations to improve research quality.
- Protect the interests of research participants.

A concrete example of how such an office, or in this case unit, may look can be seen in the UK in 2023 with the launch of the metascience unit (Chawla, 2024). This unit was tasked with exploring better ways of conducting, publishing and reviewing UK research, as well as distributing and funding it. More broadly, the unit is focused on improving the overall quality and efficiency of UK research.

Funding for National RNs could similarly help put focus on reproducibility.

Caveats for policymakers in enhancing reproducibility

The literature reviewed here highlights epistemic diversity across research fields as a crucial consideration for policymakers and governments when formulating reproducibility-related policies.

Epistemic diversity across fields. As noted in the discussion of caveats for funders, reproducibility policies must be tailored to the specific characteristics of different disciplines and research practices. A uniform approach can be counterproductive, and some fields may even need to be exempt from the current replication drive (Guttinger, 2020). At a minimum, policy interventions should be sensitive to the distinct modes of knowledge production (Ulpts & Schneider, 2023) and the local contexts in which they are implemented. Recognising and accommodating these disciplinary differences is essential to ensure that reproducibility initiatives are both meaningful and feasible across the research landscape.

Researchers

In a recent study conducted by Horbach et al. (2025), workshop participants overwhelmingly identified researchers as the most important stakeholders in shaping the future of reproducibility, because ultimately, they embody and manifest cultures of research. Researchers are central because they are not only authors, but they are also reviewers, collaborators, and mentors, meaning they are involved in different processes that are central to fostering reproducible research practices. Similarly, González and Colom (2023) have argued that the “reproducibility burden” rests on researchers, who are responsible for providing transparent accounts of their methods, sharing data and code, and ensuring that their results are replicable and verifiable by peers (p. 32). The

following will outline the role of researchers in enhancing reproducibility of scientific results.

The role of researchers in enhancing reproducibility

The literature considered here identifies many ways in which researchers can promote reproducibility. The most frequently discussed are outlined below.

Considering reproducibility from the start. Researchers can consider how to include reproducible methods and approaches in their work during the planning and application process (Rosenberg et al., 2020). Here, they may consider allocating time, resources, and infrastructure to ensure results are verifiable. An increased focus on reproducibility amongst funders may facilitate this, allowing researchers to apply for resources specifically for the expenses associated with reproducibility work. Furthermore, researchers may consider which tools and platforms they intend to use for data storage and analysis, as accessibility to these may vary between researchers.

Hrynaszkiewicz (2019) emphasises a number of considerations researchers may take before starting their research. These include checking institutional, funder, and journal policies on data sharing and reproducibility, as well as considering how to store and manage data and research outputs. Developing data management plans, using FAIR data principles, preregistering studies where possible, and leveraging available repositories can contribute to reproducibility. Researchers can also strengthen transparency by publishing protocols, registering ORCID identifiers, depositing data and code in repositories, and using preprints or data papers to increase visibility and credit (Hrynaszkiewicz, 2019; Alston & Rick, 2020).

Providing transparency about reproducibility. Authors can make their work more accessible by explicitly stating, when possible, the level of reproducibility users should expect, including which portions of the workflow can be reproduced and which cannot. Furthermore, researchers should list the hardware, software, and training necessary to reproduce the work (Rosenberg et al., 2020).

Making all materials openly available. The possibility of reproducing research is strengthened when authors provide all relevant materials, including data, models, and code, in human-readable formats within open repositories, preferably repositories commonly used in the field in question. Detailed instructions for reproducing results should accompany these materials to ensure usability (Rosenberg et al., 2020). Similarly, annotating code scripts makes them easier to follow and provides a permanent log of analytical decisions (Rosenberg et al., 2020; Alston & Rick, 2020).

Data management practices. Reproducibility begins with sound data management, as it is difficult to reproduce research when data are disorganised or missing. According to Alston and Rick (2020), good data management practices include: backing up raw, cleaned, and intermediate data; storing metadata describing methods and variables; and applying logical, consistent naming conventions to ensure that datasets remain interpretable and usable by others.

Promoting a culture of reproducibility. Researchers are in a unique position to influence each other through peer norms. If reproducible methods and approaches become standard amongst some researchers, others are more likely to adopt them. This peer effect applies both to quantitative

and qualitative researchers, the latter of whom are beginning to explore innovative methods for sharing workflows. In the study conducted by Horbach et al. (2025), qualitative researchers expressed difficulties figuring out how to share their methods and analyses. Therefore, having access to other qualitative researchers who have found a way to engage in reproducible methods can be a powerful enabler.

Caveats for researchers in enhancing reproducibility

Despite many possible actions that researchers can take to support reproducibility, there are also challenges and obstacles involved in this process. Some of these specifically affect researchers on a personal level in relation to their careers.

Time and resources versus academic reward structures. Preparing well-documented datasets, code, and workflows requires significant effort, technical skill, and financial resources. In fields where reproducibility is the key quality criteria, constraints in funding, training, and infrastructure result in uneven adoption, as some are able to make their research fully reproducible and others cannot (Liu et al., 2022; Rosenberg et al., 2020). Many researchers lack time in their daily work, with their workloads being at capacity. Therefore, a high time cost is repeatedly identified as one of the main barriers to the adoption of open and reproducible research practices (Eynden et al., 2016; Gownaris et al., 2022; Tenopir et al., 2011). Many open research practices may be viewed as essentially administrative, including writing preregistrations, data sharing documentation, and statements about the openness of open practices for different elements of a project (Hostler, 2023). Additionally, adopting any new practice typically involves making changes to a researchers' existing practices, bringing additional workload. This includes time spent learning and applying 'open' practices, the cumulative workload of novel administrative work, and the indirect labour of teaching and mentoring open research. This, combined with current systems of evaluation in academia still prioritising novel peer-reviewed publications over data curation, code sharing, or replication studies, discourages researchers from investing time in practices that, while valuable for reproducibility, are less rewarded by hiring, promotion, or funding bodies (Nosek et al., 2012).

Concerns over competition. Some researchers fear being scooped on follow-up studies if they share their data or code too early. Others worry that once materials are shared, they will be unable to support them after publication, or that no one will use them at all (Rosenberg et al., 2020). Furthermore, as was also mentioned above in relation to the role of journal policies in supporting reproducibility, some researchers intentionally withhold details of their methods to prevent replication, as they are more concerned about competition (Collins, 1974; Nature, 2013; Hrynaskiewicz, 2019; Horbach et al., 2025). There are of course also types of research where commercial interests, ethical concerns or state/security interests rightfully prevent data to be shared.

Differences across disciplines. Relevance of reproducibility vary widely across research communities. While some fields, especially quantitative ones, have developed strong norms around reproducibility, it is a less relevant concern in other fields, particularly those grounded in interpretative qualitative research, which rely on different quality criteria (Small & Calarco, 2022). Similarly, Ulpts and Schneider (2023) argue that it is necessary to take differences in knowledge production modes (KPM) into consideration when discussing reproducibility.

Research performing organisations (RPOs)

Universities, their data science centres, and research support units, have the potential to play a critical role in promoting reproducibility through creating and validating tools and processes, and subsequently enabling and encouraging their adoption (Liu et al., 2022). Furthermore, universities have the potential to be very influential stakeholders in promoting reproducibility, because they support, incentivise, and regulate research at their institutions, thereby ensuring responsible conduct of research. They are well-positioned to play an active or even leading role to provide resources, incentives, and training to make research more reproducible.

The role of RPOs in enhancing reproducibility

The literature considered here identifies a significant amount of possible actions that research performing organisations can take to support and facilitate reproducibility. These are summarised below.

Develop reproducibility policies. Such policies could, for example, determine and state the expected level of reproducibility in institutional repositories, develop standards and initiatives for open data and open-source code, and require reproducible practices for theses, dissertations, and project reports across students and employees (Kochari & Ostarek, 2018; Rosenberg et al., 2020). Such policies may also include changes to recruitment and hiring processes (see below).

Academic reward structures. As was also discussed above in relation to researchers, the lack of academic reward for reproducible research practices poses a challenge (Nosek et al., 2012). One major problem in reproducibility concerns the career advancement of researchers in academia and how their work is acknowledged and eventually rewarded. University hiring and promotion procedures shows that easily measurable quantitative indicators continue to be prioritised, while the assessment of the quality, rigor, reliability, robustness, transparency, and innovativeness of candidates' scientific work seem to be less important (Gärtner et al., 2024; González & Colom, 2023). RPOs can counteract this tendency by embedding reproducible and open science practices into hiring and evaluation processes, and by establishing formal policies requiring these practices to be included in academic job descriptions and hiring criteria. (Kohrs et al., 2023).

Training and educational activities. Training and educational activities are crucial for promoting reproducibility practices (Horbach et al., 2025; Macleod, 2022; Liu et al., 2022; Rosenberg et al., 2020). Formal training, mentorship, and role modelling play a crucial role in making researchers aware of reproducibility policies, as well as the inclusion of such policies in the everyday work of researchers (Horbach et al., 2025). This training may also extend to students and non-academic staff at universities, including support staff facilitating tasks related to open science, e.g., data management and analysis. Integrating courses into a required curriculum is an important step towards making reproducibility and open science training the norm. For graduate students, open and reproducible research practices may also be incorporated into existing required training on research integrity or good scientific practice (Kohrs et al., 2023). This could also take place through the publication of replication studies with graduate and undergraduate students (Wagge et al., 2019).

The literature considered here provides a number of examples of what such teaching and training may entail. Some examples of this include teaching early career researchers or students technical skills, research methods and statistics, as well as Open Science skills (Horbach et al., 2025), hosting software

and data carpentry workshops for students and employees (Rosenberg et al., 2020), adding or expanding research methods courses to cover topics such as protocol depositing, open data and code, and rigorous experimental design (Kohrs et al., 2023).

Reproducibility tools. Resources such as data access, data repositories, and the support for data curation are becoming indispensable components of the research infrastructure across universities. Similarly, tools for reproducing research projects and for effective data and code sharing should also become standard resources for researchers (Liu et al., 2022). Generally, universities could foster reproducible research practices by regarding resources and efforts that support reproducibility as an essential part of their research infrastructure, just like other core facilities that support critical components of research. Similarly, universities could offer consultation to researchers to improve the reproducibility of their research, including recommending tools and reviewing and auditing code. Liu et al. (2022) describe how some universities in the US have initiated such efforts by hiring so-called 'reproducibility librarians'. They emphasise that this will only be possible if universities invest resources in reproducible research and view such tools as indispensable components of the research infrastructure.

Facilitate reproducibility communities. Kohrs et al. (2023) emphasise the potential positive effects of reproducibility communities, as well as the role of RPOs in facilitating and building such communities. They suggest three concrete steps universities can take to initiate such reproducibility communities.

1. One step could be to organise community-learning opportunities where researchers can engage with their peers to gain knowledge on open science and reproducible research practices, while building a network. The format of this could include journal clubs, open science meetups or working groups, coding clubs, community-driven projects, open science pedagogical communities and communities of practice.
2. A second suggestion entails creating resource hubs focusing on reproducibility and open science. Resource hubs can serve numerous functions, including being a central hub for collecting resources, or providing training and consulting services for an institution or network. Hubs can also coordinate data collection and act as a support for decentralised reproducibility communities across an institution by helping to implement relevant reproducibility strategies.
3. Lastly, institutions should consider connecting individuals and initiatives involved in reproducible research and open science practices. Connections between groups can facilitate collaborations, provide opportunities for shared problem solving and mentorship, and allow different groups to support and amplify each other's efforts.

Caveats for RPOs in enhancing reproducibility

One obvious issue is motivating researchers to devote more time to reproducibility-related activities, particularly if RPOs do not support these efforts with appropriate rewards and recognition. Without incentives – such as integrating rewards for reproducibility efforts into performance evaluations, promotion criteria, or internal funding decisions – researchers may view these activities as merely additional workload rather than essential components of high-quality research (cf. discussion above related to 'Researchers').

Research integrity offices (RIOs)

Research Integrity Offices (RIOs) can support reproducibility by promoting rigorous research practices and ensuring adherence to relevant professional standards. They can also play an important role in education and training, helping researchers understand and implement these practices effectively.

The role of RIOs in enhancing reproducibility

The role of Research Integrity Offices is only briefly covered in the literature. Nonetheless, the little information identified is summarised below.

Training and education activities. Similarly to RPOs, research integrity offices (RIOs) also have a role to play in relation to training and education activities. In a study conducted among RIOs, Bishop et al. (2021) found that RIOs perceive part of their responsibility as entailing training activities for researchers. This training includes both reproducibility and research rigor.

Caveats for research integrity offices in enhancing reproducibility

The reviewed literature did not identify any specific challenges faced by Research Integrity Offices in their efforts to address or promote research reproducibility. However, as we will discuss below, RIOs' are typically not very powerful when it comes to changing practices (cf. next chapter, "Stakeholder mapping in relation to reproducibility").

Learned/Scientific/Scholarly societies

Learned/scientific/scholarly societies have a significant role to play in promoting reproducible research practices. This is especially related to such societies being aware of what research and research practices they are rewarding through actions such as invitations to annual meetings and conferences (Liu et al., 2022; Morris, 2014). The literature refers to these societies as both learned, scientific, and scholarly. For practical reasons, we will refer to them as learned societies in the following. However, it is important to acknowledge the diversity of functions, disciplinary focus, and organisational forms present across such societies.

The role of learned societies in enhancing reproducibility

One key thing that learned societies can do to promote reproducibility, as discussed in the literature, is to consider which research practices their actions reward.

Annual meetings, conferences, and leadership. Learned societies are able to promote open science and incentivise reproducible research through stringent requirements for publications and grant applications (Liu et al., 2022). Furthermore, Morris (2014) argues that learned societies can do more than "just being political organizations that promote their members" (p.3). For instance, they should consider whether researchers, laboratories, and institutions conduct and publish reproducible research when inviting them to annual meetings and to take on leadership positions within these societies. Similarly, the 2019 National Academies of Sciences, Engineering, and Medicine (NASEM) recommendations for improving rigor and transparency in research also touch upon annual meetings and conferences. They suggest that learned societies requesting submissions for conferences should disclose their policies relevant to achieving reproducibility and

replicability. As conference organisers, learned societies should set and implement desired standards of reproducibility and replicability, as well as consider incentives or requirements for research material transparency, design, and analysis plan transparency, enhanced review of statistical methods, study or analysis plan preregistration, and replication studies (NASEM, 2019). An example of this is the World Conference on Research Integrity's (WCRI) continuous encouragement for participants to preregister empirical research (Emons et al. 2025).

Caveats for learned societies in enhancing reproducibility

Just because researchers are encouraged to change practices, it does not mean they automatically will (for reasons discussed above). Emons et al. (2025), for example, found that across 452 abstracts submitted to the 2019, 2022, and 2024 WCRI, the prevalence of registration among presenters of empirical research did not increase and was on average 28%. However, the verifiability of claims of registration did increase over time from 44% to 88%.

National Reproducibility Networks

Naturally, National RNs are very invested in furthering reproducibility. According to the literature considered here, there are a number of actions that these RNs can and do take to support this, one of the most important being to serve as the connection between the different stakeholders discussed in this report.

The role of reproducibility networks in enhancing reproducibility

The connecting role of reproducibility networks, as described in the literature considered here, is presented below.

Connect researchers and institutions. As was stated in the introduction to this section, as well as throughout the different stakeholder descriptions above, no actor in the research ecosystem can bring about meaningful change on their own, as this requires collaboration and coordination of collective efforts (Butler et al., 2023; Munafò et al., 2022). National reproducibility networks can play a critical role in the coordination efforts necessary to facilitate such change, for instance by working collaboratively with researchers, institutions, funders, publishers, learned societies and other sectoral organisations. Furthermore, National RNs and their local nodes may provide infrastructure to support connections and collaborations between researchers working on similar topics, or in the same institutions or regions. As was also discussed above in relation to RPOs, connections created between such groups can facilitate collaborations, provide opportunities for shared problem solving and mentorship, and allow different groups to support and amplify each other's efforts (Liu et al., 2022). RNs may also support different stakeholders by promoting the dissemination of best practices through various formats of further education, sensitising particularly early career researchers to the topic of reproducibility (Fritzsche & Nüst, 2021). Participants from Horbach et al.'s (2025) workshop described National RN as promising instruments to raise awareness about reproducible research practices and bringing together individuals working with these.

Caveats for reproducibility networks in enhancing reproducibility

The reviewed literature did not identify specific challenges faced by reproducibility networks in promoting research reproducibility. However, as noted in the co-creation exercise described in the

next chapter, these networks have limited power to influence practices at RPOs or among researchers. While they can inspire and encourage change, they have no formal authority to enforce it.

Infrastructure providers

Examples of infrastructure providers from the literature include data and method repositories, including institutional repositories, scientific gateways, data platforms, and scholarly infrastructures (Brinckman et al., 2019; Boyd, 2021; Horbach et al., 2025; Hrynaszkiewicz, 2019; Rosenberg et al., 2022; Sandström et al., 2022). These different infrastructure providers play an important role in the archiving, management, analysis and sharing of research data. They provide stable, long-term storage, can improve data quality through active curation, can increase the discoverability and reusability of data through the use of controlled terms and standardised metadata, make it easier to request and transfer data, and help remove or lower barriers for reuse and collaboration (Sandström et al., 2022). Furthermore, in qualitative research they are relevant to consider in relation to ethical and responsible access to sensitive data.

The role of infrastructure providers in enhancing reproducibility

Infrastructure providers as stakeholders in reproducibility are different from the other stakeholders discussed in this report. What sets them apart is the fact that these infrastructures provide a technical service that is utilised by researchers and institutions, rather than participating in research alongside these. Nonetheless, the literature considered in this report describes several actions that infrastructures can take to support reproducibility. These are described below.

Linking across platforms. Participants in Horbach et al.'s (2025) workshop identified infrastructures as direct enablers of or barriers to reproducibility practices. However, in some cases, researchers have multiple different research items, such as data, papers, and code, that are shared across different platforms, tools, and repositories. This was identified as a challenge, due to the missing possibility of linking between scientific platforms, which was partly attributed to a lack of agreements on meta-data standards and guidelines. Similarly, Brinckman et al. (2019) argue that the scientific landscape is full of powerful cyberinfrastructure for acquiring, storing, analysing, publishing, and archiving data, but approaches regarding the dissemination, validation, and verification of computationally based research outcomes do not yet accommodate this reality. One way to address this challenge is identified by Sandström et al. (2022) who argue that infrastructure providers should assign persistent identifiers (PIDs) to data descriptions, data and complementary materials (digital object identifiers (DOI)), software (DOI, Software Heritage ID (SWHID)), authors (open researcher and contributor IDs (ORCID)) and associated research resources (RRIDs).

Increasing user-friendliness. Similarly to the issue of linking across different platforms, the user-friendliness of different infrastructure providers could be further enhanced by making them more accessible, interoperable and useful. Sandström et al. (2022) suggest standardising the formats of accepted submissions, saving users from having to reformat all their data, as well as having methods reported in a structured format, preferably a community/discipline relevant format if possible. When such community standards are not available, using a general standardisation framework is preferable, as this increases the likelihood of data and metadata being possible to transform into a future standard format. Boyd (2021) supports the need for such standardisation, emphasising that researchers are challenged by the lack of standards for descriptive metadata and file formats for

their discipline, as well as unfamiliarity with data curation practices. Data sharing practices vary by discipline and are neither intuitive nor effortless for researchers. Hence, in addition to standardisation, repository features such as automated or machine-assisted metadata creation could reduce barriers for data depositors (Boyd, 2021). The user-friendliness of infrastructures can be further enhanced by service providers implementing a FAQ section with the most common user questions, as well as a quick start guide (Sandström et al., 2022). Infrastructures should also provide training materials specific to their service, as well as refer users to other relevant training on reproducibility.

Caveats for infrastructure providers in enhancing reproducibility

The reviewed literature did not identify any specific challenges faced by infrastructure providers in their efforts to address or promote research reproducibility.

Additional stakeholders

The importance of the ten identified stakeholders for reproducibility was validated during the co-creation workshop (the Mutual Learning Exercise; see Methods section), which included representatives from nine National RNs. In addition to the ten stakeholders, participants highlighted several other important stakeholder groups (see Appendix III). These include Research Support Staff, such as data stewards and data managers, and Research Administrators, including legal experts. Organisations like EARMA (European Association of Research Managers and Administrators), which represent research support professionals, were also identified as relevant stakeholders.

Other groups mentioned as key supporters of reproducibility include Methods Experts (e.g. statisticians and data engineers), Meta-researchers, and Trainers. Open Science communities and Training communities were likewise emphasised for their contributions. Further stakeholders noted were Libraries and Librarians, as well as Citizen Scientists. The role of University Ranking Organisations was discussed in detail. Participants suggested that these organisations could significantly promote reproducibility by giving it greater weight in their ranking criteria.

Finally, we asked participants to provide examples of stakeholders in the category *Infrastructure providers* (cf. Appendix III). Responses included e-infrastructure providers, ERIC (European Research Infrastructure Consortia), and electronic laboratory notebook providers, alongside providers of hardware, software, and tools. Examples of tools mentioned were platforms like protocols.io (part of Springer Nature) for developing protocols, as well as other method repositories such as software repositories and registries (e.g., GitHub, Docker Hub, Hugging Face). Data repositories (e.g., Zenodo, EGA) and registry holders (e.g., ClinicalTrials.gov, EU Clinical Trials Register, and other platforms for pre-registration) were also highlighted as important infrastructure providers contributing to reproducibility.

Stakeholder mapping in relation to reproducibility

To help us develop a stakeholder map – similar to those discussed in the Methods section (see above) – showing both stakeholders' interest in reproducibility and their influence on reproducibility practices, we invited representatives from National RNs to participate in an online co-creation workshop (see details in the Methods section above, and the list of participants in Appendix I).

Participants first helped validate the predefined list of stakeholders and discussed additional relevant groups (see section 'Additional stakeholders' above). They were then divided into four breakout rooms. After a brief introduction, each group was asked to assess the level of interest in reproducibility among the 10 predefined stakeholder groups. Participants placed each stakeholder on a scale from -5 ('No interest in increasing focus on reproducibility') to +5 ('High interest in increasing focus on reproducibility') and provided explanations for their ratings. The stakeholder maps produced by the four groups are presented in Appendices IV–VII.

During the plenary discussion following this exercise, participants noted that the scale from -5 to +5 was difficult to use. Although some stakeholders were perceived to have very low interest in reproducibility, several participants found it challenging to assign a negative score.

Additionally, participants expressed difficulty in scoring certain stakeholder groups because some of these cover a wide range of institutions, groups, or individuals with varying levels of interest in reproducibility. For example, the category 'Researchers' includes both those working in fields where reproducibility is a core quality standard, as well as those in disciplines where reproducibility is less emphasised.

After the brief plenary discussion, participants returned to their breakout rooms to assess the influence or power of each stakeholder group to change reproducibility practices. Again, they were asked to score the 10 predefined stakeholder groups on a scale from -5 ('Not very influential – doesn't have the power to change practices to increase reproducibility') to +5 ('Very influential – has the power to change practices to increase reproducibility'), and to provide explanations for their scores using the stickers provided in the exercise. The results of this second exercise are shown in Appendices VIII–XI.

Analysing the results

When reviewing the results of the scoring exercises (see Appendices IV–XI), it quickly became apparent that the four groups had interpreted the scale differently. Some groups avoided using negative numbers, while others used them freely. As a result, the absolute scores are difficult – if not impossible – to compare across groups. In our analysis, we therefore focused on relative scores instead (see Appendix XII). Specifically, we examined which stakeholders were ranked highest in terms of interest in reproducibility, followed by second highest, and so on. We applied the same approach to the influence/power mapping.

This allowed us to generate two sets of stakeholder rankings: one based on perceived *interest* in reproducibility, and the other based on perceived *influence* or *power* to change reproducibility practices. An overview of the rankings from all four groups, for both exercises, is provided in Appendix XII.

To calculate the overall ranking for each stakeholder group, we summed the ranking positions assigned by each group and divided the total by the number of groups that provided scores (some groups did not score all 10 predefined stakeholders, see Appendix XII). The final rankings, shown in **Table 1**, are based on these mean scores. The stakeholder with the lowest mean score was ranked first, the next lowest second, and so on (see Appendix XII for the details of the calculations).

National Reproducibility Networks' ranking of stakeholders' <i>interest</i> in reproducibility	National Reproducibility Networks' ranking of stakeholders' <i>influence</i> on reproducibility/ <i>power</i> to change practices
1. National Reproducibility Networks (RNs)	1. Research Funding Organisations (RFOs)
2. Research Funding Organisations (RFOs)	2. Policymakers
3. Infrastructure providers	3. Publishers
4./5. Learned societies	4. Journals
4./5. Research Integrity Offices (RIOs)	5. Research Performing Organisations (RPOs)
6. Researchers	6. Researchers
7. Research Performing Organisations (RPOs)	7. Research Integrity Offices (RIOs)
8. Policymakers	8. Infrastructure providers
9. Journals	9. National Reproducibility Networks (RNs)
10. Publishers	10. Learned societies

Table 1: Ranking of stakeholders' perceived interest in as well as perceived influence on reproducibility (based on the results of the co-creation exercise with national RNs, see appendix XII for more details).

As shown in **Table 1**, National Reproducibility Networks are perceived as the stakeholder group with the highest interest in reproducibility. Perhaps more surprisingly, Research Funding Organisations were ranked second – above groups such as Learned Societies, Research Integrity Offices, Publishers, and Journals, which were perceived to have the lowest interest in reproducibility of the ten stakeholder categories.

Looking at the other side of the table, which reflects stakeholders' influence on reproducibility and their power to change practices, Research Funding Organisations were again ranked highest. Policymakers, Publishers, and Journals were also perceived to have substantial influence and power. At the bottom of this ranking, we find Learned Societies, National Reproducibility Networks, and Infrastructure Providers – stakeholders with a strong interest in improving reproducibility, but relatively limited power to create change.

Based on these rankings and the stakeholder maps produced by participants – along with the explanations they provided – we constructed a combined stakeholder map (**Figure 4**).

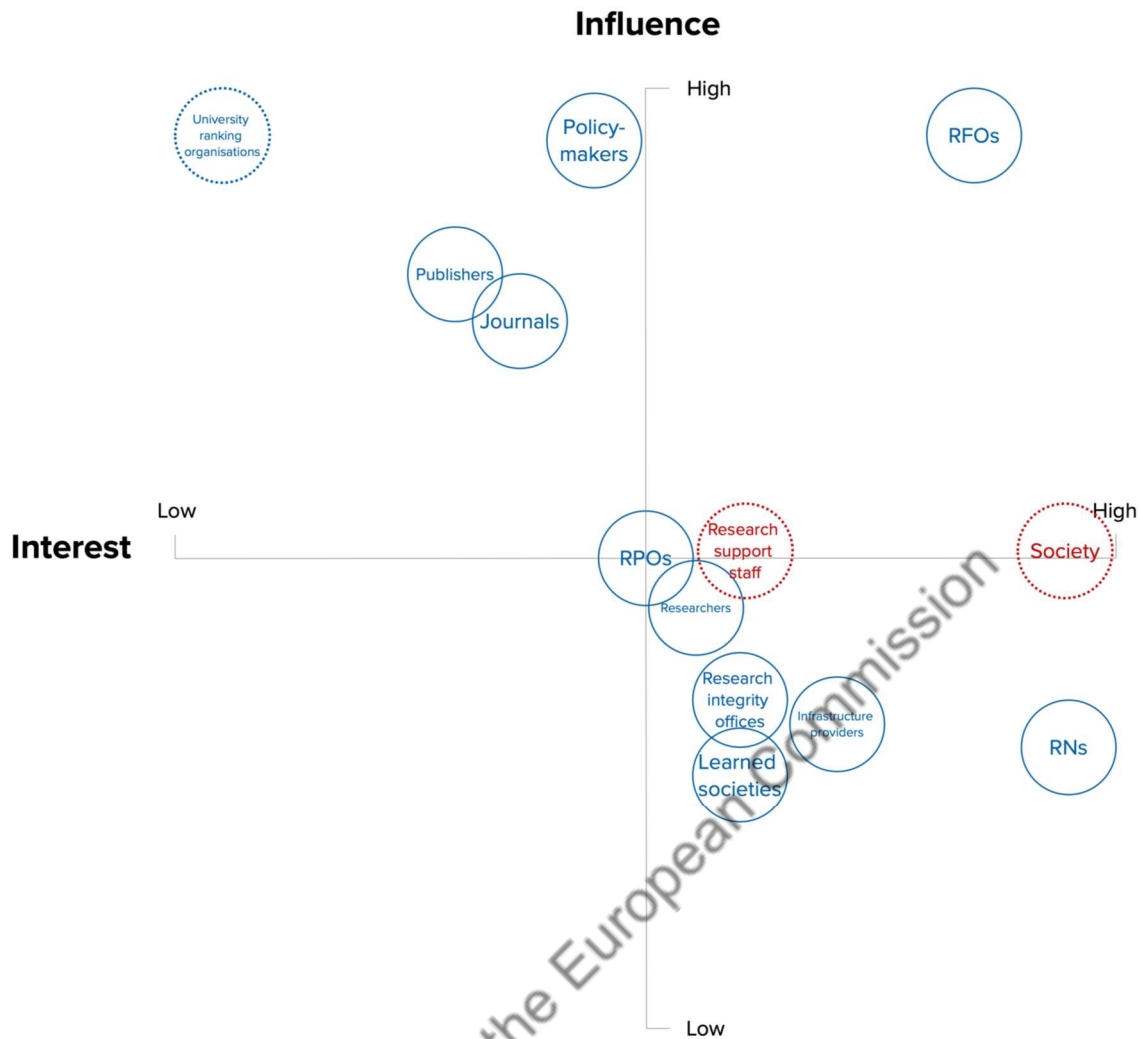


Figure 4: Stakeholder map of 10 predefined stakeholders and 3 additional stakeholders University ranking Organisations, Society, Support Staff (only scored by one group each, dotted circles).

As shown in **Figure 4**, three additional stakeholders were added to the map based on input from National RN representatives during the breakout sessions. *University Ranking Organisations* were introduced by Group 1, *Society* by Group 2, and *Support Staff* by Group 3. *Society* and *Support Staff* were only assessed in terms of interest in reproducibility and are therefore marked in red on the map (and placed in the 'neutral' position when it comes to Influence/power). In contrast, Group 1 evaluated *University Ranking Organisations* in both exercises, assigning them the highest possible score for influence/power and the lowest possible score for interest.

We included these additional stakeholders to reflect the discussions that emerged during the exercises and to highlight that this stakeholder map is shaped by input from National Reproducibility Network representatives.

It is important to emphasise that the map might have looked different had it been developed by representatives from other stakeholder groups. Therefore, we will repeat the stakeholder-mapping exercise in the three expert workshops with RPOs, RFOs, and publishers in Task 3.4. The findings from these exercises will be reported in Deliverable 3.4.

Differences in national regulations

A final subtask of Task 1.3 was to examine disparities in national regulations. We did not identify any direct differences related to reproducibility, but we did find one important area with indirect implications: differences in data protection and related regulations, including rules on data storage and data sharing. In this area, national and regional differences are substantial.

Since 2018, researchers and organisations in the EU have been required to comply with the General Data Protection Regulation (GDPR), which sets out comprehensive rules on data privacy and security. The GDPR governs how data can be collected, processed, and shared. This affects reproducibility in research because it restricts the direct sharing of raw datasets containing personal or sensitive information. Before data can be shared, it must be anonymised or pseudonymised. In multi-partner collaborations, formal data-sharing agreements must also be established before any exchange takes place. The EU has some of the strictest regulations on data collection, sharing, and storage worldwide (<https://gdpr.eu/what-is-gdpr/>), which can pose challenges for collaborative research projects between EU-based researchers and international partners.

Besides differences in data protection regulations, it is worth noting that the prominence of explicit reproducibility discussions varies greatly across national contexts. In most countries, reproducibility has not been addressed by high-level policymakers (government and parliament), but there are notable exceptions, such as the UK. In 2023, the Science, Innovation and Technology Committee of the House of Commons published a report titled *Reproducibility and Research Integrity*, focusing on the extent and impact of reproducibility issues in UK-based research. Both the committee and the UK Government, in its response to the report, agreed that “there is a need for action to address the significant problems caused by the prevalence of reproducibility issues in the scientific community” (Science, Innovation and Technology Committee, 2023a, p. 22; 2023b, p. 5). The report discusses reproducibility challenges and outlines various measures and strategies to mitigate these problems.

In this regard, the UK seems to be an outlier. Although other countries have National Reproducibility Networks, the UKRN (www.ukrn.org/) is the most established. Reproducibility discussions also appear to have penetrated deeper into UK research policy and requirements than in other countries. For example, already a decade ago, the leading public and private funders of medical research in the UK – the Medical Research Council (MRC), the Biotechnology and Biological Sciences Research Council (BBSRC), and Wellcome – started emphasising the importance of reproducibility in their guidance to applicants (cf. their joint publication “Improving research reproducibility and reliability: progress update from symposium sponsors”, published together with the Academy of Medical Sciences (2015 and updated 2016).

However, both in the UK and elsewhere, reproducibility is only briefly mentioned in general Codes of Conduct for responsible research, if at all. For instance, the ALLEA Code of Conduct refers to reproducibility only once: “Research institutions and organisations support appropriate infrastructure for the generation, management, and protection of data and research materials in all

their forms that are necessary for reproducibility, traceability, and accountability” (ALLEA, 2023, p. 6). Likewise, the UK’s Concordat to Support Research Integrity mentions reproducibility just once: “Open research practices and promoting reproducibility in research, where appropriate, may also offer tangible opportunities to embed practices that support openness and transparency” (RISC, 2025, p. 7).

Under review by the European Commission

Conclusion: Pilot institutions and stakeholder mapping

We conclude this report with a brief reflection on the significance of the results presented in this deliverable for the future work in TRUSTparenacy. Two points stand out as particularly important:

First, our project must consider relevant incentives that can help actors and institutions that want to promote reproducibility. This report provides an overview of the stakeholder landscape as it is described in the literature and as it is seen from the National RNs' viewpoint. However, the next crucial step towards more reproducible research practices is to think more deeply about incentives for positive change.

The stakeholder map shown above (see **Figure 4**) is not fixed; it can evolve. It is built on the literature and input from National RNs. It is important to note that other stakeholder groups might have a slightly different perception of the power and interest of the different stakeholders. The position of the single stakeholders within the map may also shift due to external changes (outside the science system) or internal developments. Individual stakeholders can also influence how much other stakeholders care about reproducibility. An example is University Ranking Organisations, which were discussed earlier. So far, these organisations have shown little interest in reproducibility. Yet, as highlighted by representatives from the National RNs during the co-creation exercise, ranking organisations could drive positive change in RPOs, if reproducibility policies and practices became part of ranking criteria. Similarly, RFOs hold significant power to shape practices because researchers and RPOs depend heavily on external funding. This is a power that should be used with caution. For example, RFOs should be aware that reproducibility requirements do not make sense for all types of research, as discussed above.

Second, within the TRUSTparenacy project, the stakeholder mapping presented here can serve as an initial screening of the current situation – and as a starting point for pilot institutions to create their own stakeholder maps. For these institutions to succeed in implementing new policies and practices, we recommend beginning with a local stakeholder mapping exercise. Key questions include: Who are the most important internal and external stakeholders? Who has a strong interest in reproducibility? Who has the power to make changes? Local maps should identify relevant research units and key research support staff, and they could even be detailed enough to include individual actors. This approach will give those responsible for the pilots a solid foundation for deciding where to start and whom to collaborate with. These maps can also help identify local incentives for improving practices.

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Appendices

Appendix I – MLE participants

National Reproducibility Networks represented by Mutual Learning Exercise participants:

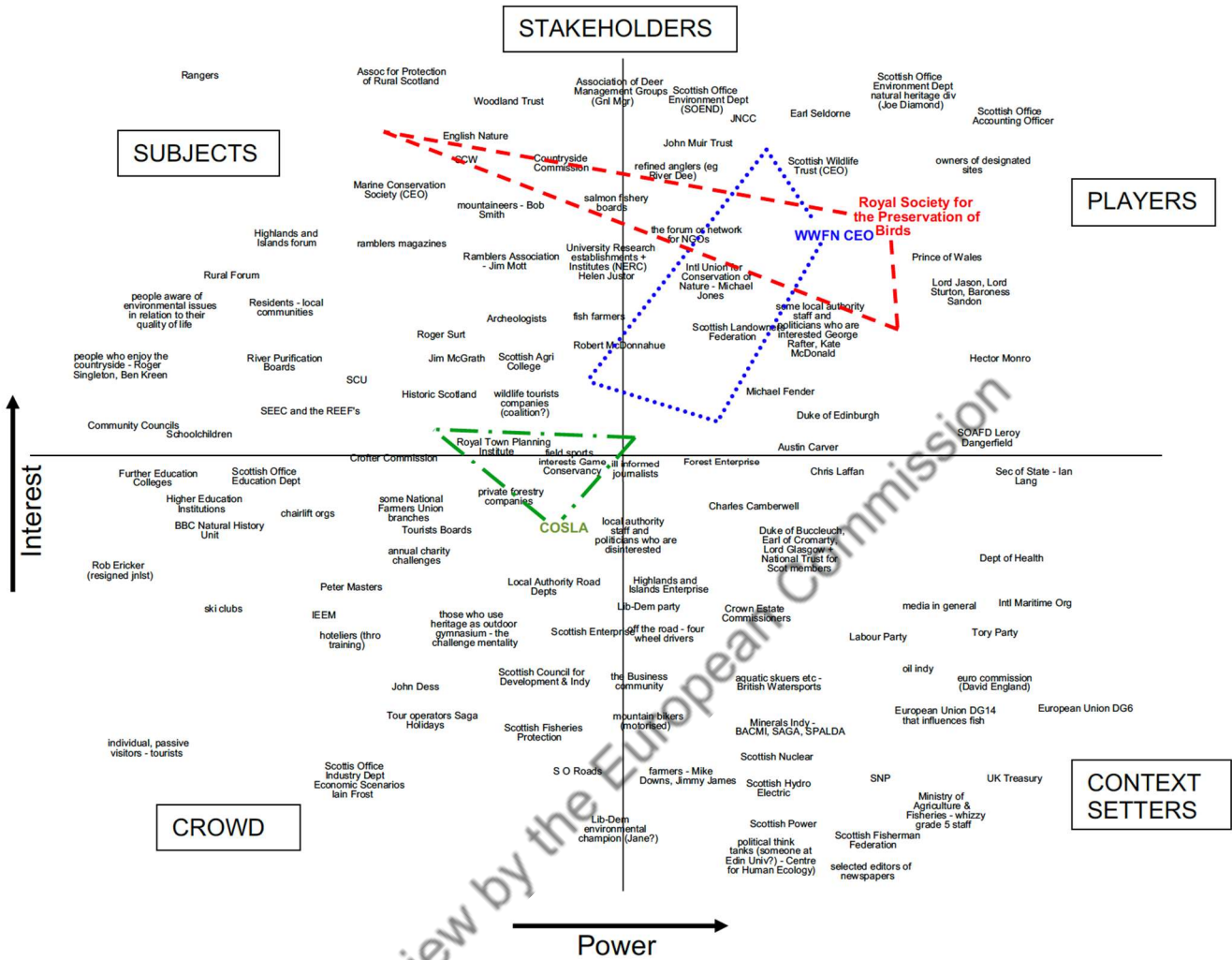
- Belgian Reproducibility Network
- Brazilian Reproducibility Network
- Finnish Reproducibility Network
- Norwegian Reproducibility Network
- Portuguese Reproducibility Network
- Slovak Reproducibility Network
- The Netherlands Reproducibility Network
- UK Reproducibility Network
- Ukrainian Reproducibility Network

Participants in the Mutual Learning Exercise:

Participant	Organisation
Agata Bochynska	Norwegian Reproducibility Network
Bert Seghers	Belgian Reproducibility Network
Daniela Gawehns	The Netherlands Reproducibility Network
Emma Ganley	UK Reproducibility Network
Enrico Glerean	Finnish Reproducibility Network
Fernando Hellmann	Brazilian Reproducibility Network
Michiel de Boer	The Netherlands Reproducibility Network
Neil Jacobs	UK Reproducibility Network
Oksana Shevchuk	Ukrainian Reproducibility Network
Oleksandr Berezko	Ukrainian Reproducibility Network
Pavol Kačmár	Slovak Reproducibility Network
Susana Magalhães	Portuguese Reproducibility Network

Anna Vigsø Pedersen	TRUSTparenacy consortium member
Daniele Fanelli	TRUSTparenacy consortium member
Edvards Francis Kuks	TRUSTparenacy consortium member
Eleni Spyrou	TRUSTparenacy consortium member
Ivars Neiders	TRUSTparenacy consortium member
Kalle Videnoja	TRUSTparenacy consortium member
Mads P. Sørensen	TRUSTparenacy consortium member
Panagiotis Kavouras	TRUSTparenacy consortium member
Petra Falin	TRUSTparenacy consortium member
Signe Mežinska	TRUSTparenacy consortium member

Appendix II – Ackermann and Eden’s (2011) stakeholder map

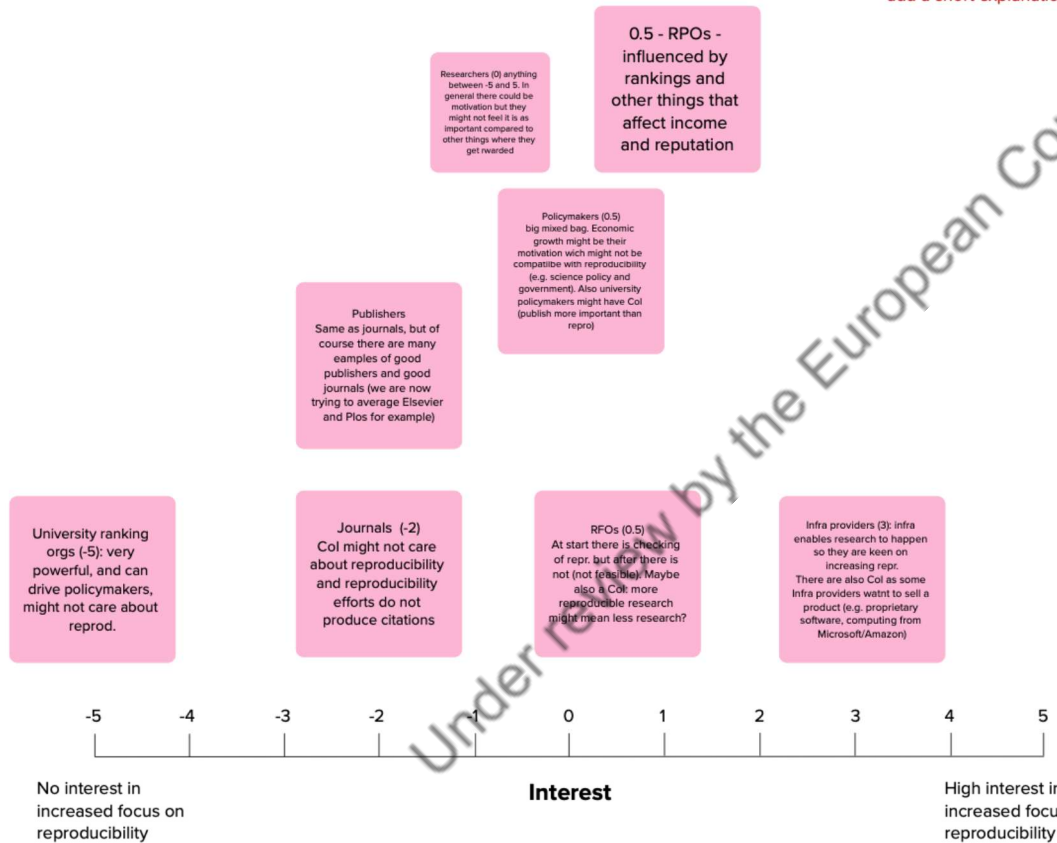


Appendix IV – MLE exercise 2, breakout room 1

Exercise 2

Breakout room 1

Please include the number indicating where on the axis you think the stakeholder should be placed - and add a short explanation.



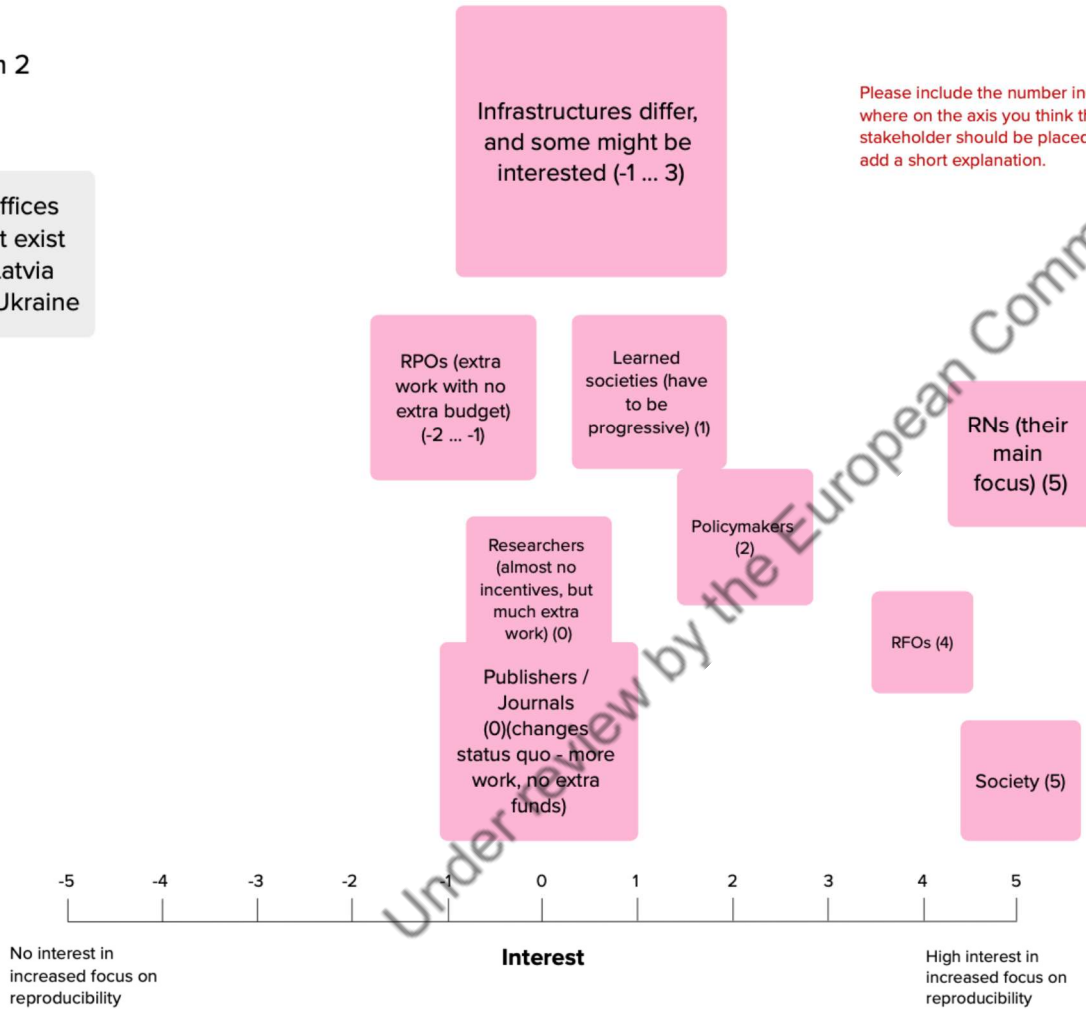
Appendix V – MLE exercise 2, breakout room 2

Exercise 2

Breakout room 2

RI offices
don't exist
in Latvia
and Ukraine

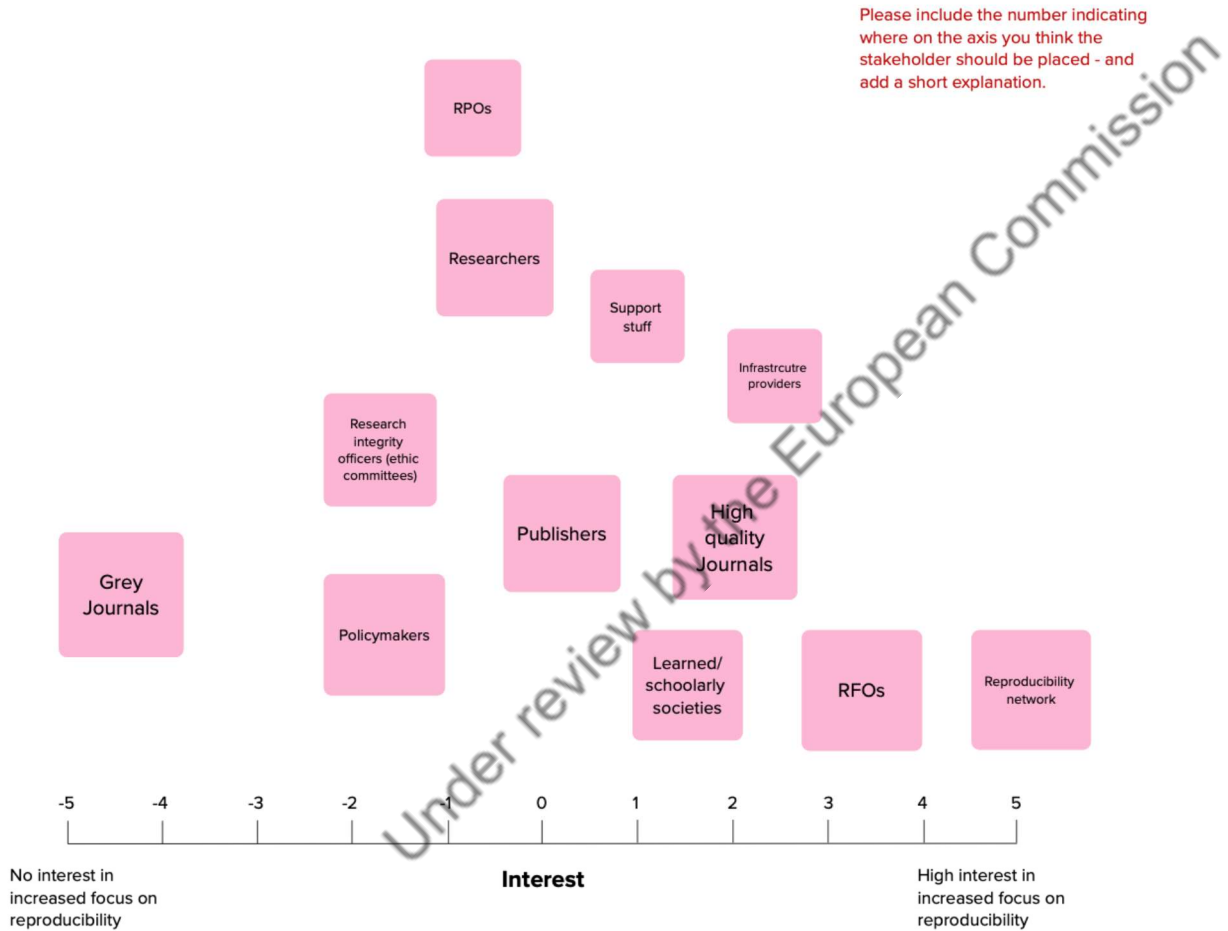
Please include the number indicating
where on the axis you think the
stakeholder should be placed - and
add a short explanation.



Appendix VI – MLE exercise 2, breakout room 3

Exercise 2

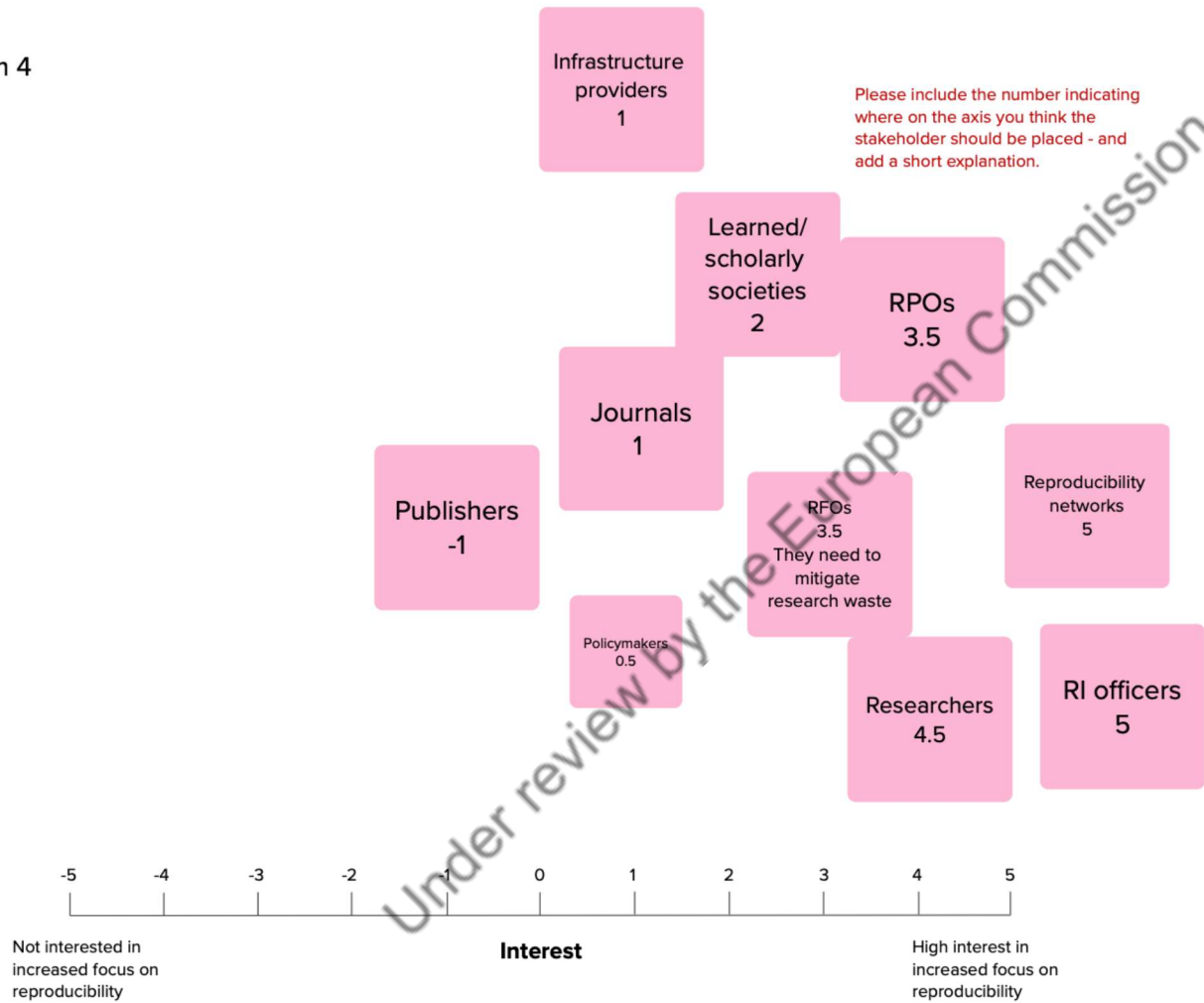
Breakout room 3



Appendix VII – MLE exercise 2, breakout room 4

Exercise 2

Breakout room 4



Appendix VIII – MLE exercise 3, breakout room 1

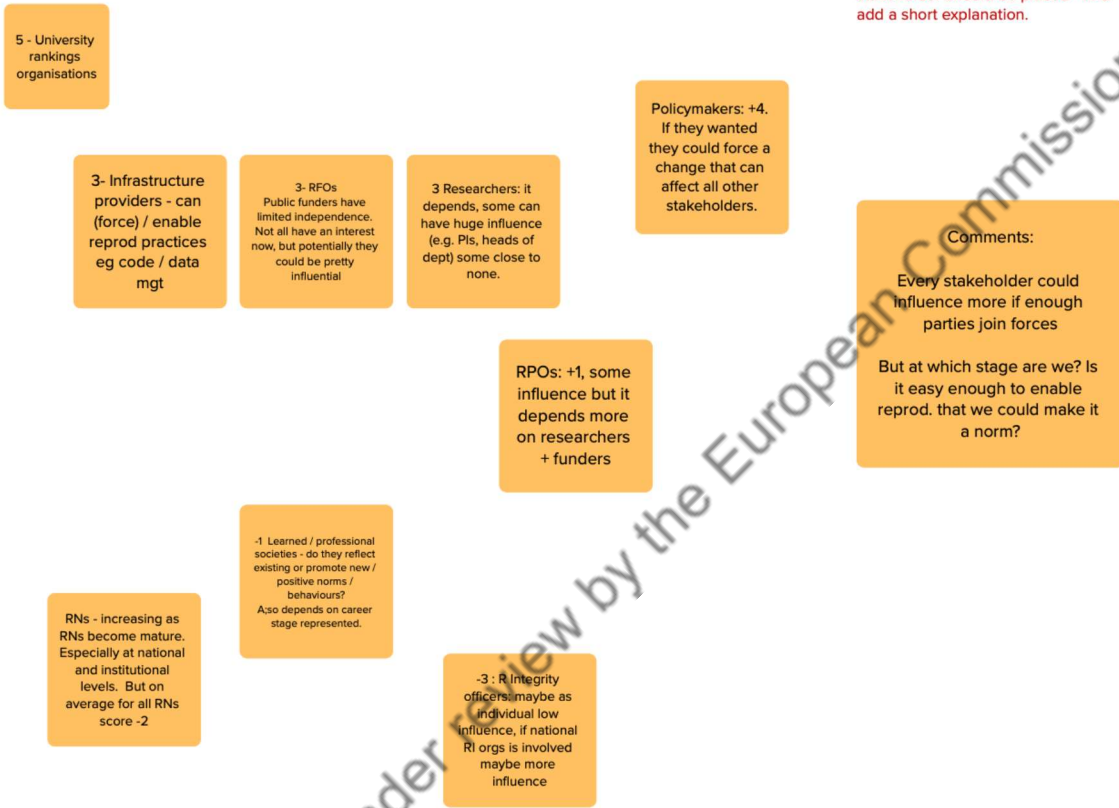
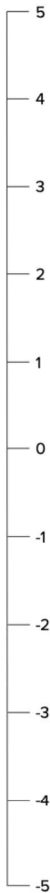
Exercise 3

Breakout room 1

Very influential - has the power to change practices to increase reproducibility

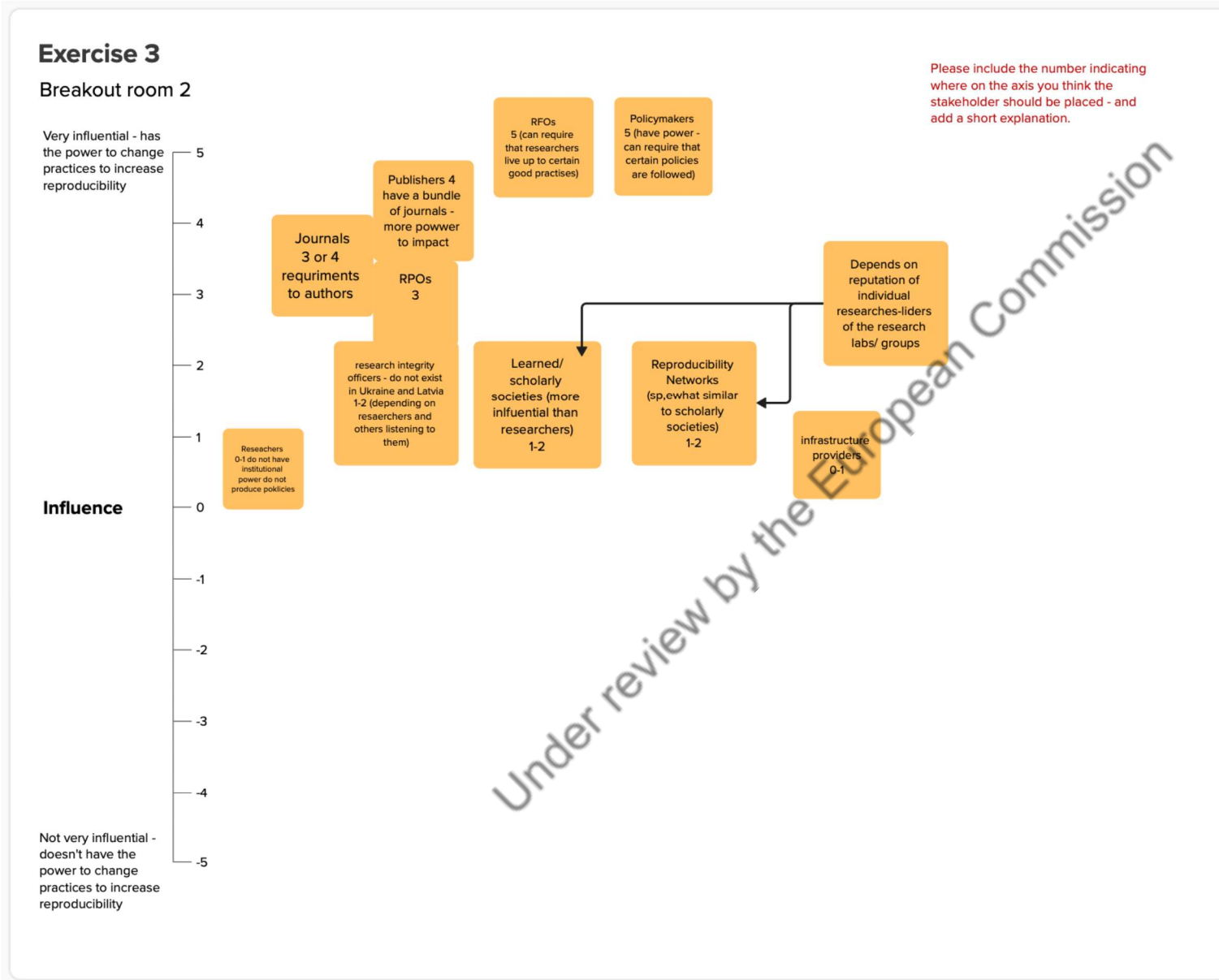
Influence

Not very influential - doesn't have the power to change practices to increase reproducibility

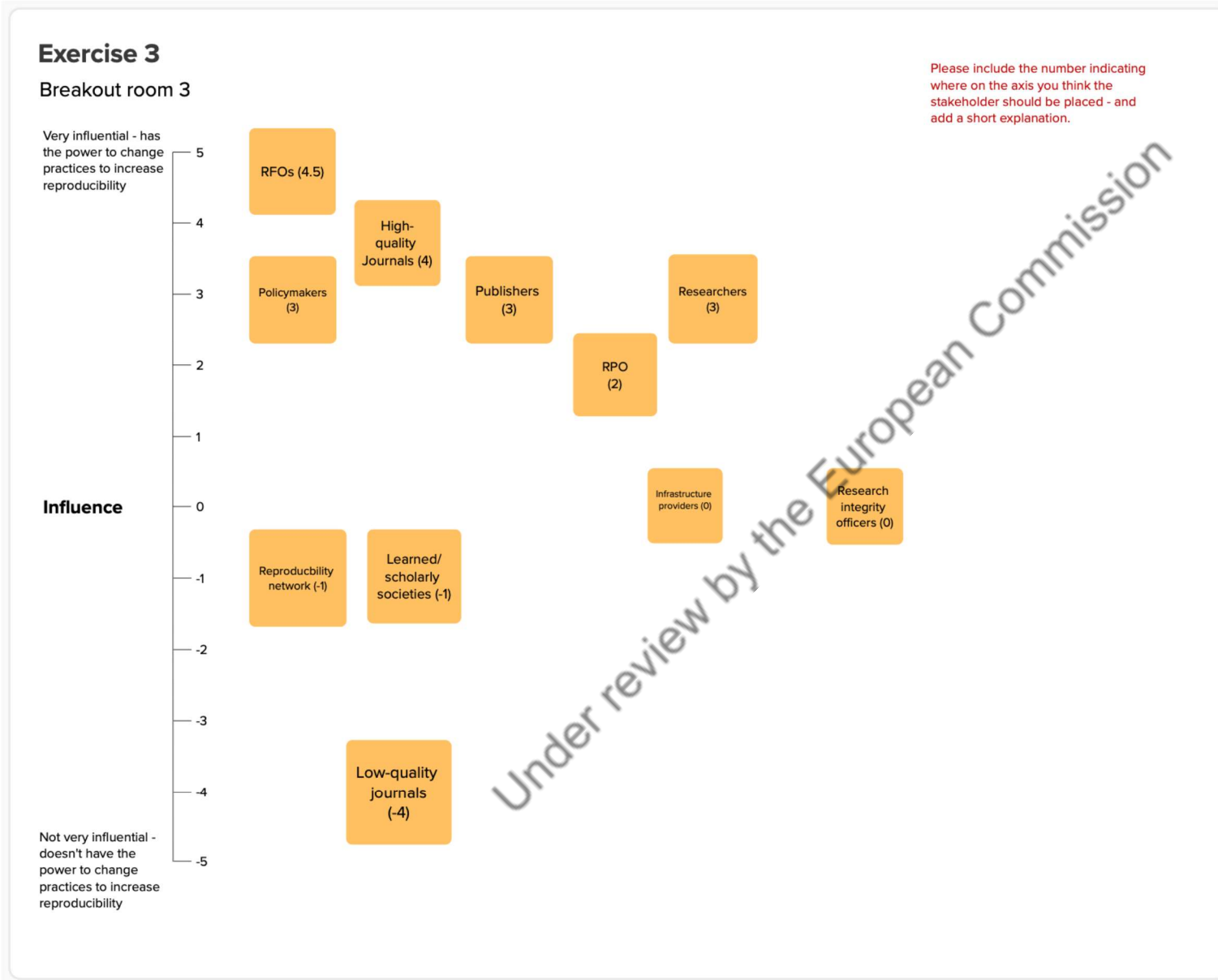


Please include the number indicating where on the axis you think the stakeholder should be placed - and add a short explanation.

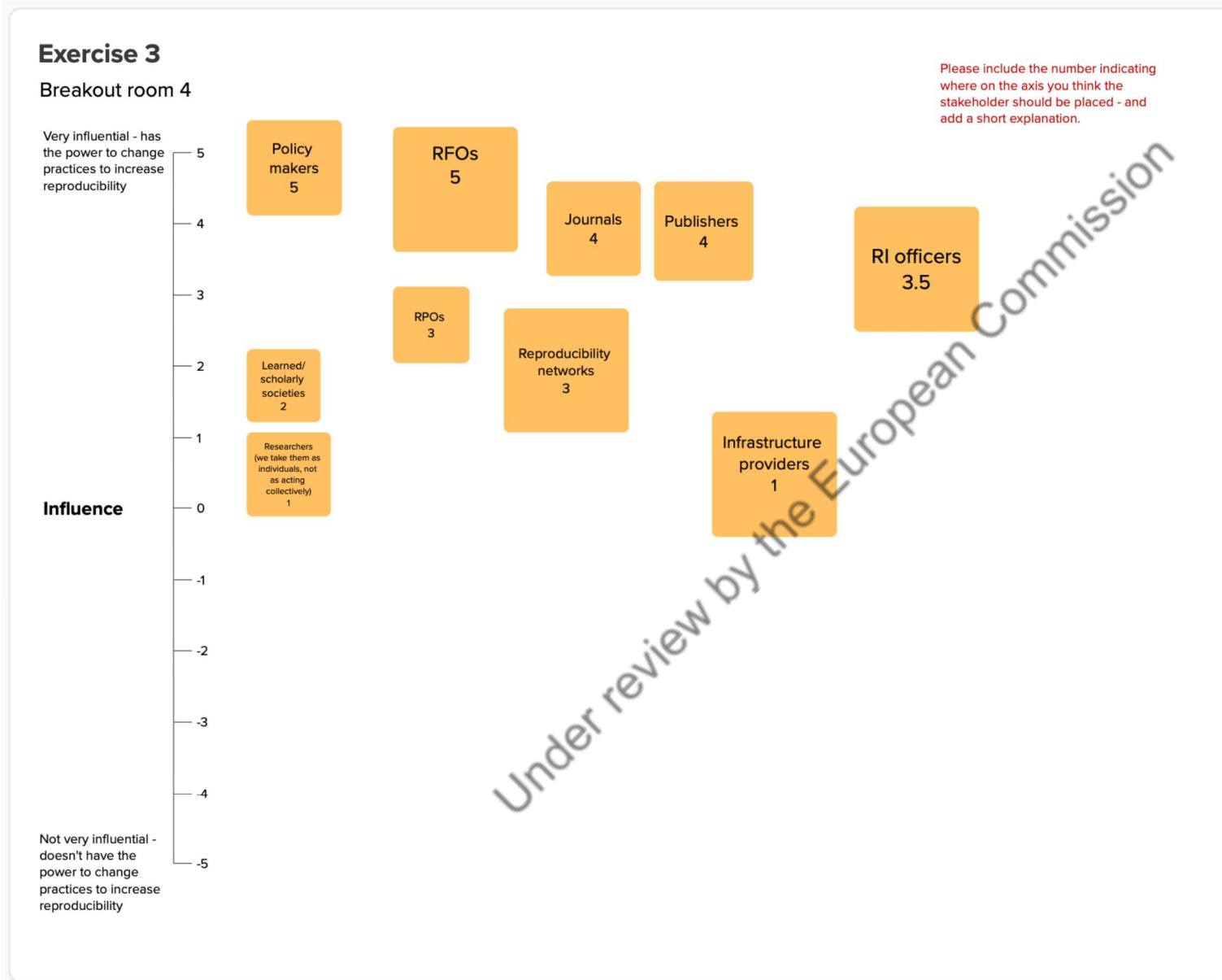
Appendix IX – MLE exercise 3, breakout room 2



Appendix X – MLE exercise 3, breakout room 3



Appendix XI – MLE exercise 3, breakout room 4



Appendix XII – Ranking of stakeholders

Ranking of stakeholders' perceived *interest* in reproducibility

(showing group results with #1 indicating the highest perceived interest, followed by #2, etc.)

Group 1 (cf. appendix IV):

1. Infrastructure providers
2. RPOs + RFOs + Policymakers
5. Researchers
6. Publishers + Journals

Group 2 (cf. appendix V):

1. RNs
2. RFOs
3. Policymakers
4. Learned societies
5. Infrastructure providers
6. Researchers + Publishers + Journals
9. RPOs

Group 3 (cf. appendix VI):

1. RNs
2. RFOs
3. Infrastructure providers
4. (high quality) Journals
5. Learned societies
6. Publishers
7. RPOs + Researchers
9. Research integrity offices + Policymakers
11. Journals (grey)

Group 4 (cf. appendix VII):

1. RNs + Research Integrity Offices

3. Researchers
4. RPOs + RFOs
6. Learned societies
7. Infrastructure providers + Journals
9. Policymakers
10. Publishers

Stakeholders' perceived *interest* in reproducibility – mean ranking scores

Ranking scores per stakeholder were calculated by summing the raw ranking numbers from all four groups and dividing the total by the number of groups that provided scores.

A lower score indicates a higher ranking, meaning the stakeholder is perceived to have greater *interest* in reproducibility than stakeholders with a higher score.

1. RNs (not ranked, 1, 1, 1) = $3/3 = 1$ (median = 1)
2. RFOs (2, 2, 2, 4) = $10/4 = 2,5$ (median = 2)
3. Infrastructure providers (1, 5, 3, 7) = $16/4 = 4$ (median = 4)
4. Learned societies (not ranked, 4, 5, 6) = $15/3 = 5$ (median = 5)
4. Research Integrity Offices (not ranked, not ranked, 9, 1) = $10/2 = 5$ (median = 5)
6. Researchers (5, 6, 7, 3) = $21/4 = 5,25$ (median = 5,5)
7. RPOs (2, 9, 7, 4) = $22/4 = 5,50$ (median = 5,5)
8. Policymakers (2, 3, 9, 9) = $23/4 = 5,75$ (median = 6)
9. Journals (6, 6, not ranked*, 7) = $19/3 = 6,33$ (median = 6) (*group 3 not included because it ranked journals as both 4 and 11, depending on quality)
10. Publishers (6, 6, 6, 10) = $28/4 = 7$ (median = 6)

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Ranking of stakeholders' perceived *influence* on reproducibility/*power* to change things practices

(showing group results with #1 indicating the highest perceived interest, followed by #2, etc.)

Group 1 (cf. appendix VIII):

1. Policymakers
2. Infrastructure providers + RFOs + Researchers
5. RPOs
6. Learned societies
7. RNs
8. RIOs

Group 2 (cf. appendix IX):

1. RFOs + Policymakers
3. Publishers
4. Journals
5. RPOs
6. RIOs + Learned societies + RNs
9. Researchers + Infrastructure providers

Group 3 (cf. appendix X):

1. RFOs
2. (high quality) Journals
3. Policymakers + Publishers + Researchers
6. RPOs
7. Infrastructure providers + RIOs
9. RNs + Learned societies
11. (low quality) Journals

Group 4 (cf. appendix XI):

1. Policymakers + RFOs
3. Journals + Publishers
5. RIOs

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6. RPOs + RNs
8. Learned societies
9. Researchers + Infrastructure providers

Stakeholders' perceived *influence* on reproducibility – mean ranking scores

Ranking scores per stakeholder were calculated by summing the raw ranking numbers from all groups and dividing the total by the number of groups that provided scores.

A lower score indicates a higher ranking, meaning the stakeholder is perceived to have *greater influence* on reproducibility/*more power* to change practices than stakeholders with a higher score.

1. RFOs (2, 1, 1, 1) = $5/4 = 1,25$ (median = 1)
2. Policymakers (1, 1, 3, 1) = $6/4 = 1,5$ (median = 1)
3. Publishers (not ranked, 3, 3, 3) = $9/3 = 3$ (median = 3)
4. Journals (not ranked, 4, not ranked*, 3) = $7/2 = 3,5$ (median = 3,5) (*group 3 not included because it ranked journals as both 2 and 11, depending on quality)
5. RPOs (5, 5, 6, 6) = $22/4 = 5,5$ (median = 5,5)
6. Researchers (2, 9, 3, 9) = $23/4 = 5,75$ (median = 6)
7. Research integrity offices (8, 6, 7, 5) = $26/4 = 6,5$ (median = 6,5)
8. Infrastructure providers (2, 9, 7, 9) = $27/4 = 6,75$ (median = 8)
9. RNs (7, 6, 9, 6) = $28/4 = 7$ (median = 6,5)
10. Learned societies (6, 6, 9, 8) = $29/4 = 7,25$ (median = 7)

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