ROSiE

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D3.4: Recommendations resulting from the analysis of the consultation process

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ABSTRACT:	This report summarises key insights and recommendations from the stakeholder consultation conducted during the exploratory phase of the ROSiE project. It briefly describes the consulted stakeholder groups and how they were engaged during the first 16 months of the project through interviews and focus groups. Thereafter, insights are mapped on the relationships between open science and, respectively, the ethos of science, research ethics, research integrity and citizen science, before specific recommendations regarding the development methodology, content and design of key outputs ROSiE will create are given. The report concludes with a short outlook on the next project phases and how stakeholders will be involved during the remainder of the project.

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Table of contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

List of figures

List of tables

List of abbreviations

ALLEA	All European Academies
ECoC	European Code of Conduct for Research Integrity
ECSA	European Citizen Science Association
ENERI	European Network of Research Ethics and Research Integrity
EU	European Union
EUREC	European Network of Research Ethics Committees
GDPR	General Data Protection Regulation
REC	Research ethics committee
RFO	Research funding organisation
RIO	Research integrity office(r)
WP	Work package

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1 Introduction

Fostering responsible open science and realizing its promises presupposes widespread uptake of practices that support a legally compliant and ethically appropriate opening of research processes reflective of the "as open as possible, as closed as necessary" approach. Unfortunately, the implications of this seemingly simple and straightforward principle currently often remain opaque to researchers and other actors in the research ecosystem, pointing to practical difficulties in balancing data protection requirements, legitimate interests related to the exploitation of research results and open science mandates and recommendations. Thus, promoting the transition to open science while simultaneously reinforcing compliance with data protection requirements, ethical rigour and research integrity requires operational guidance and practical tools capable to facilitate behavioural change.

Supplementing high level guidance on research ethics, research integrity and open science, the ROSiE project will develop a set of operational guidelines, tools and platforms to facilitate the translation of legal requirements and general ethics, integrity and open science recommendations into responsible practices that increase the transparency of research and innovation, while also protecting data subject rights and other legitimate interests. In this way, ROSiE ultimately aims to help strengthening the nexus between science and society by facilitating engagement with and, where possible, societal participation in research as well as by promoting transparent and reliable research. Consequently, the project aims to align research ethics and integrity with open science and vice versa to strengthen research governance, improve research conduct and enhance trust in research and innovation.

Accomplishing this ambitious set of objectives requires endorsement, uptake and embedding of project outputs by various actors and institutions in the wider research ecosystem. To that end, ROSiE engages stakeholders throughout all phases of the project to ensure that all outputs the project will develop are responsive to the needs of stakeholders and aligned to societal values. During the first 16 months of the project, several exploratory stakeholder engagement processes were implemented to chart the research ethics and integrity and open science territory from a multi-stakeholder perspective. This report summarizes key recommendations for the upcoming EQUIP and GUIDE phases of the ROSiE project derived from an analysis of the findings of stakeholder engagement activities conducted so far. Moreover, the report will provide guidance on stakeholder engagement activities in the next phases of the project, which will focus on co-creating outputs with key stakeholders and continuously gathering their feedback and advice in a systematic and structured manner. Consequently, this report is not a complete summary of all stakeholder engagement results ROSiE will generate, but rather an outline of interim results at the stage of the project where stakeholder engagement will transition from an exploratory to an output-oriented phase.

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The report strongly focuses on translating findings from the consultation into actionable recommendations for the next phases of the project rather than on describing every facet of the engagement formats in detail. Interested readers may find further information on the formats in deliverable D3.3 (interviews) and milestone reports MS11 (online focus groups in February 2022) and MS13 (in-person focus group in June 2022). Reflective of this focus, the report is structured as follows: In a first step, the stakeholder consultation methodology underpinning the report will be described concisely. Thereafter, an overview of major issues and challenges related to research ethics and integrity and open science as characterised by stakeholders will be given to summarise overarching key findings from the interviews and focus groups. Subsequently, an outline of recommendations for each key output ROSiE will develop is provided that differentiates between substantive/content-related and methodological/procedural recommendations.

2 Stakeholder consultation methodology

The report is based on an analysis of findings from semi-structured interviews, focus groups and written feedback on draft project outputs. Unlike foreseen in the description of the action of the project, the focus groups could not be based on scenarios due to delays in other work packages caused by changes in the composition of the consortium.

12 semi-structured interviews lasting between 30 and 60 minutes were conducted between January and April 2022. All interviews were based on an interview guide that the interviewers adjusted to the expertise of the interviewees and transcribed afterwards. Eight interviewees are female, four are male. Key insights from nine of these interviews are summarized in detail in deliverable D3.3. Three further interviews were conducted after the due date of that deliverable to broaden the scope of stakeholder categories covered and to include non-European perspectives, supplementing efforts of WP2. Unlike originally planned (see deliverable D3.1), members of research ethics committees (RECs) were not engaged through interviews, but via a dedicated focus group.

Stakeholder categories covered by the interviews are researchers, research integrity officers (RIOs), research managers, research funding organisations (RFOs), research policymakers and science educators. According to the Frascati manual, the disciplinary backgrounds of the researchers are in medical and health science, social sciences and the arts and humanities. The research managers have a background in natural sciences, engineering and technology and the arts and humanities, while the other interviewees are from the medical and health sciences, the social sciences and the arts and humanities. When using the Frascati manual to differentiate between disciplines, the only field of research not covered by the interviews is agricultural and

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veterinary sciences. However, it is worth mentioning that non-researchers are not necessarily speaking from a disciplinary perspective as their jobs often have a transdisciplinary character.

The interviews explored the following topics in depth:

- Conceptions of open science
- Open science related tasks of interviewees
- The relationship between open science and research integrity
- The relationship between open science and research ethics
- Main ethical challenges related to open science and strategies to address them

The basic version of the interview guide can be found in the appendix of this report.

In addition to the interviews, three focus groups were organized in February and June 2022. More precisely, two online focus groups were held in February, reaching nine participants in total, while an in-person focus group was conducted in June, reaching eight participants. As described in more detail in milestone report MS11, the online focus groups pursued partially overlapping, yet complementary objectives:

Focus group 1

1. Explore research ethics and integrity challenges different stakeholders face when aiming to pursue open science practices
2. Identify obstacles that make it difficult to realise the transformative potential of open science
3. Gain insights that might help to develop tools and guidelines to support stakeholders in implementing responsible open science practices

Focus group 2

1. Validate key topics of the first focus group
2. Explore possible trajectories of open science practices.
3. Identify potential pathways for addressing research ethics and integrity challenges in a manner conducive to the responsible conduct of research, as well as to linking science and society.

The in-person focus group zoomed in more explicitly on research ethical challenges of open science, in particular as they relate to the ethos of science and the work of RECs.

The 17 focus group participants fall into the following stakeholder categories:

- Five researchers of varying career stages and from different disciplinary backgrounds:
  - Two senior researchers from the medical and health sciences
  - One mid-career and one junior researcher from the social sciences

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    - One senior researcher from engineering and technology with ample experience in citizen science
- One representative of an RFO
- One research manager responsible for research ethics and research integrity at a higher education and research performing organisation
- Two policymakers with ample expertise in research integrity and close links to RIOs and RECs
- One data journalist
- One science educator with ample expertise in open science
- One representative of a science engagement organisation, with ample expertise in research ethics
- Six members of RECs linked to the European Network of Research Ethics Committees (EUREC)

The following tables summarise core information on the focus groups.

FOCUS GROUP 1 (ONLINE)	
PARTICIPANTS	2 senior researchers from the biomedical and health sciences, 1 representative of an RFO, 1 data journalist
OBJECTIVES	• Explore research ethics and integrity challenges different stakeholders face when aiming to pursue open science practices • Identify obstacles that make it difficult to realise the transformative potential of open science • Gain insights that might help to develop tools and guidelines to support stakeholders in implementing responsible open science practices

Table 1: Overview focus group 1

FOCUS GROUP 2 (ONLINE)	
PARTICIPANTS	2 researchers from the social sciences, 1 senior researcher from engineering and technology with ample experience in citizen science, 1 research manager, 1 research policymaker
OBJECTIVES	• Validate key topics of the first focus group • Explore possible trajectories of open science practices. • Identify potential pathways for addressing research ethics and integrity challenges in a manner conducive to the

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	responsible conduct of research as well as to linking science and society.

Table 2: Overview focus group 2

FOCUS GROUP 3 (IN-PERSON)	
PARTICIPANTS	6 members of RECs, 1 research policymaker, 1 science educator, 1 representative of a science engagement organisation
OBJECTIVES	• Analyse the relationship between open science and the ethos of science • Analyse the relationship between research ethics and open science, especially from a REC perspective • Identify gaps and issues related to the work of RECs and open science

Table 3: Overview focus group 3

Moreover, a set of stakeholders was invited to provide written comments to a draft of the didactical framework for the ROSiE training materials. 16 stakeholders provided comments and suggestions between October and November 2021. All reviewers have significant expertise in the realm of either research ethics and integrity education or citizen science support.

To systematically include a citizen science perspective, the European Citizen Science Association (ECSA), which is part of the ROSiE consortium, was invited to contribute a perspective on the relationship of open science and citizen science as well as issues and challenges pertaining to the interaction of research ethics, research integrity, open science and citizen science.

Thus, the following stakeholders from the following categories mentioned in the stakeholder engagement strategy (deliverable D3.1) have been systematically consulted so far:

Stakeholder category	**Consulted yes/no**
Researchers	yes
Research performing organisations	indirectly through researchers and research managers
RECs and RIOs	yes
Research funding organisations and scientific journals	yes

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Research managers	yes
Research policymakers and advisory bodies	yes
Science educators and science journalists	yes
Industry associations	no
Citizen science associations and civil society organisations	yes
General public	no

Table 4: Overview of stakeholders engaged so far

3 Open science and research ethics and integrity

This chapter provides an overview of how the envisioned transition to open science affects research ethics and integrity from the point of view of the consulted stakeholders. Although precisely delineating a boundary between research ethics and research integrity is neither possible nor necessarily desirable, we will heuristically differentiate between them by conceptualising research ethics as *ethics ad scientia* and research integrity as *ethics in scientia.* According to this distinction, research ethics primarily refers to how research and researchers should relate to actors and institutions outside the research system, whereas research integrity primarily refers to how research should be conducted within the research system.

Even though open science as well as citizen science and general increases in the frequency and density of science-society interactions enabled by new and emerging technologies tend to blur the distinction between research ethics and integrity ever further, the two continue to be governed by somewhat different regimes. While the research ethics system is built around various ethics review and appraisal schemes that historically were shaped by the evolution of ethics safeguards in the life sciences, the research integrity system is based on nowadays mostly codified professional norms and formalised research misconduct investigation schemes. As a result, RECs and other ethics review bodies and schemes occupy a central position in the research ethics regime, whereas RIOs and organisations and networks codifying norms on good scientific practice and investigating allegations of research misconduct are main actors in the research integrity regime. However, both regimes overlap in many ways, as the following figure developed by the ENERI project illustrates:[1]

[1] https://eneri.eu/overlaps-between-re-and-ri/ (last accessed 30 June, 2022)

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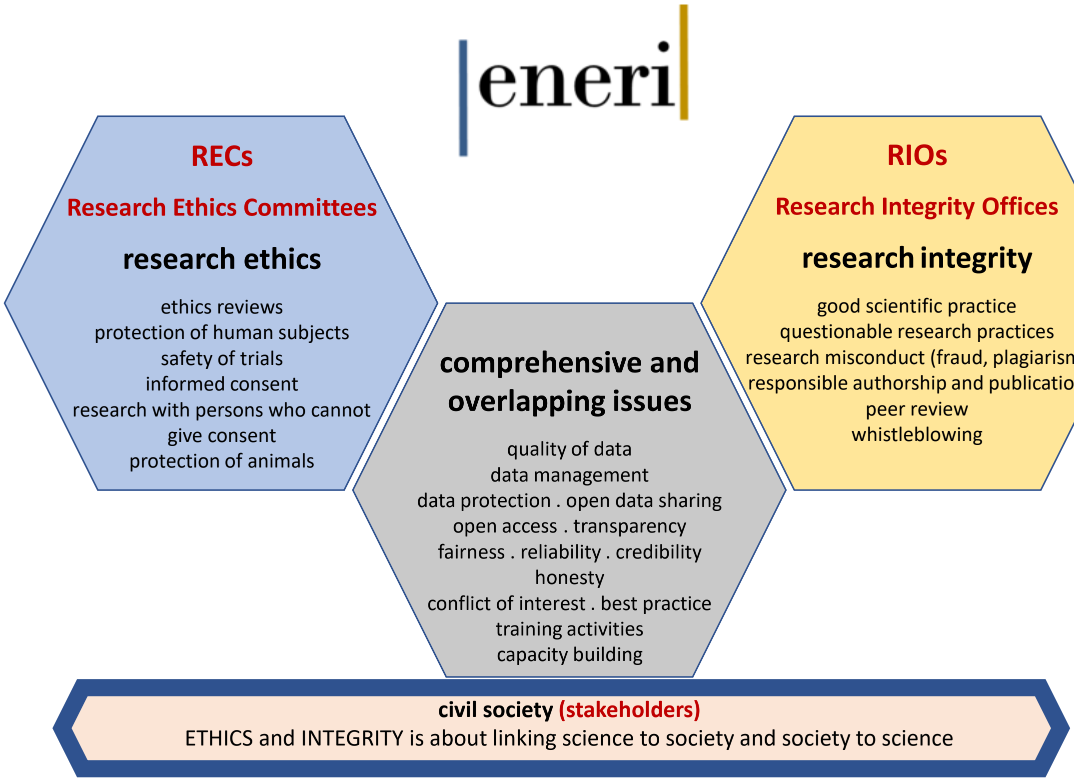

Figure 1: Relationship between research ethics and research integrity

Therefore, the following analysis will not only focus on research ethics and research integrity narrowly conceived, but also address comprehensive and overlapping issues that affect both regimes. More precisely, we will, on the one hand, elaborate how open science affects key research ethics principles and ethics review practices to address the relationship between open science and research ethics and, on the other hand, expound how open science affects the principles and good practices outlined in the European Code of Conduct for Research Integrity (ECoC) to address the relationship between open science and research integrity. Before that, we will tentatively analyse how, according to discussions with stakeholders, open science affects the ethos of science to get a better understanding of how it relates to the responsible conduct of research and the normative foundations of research more generally.

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3.1 Open science and the ethos of science

In a nutshell, what is meant by the ethos of science is adherence to four sets of institutional imperatives, namely communism (often also referred to as communalism, see Ziman, 2000), universalism, disinterestedness and organised scepticism. Sometimes originality is added as a fourth norm, yet there is no consensus on whether its inclusion has actual merit. The institutional imperatives, often referred to as norms, were first outlined by the eminent sociologist Robert K. Merton, who conceptualised science as a distinct and largely autonomous social institution governed by a specific ethos (internalised to different degrees by individual researchers):

- *Communism:* common ownership of scientific goods by the entire research community to enable collective collaboration based on shared knowledge
- *Universalism:* claims of scientific validity are assessed solely according to scientific criteria, the socio-political status or other personal attributes of the person making the claim are irrelevant
- *Disinterestedness:* research institutions pursue a common research endeavour and act for its benefit, rather than for personal gains of individuals within the research community
- *Organised scepticism:* the methodology underpinning claims of scientific validity and its conformity to codes of conduct is scrutinised before claims are accepted (Merton, 1973)

Ziman has argued that the Mertonian norms do not adequately characterise non-academic science, which encompasses a significant part of the research endeavour. In other words, he points out that the research enterprise, if understood to also include non-academic research, is not governed by adherence to a common ethos. Instead, Ziman argues that industrial and post-industrial science, focused on problem-solving and driven by commercial research and development, follow a different set of norms, which he refers to as proprietary, local, authoritarian, commissioned and expert. According to Ziman, these norms also permeate academic science, giving rise to a post-academic system (Ziman, 2000).

As Ziman postulated the rise of a post-academic system around the turn of the millennium, his diagnosis roughly coincides with the ascent of information and communication technologies that enable the transition to open science. Due to that, it seems a plausible starting point of normative analyses of open science to ask how it relates to the ethos of science and to assess whether the envisaged transition can counteract post-academic tendencies, not least because they overtly contradict open science. To supplement the systematic philosophy of science analysis conducted by work package (WP) 1 of the ROSiE project with a stakeholder perspective, the relationship between the ethos of science and open science was discussed explicitly in the third focus group and addressed implicitly in several other consultation formats investigating the normative basis of open science. In the following, key points of these discussions will be summarised.

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While all discussants of the third focus group agreed that open science and the ethos of science are at least complementary and potentially mutually reinforcing, one participant (REC member) — in response to a statement from a policymaker that open science, despite risks that require proper safeguards, is the only way forward if done right and the only way to fully adhere to the Mertonian norms — argued that open science could also be seen as a fad. Deliberately adopting an *advocatus diaboli* position, he elaborated that not following open science practices actually is not doing science in the sense of the ethos of science. As a result, open science cannot claim novelty but might be better understood as science without adjective, unless one conceptualises science conducted in what he referred to as "a right economic environment" where research and education are not funded publicly and where free conduct of science is replaced by a competition-centred approach not as a derogation from what science should be, but as a normatively acceptable state of affairs. From that perspective, open science seems to reinvent the wheel, while it actually just refocuses on what science once was understood to be. Some other participants tended to disagree and stressed that changes in the research environment and technological break-throughs enable a new kind of openness and give rise to new challenges that go beyond changes in science-business or science-economy relations and that include new modes of science-society interactions, such as citizen science. Also, a participant stressed that arguing that open science is just science as it used to be is problematic because it leaves open to what time period the statement refers and disregards the several challenges researchers nowadays face that are different from typical challenges in the past. From this broader perspective, claims alleging a transition to something new seem indeed justified.

Besides, a participant (REC member) pointed out that the Mertonian norms also in the past referred primarily to an ideal to be realised by the research community rather than a description of actual research practices of individual researchers. He elaborated that due to this intersubjective community-focus, open science in a way always had existed, yet added that elements (such as data sharing) are new because they presuppose the existence of an enabling technological infrastructure. Another participant (REC member) bolstered Ziman's claim that post-academic norms permeate also what is institutionally academic research by stressing that many of his students as well as their supervisors seem driven by norms contradicting the ethos of science (especially the norms of interestedness and particularism) and, by extension, also open science, which he understands as reinforcing the ethos of science (a point of view shared by most discussants). He views open science as an important and urgent development that can help strengthen adherence to the scientific ethos if appropriate safeguards are defined and implemented that allow a proper balancing of goods (*e.g.,* privacy and openness). Furthermore, it was pointed out by another REC member that structural problems (such as the strong competitive pressures many researchers currently are confronted with) create obstacles to change and therefore need to be addressed if the envisaged transition should succeed. Important questions in that regard that should be addressed, raised by the participant doubting

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the genuine novelty of open science, include who funds science; how legitimate rewards are created in the scientific system; how the relationship between funders, researchers and rewards should be structured; and how research should be made available and accessible. In this way, open science raises questions linked to benefit-sharing (*i.e.,* questions related to how the community accesses benefits from science) and, ultimately, dignity in the science-society relationship as well as in the science community itself.

3.2 Open science and research ethics

Although key principles of research ethics, such as beneficence, non-maleficence, autonomy and justice (see Beauchamp and Childress, 2019), seem by and large compatible with open science, at least in Europe interactions among the open science movement and the research ethics system have been rather limited. According to consulted REC members, open science considerations hardly play any explicit role in ethics reviews, although pressing issues in open science and research ethics overlap in several ways. Consequently, developing guidance on how open science could potentially be considered in ethics reviews and appraisals would be welcomed by the consulted REC members.

In general, RECs support researchers in conducting research in an ethically sound way by safeguarding the autonomy, rights and dignity of research participants, including their right to privacy and data protection. Thus, RECs due to their mandate are inevitably concerned with the "as closed as necessary" side of the "as open as possible, as closed as necessary" approach and seem well-positioned to inform the drafting of guidance on how this approach can be translated into practice, which several consulted stakeholders identified as a major problem for researchers that currently hampers widespread adoption of open science practices. Even though the precise role of RECs in ensuring legal compliance with data protection law is an issue of debate where multiple *modi operandi* are possible in principle (Lekstutiene *et al.,* 2021, chapter 4.3), privacy also is an ethical concern and therefore a perennial issue on their agenda. Unsurprisingly, pertinent issues of relevance to both RECs and the open science movement discussed during the stakeholder consultation are primarily related to how to ensure proper data protection in changing research environments. Especially discussions on appropriate legal bases for the processing of personal data for research purposes under data protection law (informed consent or public interest) and informed consent models suitable to govern the use of participant data in future research projects in a legally compliant and ethically sound manner were mentioned in the third focus group. While public interest might often offer a better basis to enable data sharing, it also give rise to tensions with key research ethics principles based on autonomy and informed consent. Whether this is perceived as threatening might also depend on the societies where the research is implemented. As a REC member stated, safe societies with high degrees of trust tend

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to have fewer problems with a move towards public interest as a basis for data processing than societies characterised by less trust. Another discussant elaborated that in that way political developments might have repercussions on enabling or disabling certain kinds of research, at least as regards degrees of ethical acceptance by stakeholders.

Besides, data access management models and data curation approaches that decrease privacy risks were mentioned as important topics of interest to RECs. What is more, when assessing whether broad or specific consent should be obtained, the type of data to be processed affects whether a broad consent model could be ethically justifiable or not. A practical issue for RECs could become how to deal with requests to review protocols that consider obtaining re-consent impossible and would like to proceed on a different basis for data processing (*i.e.,* how RECs should deal with such protocols is a question likely to become more urgent to address).

As pointed out by one discussant (REC member), on a higher level many of these questions are related to reflecting on what the purpose of RECs is, namely safeguarding the legitimate interests of research participants, and analysing what follows from this purpose. In his review, this requires a substantive notion of science that respects human rights and assesses the veracity of claims as scientifically valid (creating a bridge between research ethics and questions related to how peer review should function). This presumably requires a constant negotiation within communities engaging in and affected by research. In a similar vein, it was briefly discussed whether at least in principle RECs could potentially review whether projects follow open science (an issue they currently do not focus on at all), which, however, would be difficult as long as open science — similar to the Mertonian norms — is an ideal rather than a concrete set of clearly discernible practices and requirements. And even if this would be the case, it would be questionable if RECs – rather than, for example, RFOs or journals – would the most suitable actors to conduct such a review.[2]

In addition to protecting research participants from violations of their rights, RECs also have the task to facilitate research of high social value, although the extent to which RECs should focus on such questions of is an issue of contention among REC members, as several discussions in the EUREC network have shown.[3] Yet it seems appropriate to state that to the degree open science facilitates research of high social value, the production of desired common goods and benefit sharing with research participants, RECs also are concerned with the "as open as possible" side

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[2] In the stakeholder interviews a preference to focus on RFOs rather than journals as engines of open science was communicated because of their better ability to shape incentives and to avoid overburdening journals.

[3] See Penders *et al.,* 2018, chapter 2 and https://eneri.mobali.com/research-ethics-committees-main-tasks-and-challenges (last accessed 30 June, 2022) for an overview of the mandate and task of RECs.

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of the equation.[4] In particular, the research ethical governance of biobanks is an important topic in this regard as biobanks can facilitate research of high social value, but also create new data protection concerns and challenges to established informed consent procedures.

Moreover, research ethics and open science share a concern for inclusivity and non-discrimination, both of which in many ways are related to wider questions of justice. In the third focus group a REC member brought up the question whether participation in a study conducted in country X should indeed only be open to participants fluent in the official language(s) of that country. Currently, in many protocols insufficient mastery of the language is an exclusion criterion. He asked whether RECs should rather ask researchers to translate participant information sheets and informed consent forms into multiple languages to avoid restricting the study population and increase inclusivity. This issue might merit further investigation by ROSiE if the project intends to explore how openness and inclusivity can strengthen the science-society nexus. This would, however, presuppose a broad understanding of open science that goes beyond open access and open data and subsumes all inclusivity-related issues under its label. As one interviewed research manager put it, a narrower conception of open science makes it primarily beneficial for researchers, as utilising openly accessible publications and datasets requires expertise and skills. In that view, the relevance of open science to the general public is more tangential and primarily related to the question if and how open science can contribute to increasing the trustworthiness and reliability of research.

However, also critical questions about the ethical desirability of open science were raised. During the third focus group, a REC member expressed concern that a move to "do-it-yourself science", not regulated by codified norms, could lead to irresponsible or incompetent usage of research procedures and results. For example, in the area of gene editing malignant actors with access to sophisticated research infrastructures could abuse open research so that safeguards are necessary to ensure open science is conducted responsibly and to avoid problems similar to dual use concerns. Somewhat ironically, several participants stated that to be responsible open science requires a certain degree of closure, highlighting that openness is a good that needs to be balanced against other goods, as one interviewed researcher put it. The issue of gatekeeping and that it can be desirable to at least a certain extent was also mentioned by a research manager in the second focus group, who suggested that gatekeeping could also be conceptualised as a value underpinning responsible open science. Thus, assessing the potential value of gatekeeping as a mechanism to safeguard responsibility in open science and identifying where complete

[4] See London, 2022 for a comprehensive perspective on research ethics that focuses on the common good and questions of justice. While his discussion is focused on the American research ethics system, the wider questions he addresses arguably are of global relevance.

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openness could create undue risks is an issue ROSiE and other projects and initiatives should consider investigating further.

Broader social questions with high ethical relevance are particularly pressing in fields of research where ethics review systems and appraisal schemes are less well-developed than in the health and life sciences. Especially research on and with new and emerging technologies gives rise to many novel ethical challenges that tend to differ significantly from ethical challenges in biomedical research. Unlike the latter, technology research often does not involve human research participants, but nonetheless can have significant impacts on humans and their autonomy, privacy and safety once used on a broader scale (Brey *et al.,* 2021, 78). While such questions were only touched upon briefly in the stakeholder consultation so far, they unquestionably are urgent and central loci of attention of several other projects, with which ROSiE liaises under the auspices of WP4.

In contrast to most biomedical research, an *ex-ante* model of ethics review (that is, a research protocol is reviewed before its implementation, whereas monitoring during and after the end of the project is rather weak) often is not feasible in technology research because of high degrees of uncertainty, for example in relation to data protection (see Lekstutiene *et al.* 2021, chapter 4.1.2). A prominent family of models to govern technology research ethically is commonly referred to as ethics by design. In ethics by design models, stakeholders are involved in various phases in the progression from basic research to product development and deployment (see Brey *et al.,* 2021), and open science could potentially facilitate and strengthen stakeholder engagement in participatory ethics governance schemes.

Usually, stakeholders are invited to participate in a project activity based on a prior stakeholder mapping. While such mappings typically strive to be inclusive and utilise methods that are intended to support inclusivity (see Häberlein, Mönig and Hövel 2021), such mappings inevitably rely partly on a top-down approach because they are at least initially driven by the research team. If research processes are opened up and accessible to stakeholders without prior invitation, stakeholders would be empowered to reach out to projects on their own initiative and add a bottom-up component to the stakeholder mapping process, thereby potentially enhancing its inclusivity and reducing the likelihood of inadvertently failing to engage important groups. Consequently, examining the relationship between open science and ethics by design seems recommendable.

3.3 Open science and research integrity

In Europe, the ECoC has become the key reference document for questions related to research integrity, although variation in how national codes of conduct are framed interestingly persist

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(see Desmond *et al.,* 2020 for an overview) The ECoC is based on four principles, which, as stated by a senior researcher from the health and life sciences participating in the first focus group, also could be referred to as values or virtues, and eight concise chapters on good practices. In the following, it will be expounded how open science relates to the principles and good practices of the ECoC from the point of view of the consulted stakeholders. As the consultation process was exploratory and as the ECoC was not used as an explicit guidance in the engagement formats with the exception of the first focus group, it should be kept in mind that the following analysis is not necessarily exhaustive of all potentially relevant issues related to open science and research integrity.

3.3.1 Principles

The ECoC is based on the following principles:

- **Reliability** in ensuring the quality of research, reflected in the design, the methodology, the analysis and the use of resources.
- **Honesty** in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way.
- **Respect** for colleagues, research participants, society, ecosystems, cultural heritage and the environment.
- **Accountability** for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts.

(ALLEA, 2017, 2, emphases in original)

The two online focus groups explicitly addressed which values stakeholders believe should underpin open science to ensure it is implemented responsibly and with integrity. The question was asked openly in the first focus group, whereas the second focus group was presented with the values identified by the first group and asked whether they agree and/or would like to add further values.

Participants in the first focus group expounded that from their points of view the principles of the ECoC also apply to open science and suggested that the respect principle could be broadened to explicitly include respect for data, especially data of others. Putting increased emphasis on the importance of respect for data could potentially help alleviate concerns about scooping that might contribute to the reluctance of many researchers to share data already early in the research process. Scooping refers to "having someone else claim priority, usually through publishing, to a research idea or result" another researcher or research team has been working on (Laine, 2017, 2). In an open science context, "the discussion turns to illegitimate scooping; taking someone's work and presenting it as your own" and thus is linked to misappropriation and plagiarism (Laine, 2017,3).

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As a senior researcher elaborated in the first focus group, especially researchers from the scientific periphery, who often need more time to move from research idea to actual implementation due to limited access to resources and infrastructures, might be reluctant to open up their research because of such fears, even though the stakeholder consultation suggests that such fears also exist outside the periphery, albeit perhaps to a lesser extent.

Participants of the second focus group agreed that the principles of the ECoC also apply to open science, yet mentioned several further values that might also merit consideration as principles of responsible open science:

- Sharing
- Collaboration
- Equity
- Fairness
- Trustworthiness
- Reproducibility

The following quote from milestone report MS11 summarises the contexts in which these values were discussed:

> With regard to the proposed value of sharing, especially sharing resources and experiences were discussed, and collaboration was mentioned as a closely related value. The importance of equity was mentioned in relation to the problem of high article processing charges that can effectively prevent especially researchers from the scientific periphery from publishing in open access mode. Fairness was proposed primarily because it is a key value that is also easy to understand for researchers who do not usually reflect on the normative underpinnings of the research endeavour.
>
> Trustworthiness and reproducibility were both mentioned as closely related to the ECoC principle of reliability, yet the discussion also addressed data quality as a key issue. Already participants of the first focus groups pointed out that openness does not necessarily mean quality. Based on considerations related to the importance of high data quality, one participant of the second focus group (research manager) elaborated that gate-keeping could actually be considered a value if gate-keepers are conceptualised as stewards of quality who help signal credibly which data is credible and which data is not.
>
> (Lindemann, Häberlein and Hövel, 2022, 7)

As pointed out in milestone report MS11, many of these values are already reflected in the ECoC, without, however, being explicit principles. One participant of the second focus group (senior researcher in engineering and technology with ample experience in citizen science) cautioned against inflating the number of core values or principles. Therefore, it would be plausible to

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proceed in the next phases of the ROSiE project with decomposing the principles of the ECoC and assess whether the other mentioned values are implicit in the extant ones. Based on such a decomposition, it could be decided whether to propose an expansion of the list of key research integrity principles.

3.3.2 Research environment

Stakeholders strongly emphasised that a successful transition to open science presupposes a research culture and environments that endorse and promote open science practices and that existing research environments are insufficiently supportive. One senior researcher even referred to the current research system as failing with regard to the provision of incentives to reward open science practices.

Thus, a crucial pathway towards fostering a culture and environment supportive of open science would be the widespread adoption of research assessment and funding schemes that enable and reward researchers who act in accordance with good open science practices. Most current assessment systems were perceived as inadequate by stakeholders, for example because opening up research processes early increases risks of being scooped. In other words, researchers who share ideas and/or data early in the research process, risk that their ideas and/or data are used by other researchers who could potentially generate and publish results faster. Unless performance assessment systems stop prioritising results and the number of publications over transparency, fears of being scooped are likely to create barriers to open science, especially in the scientific periphery where researchers often need more time to move from idea to result due to limited access to infrastructures and equipment. Whether platforms that time-stamp publications of ideas and data could alleviate concerns about scooping remained unclear to stakeholders because the actual worth of a time stamp seemed hard to assess.

While stakeholders almost unanimously agreed that open science practices require funding because especially data management can be costly, views on existing research funding schemes varied. Some stakeholders stated that RFOs are currently the engines of the transition to open science, especially in countries where open science has not yet been recognised as an important issue in national research policy (statement from a policymaker in an interview). Others, however, were far more sceptical. The sceptics pointed out that a full transition to open science would not only require open science mandates and support by flagship RFOs, such as the EU, but also endorsement and support from smaller national RFOs because they actually fund the majority of research in Europe. In their view, the picture of RFO support of open science is more heterogenous. Also, an interview with a representative from a national RFO showed that open science, despite being viewed positively in general, is not a major theme in all funding schemes.

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Interestingly, no consulted stakeholder based in the EU referred to inadequate technological infrastructures as a major problem. While some issues might still exist, the following quote illustrates the view stakeholders seemed to share:

> Yes, there are technical challenges, but I think these will be resolved within the next five to ten years. So, the EU is pushing forward the open science cloud, the institutions now are installing large scale servers for data because they see that there is money in the data that they have. So, they are supporting with more and more infrastructure. I think, we should push this of course but I think this is a problem that is already solved, but now the implementation needs to come.
>
> (Researcher from the health and life sciences, interview)

In light of results from stakeholder consultations conducted by UNESCO (2020), this finding is likely specific to high-income countries, where access to technical infrastructure, such as the European Open Science Cloud, and technical equipment is mostly given. ROSiE explicitly addressed open science challenges in low and middle income countries in analyses conducted by WP1. To provide an additional perspective from low and middle income countries on open science, two interviews were also conducted as part of the stakeholder consultation of WP3. While these interviews not only focused on issues related to the research environment but also on other research ethics and integrity issues of open science in low and middle income countries, their main themes are summarised and contextualised here.

At the 7th World Conference on Research Integrity, which took place in Cape Town, South Africa, the topic of open science was addressed from a low- and middle-income country perspective and raised the question of how to end exploitative research practices and how to dismantle systematic exclusion, which have been common research practice for decades.

In ROSIE, these issues raise the question of what role open science can play in embedding ethical and responsible research behaviour and fostering a culture of research integrity, for example by adhering to local data protection standards, adapting informed consent forms to local requirements, or feeding back research results to local communities so that citizens in lower-income settings see benefits from research that has often been conducted with their data or in collaboration with local researchers.

In many of our interviews, it was emphasised that open science plays a particularly significant role for low- and middle-income countries and that this is where most of the benefits can be gained. Interviews conducted with stakeholders from Africa and Asia showed that open science is still an unknown concept.

Nevertheless, related topics from the areas of research ethics and integrity, such as the need for ethics approval, informed consent, or the prevention of plagiarism, were raised during the

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interviews. In addition, the interviews revealed a strong awareness of the importance of promoting open science, especially where access is limited. Lack of resources for conducting research is a frequently mentioned problem. This includes lack of access to literature, since full text is usually locked behind paywalls. An interviewee from Thailand (researcher) emphasised that without freely accessible online resources, he would not be able to conduct research, as he often has no other way to benefit from and build on the knowledge of others: "Well, this is really necessary for me, because buying a book is not easy. But it is easy to get information on the internet". However, as more information are made available online, it is becoming easier and faster for our interviewee to get the information he needs.

One interviewee from Zimbabwe (junior researcher) points to the unfulfilled promise of open science:

> I really appreciate open science, but my concern is that we call it open and yet it is closed. But if it achieves its goal, which is to disseminate research results around the world so that they reach everyone, then that's brilliant. That's very brilliant. I would endorse that.

He suggested that journals or publishers could introduce two distinct categories of publications. One that is open and one that requires payment of an affordable amount. This should be based on the target audience and their background.

This idea is right in line with the spirit of the time: The publisher of the medical journal *The Lancet* recently acknowledged that pricing is a crucial factor in the choice of publisher for many researchers from low- and middle-income countries. For this reason, *The Lancet* now charges different prices for different regions. This was done in recognition that the journal focuses strictly on the quality of the work done when evaluating manuscripts but had not previously considered criteria such as equity and diversity, which play a key role when it comes to research in different regions of the world. The journal now rejects papers with data from Africa that do not mention African collaborators. This was done in response to so-called helicopter research, in which privileged researchers, conduct studies in lower-income settings or with marginalised groups, with little or no involvement from those communities or local researchers. Now, the WCRI, prepares to publish a statement urging action on journals to call out inequity and unfair practices in research collaborations as a matter of research integrity. This example shows that the research community and its institutions all bear the responsibility for realising the promise of open science (*Nature,* 2022)

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3.3.3 Training, supervision and mentoring

Several stakeholders emphasised the importance of training in open science, research ethics and integrity, yet interestingly no references to open educational resources as a key component of open science were made. The stakeholder consultation identified three potentially important issues training initiatives should consider:

- Trainings in open science should focus on the entire research process and start early-on. Turning open science into a structural component of the scientific endeavour requires integrating skill development in relevant practices into higher education and perhaps even high school curricula. In other words, education in open science should not be viewed as a small add-on to doctoral training only.
- Researchers who do not view open science favourably are less likely to participate in open science trainings than researchers who welcome initiatives to support open science. A major problem some open science sceptics perceive is that efforts to promote open science are insufficiently attentive to competing goods, such as intellectual property rights. To respond to this criticism, one stakeholder (researcher from the health and life sciences) recommended to frame open science as a component of responsible research as this could help show that openness needs to be balanced with other goods. In a different context, the need to balance openness with competing goods was also mentioned in the third focus group in the context of the need to create some safeguards to avoid misuse and abuse of fully open research.
- Implementing high-quality trainings in open science presupposes the availability of adequately qualified educators. The assumption that such educators are available, however, is by no means trivial. Competent open science trainers need significant expertise in research ethics and integrity as well as data management and technology. According to some consulted stakeholders with experience in designing and implementing training programmes for researchers and students, this might be a rare combination, especially because older educators are not digital natives and thus often not well-versed in the use of information and communication technology. Consequently, a train-the-trainer programme could perhaps help to increase the pool of adequately skilled educators. Alternatively, teaching open science in teams could be a way to address the skill-problem, which, however, would strain often already scarce teaching resources.

As regards mentoring and supervision, it was mentioned that currently many research groups are based on a culture not conducive to open science. When young researchers are socialised into such cultures, they are likely to perceive relatively closed science as the normal mode of conducting research and thus are likely to eventually help perpetuate practices that hamper the open science transition by inadvertently becoming negative role-models for the next cohorts of young researchers themselves. Thus, open science education should also consider the potential

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effects of informal education though, for example, role-modelling and education and create awareness for the benefits of open science conducted responsibly among supervisors and mentors.

However, an open science educator as well as a research manager pointed out that there also are different experiences. They stressed that often younger researchers already are aware of a cultural turn to open science, whereas views and practices of senior researchers are more diverse. In this view, the result is rather friction of research practices within some research teams along generational lines, rather than a continued socialisation into practices not conducive to open science. In this view, an eventual cascade to widespread endorsement of open science seems possible even if efforts to mobilise senior researchers in favour of open science fail, whereas the aforementioned view is more sceptical in this regard and suggests a need to turn them into change agents.

3.3.4 Research procedures

Overall, stakeholders stated that open science supports researchers in taking into account the state-of-the-art in developing research ideas because it removes access restrictions to the existing stock of knowledge. Moreover, it increases the importance of well-considered and transparent data management, which requires sufficient funding for data storage infrastructures and, especially, data management specialists who curate the data and manage access. This presupposes targeted funding for data management infrastructures and eligibility of data management costs in projects.

Challenges were mentioned by some stakeholders (especially in the first focus group) with regard to the absence of agreed-upon standards on how to actually open up science and share data, although other stakeholders (especially in the second focus group) were sceptical that general actionable standards can be developed across different fields of research. In their view, overarching guidance on open science should be on a level of granularity above standards, not least to avoid inadvertently creating opportunities for open washing through exploiting ambiguities.

An even bigger challenge many stakeholders referred to is that researchers often do not know how to reconcile open science with data protection and intellectual property rights. Faced with what is perceived as a choice between a “should” (open science) and a legal “must” (data protection and other legal obligations), researchers tend to refrain from following open science practices whenever they are unsure what to do. Adequate support structures, such as data stewards on the institutional level, could perhaps mitigate these concerns and help researchers translate “as open as possible, as closed as necessary” into practice. The stakeholder consultation

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suggests that a mere statement is insufficiently operational unless enriched by more specific guidance. This should be a major consideration in the development of the ROSiE guidelines.

3.3.5 Safeguards

As ensuring privacy and protecting data of research participants is a key principle of research ethics and a legal requirement under data protection law, the difficulties in balancing open science and data protection appropriately described above not only affect research procedures, but also safeguards. An important issue is that the distribution of benefits and risks related to open science requires careful analysis to get a better grasp of how it affects the equity and justice concerns discussed in the previous chapter on open science and research ethics. As safeguards generally refer to research ethics rather than research integrity, the relevant issues are discussed in chapter 3.2 of this deliverable and are not repeated here.

3.3.6 Data practices and management

In many ways, data practices and data management are a cross-cutting issue so that many of the points already mentioned could also be addressed in this sub-chapter. For the sake brevity, issues already discussed at some length above will not be repeated here.

Open science depends on good data practices and management to ensure that shared data are compliant with the FAIR principles to the maximum extent possible and of high quality. This requires turning data management into an integral component of the entire research process as opening data retroactively is, in the words of an interviewed policymaker "close to impossible". As stated above, this not only presupposes the availability of data management infrastructures, but also competent data managers because otherwise following open science practices would increase the already significant workload most researchers have to shoulder and presumably decrease support for the envisaged open science transition. In other words, data management needs to be funded, ideally on a permanent rather than a project basis to facilitate the development and cultivation of pertinent skills and to reap gains from specialisation.

In addition, it would be helpful to concretise what the FAIR principles mean in actual scientific practice in jargon-free guidance documents researchers from all fields of research can understand. In the view of a researcher from the health and life sciences it would be especially helpful to also specify under what conditions data access can remain limited or be subject to payment of a fee to ensure data curation costs are effectively reimbursed. As elaborated in deliverable D3.3:

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> Another crucial aspect related to responsible data management extensively discussed by one interviewee is the question under what conditions access restrictions are justified and how access to data could be managed. He outlined that curating data is costly and that data is highly valuable to, for example, tech companies and insurers. Therefore, he argued restricting access is justifiable if access conditions are clearly specified and transparent. In such instances access could, for example, be controlled by a data access committee, and waivers could be granted if, for example, patient organisations would like to access data. In this way, open science in his view can also mean creating legitimate yet transparent access restrictions that recognise the value of data. By extension, this also implies that open science should mean transparency about why some data is not or cannot be made open.
>
> (Lindemann, Häberlein and Hövel, 2022, 14)

3.3.7 Collaborative working

In general, it can be expected that open science facilitates collaborative working as it enhances transparency and facilitates access to and sharing of knowledge and data. However, the stakeholder consultation also showed that some legal frictions created by differences in data protection legislation and its national application even within the EU can exacerbate opening research processes because there are cross-national differences on which data actually can be opened. These frictions are even more pronounced in international consortia that include partners from outside the EU. Because of that, "international consortia often need advice on which infrastructure to use for storing publications and data in a manner both compliant with pertinent regulation and conducive to open science" (Lindemann, Häberlein and Hövel, 2022, 14). Legal aspects related to open science are addressed in more detail by WP2 of the ROSiE project so that readers interested in these topics are advised to consult reports published by WP2. Also, disciplinary differences in open science practices can pose new challenges to collaborative working because many open science policies were developed with a view towards the sciences and are not easily applicable to, for example, the arts and humanities.

3.3.8 Publication and dissemination

In addition to the fear of being scooped that is also related to publication and dissemination, several issues related to publication and dissemination were mentioned in the stakeholder interviews. These were summarised as follows in deliverable D3.3:

> The move to open science also has created new challenges when it comes to publishing and disseminating research, albeit seemingly with some notable differences between different disciplines. A first major challenge identified by an

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> interviewee is that following open science practices sometimes is not possible, even if authors of a publication would generally like to make it openly accessible. She illustrated this point by citing an example where she was invited by a publisher to contribute a chapter to a large edited volume. Accepting the invitation was only possible by agreeing to the publisher's terms on access. This challenge might be particularly acute in disciplines where books are a major type of publication, even though high open access fees could presumably have similar effects on journal publications, unless such fees can be covered by grants or otherwise reimbursed. Another issue particularly relevant to disciplines where book publications are common is related to the problematic effects creative commons licences, such as CC-BY, can have. Publications licenced under CC-BY, as a policymaker from arts and humanities field explained, can be republished in inadequate formats without the consent of authors or original publishers, as long as the text corpus remains unchanged.
>
> A third issue related to publication and dissemination brought up in the interviews is related to the rise of pre-prints. In general, all interviewees who referred to pre-prints view them by and large favourably, and none of them argued that their negative effects pre-prints outweigh their benefits. Nonetheless, two major challenges related to pre-prints were discussed in the interviews: Firstly, pre-print servers, by facilitating access to research, inadvertently also decrease the barriers to publishing bad research on visible platforms. At least under certain circumstances this becomes a problem because, secondly, not all readers of papers published on pre-print platforms are aware that pre-prints have not been subjected to formal quality control, such as peer review, and thus should be read carefully, especially by non-experts.
>
> Interestingly, an issue generally considered a major challenge in the open science transition was only briefly touched upon in the interviews, but not expounded in greater length by any interviewee, namely high open access fees. While largely omitting discussions of high open access fees might reflect the view shared by several interviewees that RFOs rather than journals should be regarded as the engines of the open science transition, this issue will be addressed in more depth in upcoming stakeholder engagement activities to get a clearer understanding about prevalent opinions.
>
> (Lindemann, Häberlein and Hövel, 2022, 14-15)

Another presumably relevant issue that was not mentioned in the stakeholder interviews and focus groups is how the contributions of citizen scientists can be acknowledged adequately. Therefore, we consulted the European Citizen Science Association (ECSA) to provide a citizen science perspective on open science that is described in section 3.4 below.

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3.3.9 Reviewing, evaluating and editing

The topic reviewing, evaluating and editing was prominently yet mostly indirectly mentioned by stakeholders because all issues related to creating research environments that reward open science have repercussions also on performance assessment schemes and research and researcher evaluation. In addition, as stated in deliverable D3.3, "two interviewees with a background in research management mentioned that in their view guidelines and trainings also for reviewers (one interviewee referred to ethics reviewers, the other to grant reviewers) would be desirable to ensure they have the necessary understanding and awareness of open science issues" (Lindemann, Häberlein and Hövel, 2022, 15).

3.4 Open science and citizen science

When asked for positive examples of good open science practices, several of interviewees pointed to citizen science, especially because of its enormous potential for social innovation. For example, one interviewee (research manager) referred to collaborative work between researchers and citizen scientists who, inspired by the citizen scientists' pre-existing interest in programming language, shared programming skills on research datasets. She also stressed that interest in citizen science according to her experience is often associated with applied research projects and close collaboration with end-users or industry. This might be taken as an indication that the shift from traditional models of public engagement, where dialogue between science and society is limited, to intensive and influential exchange, as described for example by Rask, Matschoss and Kaarakainen (2017, 19), is evident in practice.

Nevertheless, there seems to be a deficit in terms of awareness of citizen science and the acquisition of appropriate methods. The research manager already referred to in the previous paragraph explained that educational needs analyses at her institution (a research performing organisation) indicate a high demand for training in citizen science approaches. In addition, more coordination work would be needed to ensure that existing knowledge about citizen science approaches is shared so that researchers can learn from each other and exchange ideas and experiences.

However, another interviewee views the current understanding of citizen science as problematic. In that view, there seems to be a misunderstanding about the relationship between science and society based on the assumption that science already provides a link to society by researching something that is in some way related to society. Citizen science, though, is about doing science with and for society, so that society is fully involved in finding solutions to problems that science could help to address.

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Maintaining communication in this process appears to be of particular importance; an aspect that is discussed, for example, by Schütz, Heidingsfelder and Schraudner who argue for a two-way exchange between science and society to ensure that different perspectives are considered (Schütz, Heidingsfelder and Schraudner, 2019). Ravn and Mejlgaard, in turn, emphasise that such a dialogue allows for careful consideration of alignment with societal values, needs and expectations (Ravn and Mejlgaard, 2015, 132 and 146). Nevertheless, two interviewees (research integrity officer and policymaker) pointed out that in their view citizen science approaches and their potential often remain unnoticed, as exemplified by the following quote from an interview with a research integrity officer, "Somehow we are not able to move forward".

As explained with a slightly different focus in chapter 3.3 above, sceptical voices about engaging non-professional researchers in research processes were also raised in the third focus group discussion. Concern was expressed about the danger of do-it-yourself or so-called garage research, perceived as a risky outcome of open science if implemented irresponsibly or incompetently. It was emphasised in the discussion that people need to be qualified to use data and a difference between institutionalised and non-institutionalised research was highlighted insofar as institutional researchers know the relevant methods and standards or at least are obliged to do so, whereas non-professional researchers have no such obligation. However, from the perspective of an experienced citizen science researcher, citizen scientists usually are interested in existing norms and cautious in their actions, so that the risks might be overstated.

In view of these diverse perspectives, it seems particularly significant for ROSiE to take a closer look at the connection between citizen science and responsible open science. Therefore, ECSA provided an analysis of the relationship between open science and citizen science with a particular emphasis on issues related to the responsible conduct of research, which is outlined in the remainder of this chapter.

With a shift from curiosity-driven research to applied research (Lave, 2017) where private funding constitutes more than half of the total expenditure within the EU (Eurostat, 2018), research and innovation is being increasingly influenced by market forces (*e.g.,* with private and public cooperation agreements guiding research topics and priorities; Vohland, Weißpflug and Pettibone, 2019). Thereafter, by scientific developments and innovations responding to a limited subset of the needs of society (*e.g.,* nanotechnologies and genetically modified organisms) citizens are being affected in a daily basis by research that is partially funded by their taxes (Ruphy, 2019). Which is why it is natural to question why they shouldn't have a greater say, so that research is more aligned with the needs of the people.

A more inclusive deliberation (involving relevant stakeholders including the public) on the direction of research and innovation is therefore advisable to take place from the outset of a project (Molla, Line and Harald, 2019). Citizens' engagement increases the significance of research

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agendas for the broader society, thus enhancing the societal relevance of science (Göbel *et al.,* 2017), which, in turn, increases the possible impact of its outcomes (Lamy Committee, 2017).

Citizen science is of particular significance for the growing open science movement, as it takes, for example, open science activities beyond the purview of professional scientists' circles by exploring the involvement of citizens in scientific research (Knack *et al.,* 2017). Besides potential improvements to the scope, speed, quality and resource efficiency of their research activities, one of the principal advantages of citizen science for academic researchers is seen to be the opportunity to widen dissemination and impact of their work (democratising science), while also encouraging appreciation of science in future generations by building trust in science (Knack *et al.,* 2017).

However, in order to reap these advantages a number of aspects need to be considered, namely: the design and adoption of indicators to measure the above-mentioned outcomes; the development of infrastructures and platforms to support these activities (i.e., cross European initiatives); international mutual learning activities; training and capacity building; and finally, promotion of career and incentive systems embedding these approaches within research institutions (Warin and Delaney, 2020).

Among the key incentives and barriers for citizen engagement, Wehn and Almomani (2019) identified the topic of interest, fun and recognition as supporting factors, and the neglect of privacy concerns and inadequate use of data as hindering factors. On the other hand, for scientists, data quality together with their limited resources (time, staff, funding) play a key role (Balázs *et al.,* 2021).

Citizen science research may thus have a different set of incentives to those typically related with more academic reward systems. While academic researchers tend to focus on individual attribution and ownership of information, citizen science is more associated with the free flow of information and a collective sense of achievement, in line with the principles of open science (Haklay *et al.,* 2020; Knack *et al.,* 2017).

Academic researchers, research institutions and their funding are more often than not subjected to the "rat race" of publication metrics, the so-called publish-or-perish culture. This creates a challenge for the advancement of citizen science and a reluctance among scientists to make use of this research approach as it often requires more time and effort and financial resources to carry out to come up with similar publishable outcomes. Moreover, as part of their main principles and similar to open science (ECSA, 2015), citizen science outcomes are published in an open access format, where possible, which are still perceived by many researchers to have a lower prestige and a lower impact, thus further affecting their publications in journals with high journal impact factor.

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To overcome this, the current academic reputation systems ought to be expanded, including alternative metrics and incentives for scientific curricula that recognise social impact and engagement (Göbel *et al.,* 2017). For this purpose, and supporting the above aspects to be considered, there is a need for measurement indicators and metrics that assess public engagement activities and the impacts achieved.

On the other hand, and in addition to the sense of accomplishment citizens experience from contributing to a project, scientists should offer them a fair share of the benefits to avoid exploitation, for example: authorship or ownership of intellectual property (if appropriate; Haklay *et al.,* 2020), formal recognition (certificate or a letter of gratitude), education related to the research being conducted, or money (Resnik, Elliott and Miller, 2015).

In addition, open access to academic publication plays an important role for citizen science for two reasons: for participants to see the outcome of their contribution and to support their learning process (Haklay, 2015). In this sense, citizens become providers and users of data. This openness enhances citizens' and citizen groups' capacity to participate in evidence-based policy and decision-making and therefore supporting the policy of open access to publications and data (Lamy Committee, 2017). Scientific data and research findings can also be communicated to participants through projects newsletters or blogs, forums, and social media channels, serving also as a space for participants to discuss their findings and interact with scientists (Golumbic *et al.,* 2017).

Conflict of interests raise ethical issues for investigators as they can bias research and/or undermine trust in science (Elliott and Resnik, 2015). Some citizens or citizen groups may have relationships with private, non-profit, or political organizations, for example they might receive funding from or advise an environmental group or might be involved in a lawsuit related to the research (Resnik, Elliott and Miller, 2015). What is more, some participants volunteer to help collect data to advance their political agenda (Riesch and Potter, 2014). To counter these conflicts of interests, a common strategy used is disclosure, embodying the virtues of openness and transparency (Resnik, Elliott and Miller, 2015). Open science practices are another strategy for responding to conflicts of interests in citizen science, by making data publicly available after publication so that data processing, analysis and interpretation can be independently evaluated (Soranno *et al.,* 2015).

Openness and transparency are also important to safeguard the research methodology employed, taking into consideration the potential bias (unintended or not) during the implementation of engagement activities, such as to avoid enrolling participants that support the perspective of powerful or particular groups (Mejlgaard *et al.,* 2018).

Like in open science, data ownership and intellectual property (*e.g.,* patenting) issues may arise in citizen science as participants or citizen groups may claim ownership over the data gathered

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and expect to have some control over how it is shared and used (Riesch and Potter, 2014). In that sense, policymakers at the European level should debate on the use of open data by private companies for products or services subject to copyrights or patents. The fact that companies make profit out of the voluntary participation of citizens and from the findings and data made publicly available (without having to pay anything) is a clear concern — related to citizen science and open science — for the research community (Resnik, Elliott and Miller*,* 2015).

Open data policies need to be sensitive and allow citizen scientists control and judgment over the information that should be released for which specific incentives might be needed to encourage them to share their data (Haklay, 2015). Researchers should set clear expectations in this regard by informing participants about rules and procedures for sharing data, including whom data may be shared with, when, and why (Riesch and Potter, 2014). Organisations within the EU are legally required to uphold privacy rights safeguarding personal data that has been collected or processed data by following the General Data Protection Regulation (GDPR). While this is seen positively by citizen scientists and users in general, the implementation of GDPR in large-scale citizen science projects has created a big challenge mainly for small organisations that struggle with higher costs and implementation issues including short deadlines, too much effort, and lack of knowledge or non-clarity of the legislation (Mangini, Tal and Moldovan*,* 2020).

Regarding data quality, although difficulties can occur in any type of research (Shamoo and Resnik, 2015), citizen science projects may have more challenges as participants probably lack training in scientific data management or research integrity, and therefore may not understand how to collect, record, or manage data properly. Data might be prone to unintended systematic errors or even falsified in an attempt to sway particular outcomes or meet deadlines **(**Resnik, Elliott and Miller*,* 2015). On the other hand, citizen science projects can have a positive impact not only on participants' research skills (*e.g.,* data collection or assessing variables) increasing their scientific knowledge, but also for project leaders, since the previous also increases project data quality.

Moreover, to enhance research integrity and data quality in citizen science, an effective approach is to make research as transparent as possible to others, creating thus opportunities to independently assess questionable or poor-quality data (Rasmussen, 2019).

To have a genuine and impactful citizen engagement, researchers should try not merely to increase the diversity of participants through the inclusion of women, indigenous people and other underrepresented groups, but actually to capture the diversity of the target population (Brouwer and Hessels, 2019). These measures will help reverse the skewed representation in the production of knowledge and thereby increase both the quality and legitimacy of research (Bäckstrand, 2003).

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Nonetheless, challenges remain concerning the empirical configuration of the inclusion of citizens and citizen groups in open science (Owen, von Schomberg and Macnaghten, 2021), for example, in defining who constitutes the public in a specific context and how to account for biases of social norms and values in the production of knowledge (Molla, Line and Harald, 2019). However, in fairness, these concerns have also been raised for the overall public engagement with science and technology from the outset (Owen, von Schomberg and Macnaghten., 2021). Moreover, the level of inclusiveness in citizen science is also influenced by the projects' limited resources such as time. Researchers should anticipate these issues when designing the research, as the presence of supporting structural elements (*e.g.,* legislative prerequisites such as gender quotas) are time demanding for researchers and, as previously mentioned, this conflicts with the (publicly funded) research projects' limited duration (Molla, Line and Harald, 2019).

There is a lack of regulatory oversight for a number of citizen science research areas. This poses a challenge considering that allowing as many groups as possible to contribute to citizen science research and making it available to the public are among the most important values of citizen science. Thereafter, inevitably, some less rigorous or even fraudulent research will be disseminated (Rasmussen, 2019). Conversely, limiting the number of groups being able to contribute (or increasing the participation prerequisites) by making more stringent gatekeeping decisions, researchers would start reproducing the very structure of professionalism in science that citizen science research tries to circumvent (Rasmussen, 2019).

In order to foster a culture of research integrity and commitment to ethics in citizen science, researchers and participants ought to be sensitised to ethical issues, removing obstacles and educating them about solutions. The more emphasis on making ethics explicit, the more participants are reminded to consider ethical issues in their research. Through greater collaboration between citizen science researchers and scholars in the field of research ethics, the former will ensure their knowledge on ethical challenges and standards so that they can emphasize the importance of those issues with their collaborators. One of the 10 key principles of citizen science is that leaders of citizen science projects "take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities" (ECSA, 2015).

Henceforth, it is strongly suggested that researchers, research institutions and other stakeholders elaborate guidelines for the participation of citizens in citizen science projects, explicitly state their roles and responsibilities from the outset, provide them with appropriate training on data collection and analysis, and provide education on the responsible conduct of research. Besides the above, Resnik, Elliot and Miller (2015) describe a number of strategies that researchers can use to address this issue including inquiring citizens about their data collection, recording, and data management methods to ensure that guidelines are being followed, or overseeing the collected data, making sure that it meets scientific standards, among other things.

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All in all, if people cannot be confident in citizen science research findings, their outcomes will not be used, which is why citizen science ought to commit itself to rigorous standards of practice ensuring the integrity of research (Rasmussen, 2019).

4 Recommendations

The analyses in this chapter extend the recommendations outlined in deliverable D3.3 and the milestone reports on focus groups by describing options ROSiE could utilise to ensure major project outputs are responsive to the needs and values of important stakeholders. To provide advice on an actionable level of granularity for the next project phases, specific recommendations will be given for each major output, partly enriched by illustrative quotes from interviews and focus groups.

More precisely, this chapter translates the insights obtained during the stakeholder consultation into specific recommendations on key outputs ROSiE will develop. It supplements and extends the general recommendations outlined in chapter 3. The general recommendations outlined above primarily have implications for the guidelines, the ECoC supplement and the strategic policy paper, whereas this applies to a lesser extent to the knowledge hub and the training materials. Because of that, the sub-chapters on the knowledge hub and the training materials add several contextual arguments. By contrast, the other sub-chapters give rather concise overviews of key recommendations directly derived from the previous analysis.

However, before addressing the key outputs of the ROSiE project in more detail, it should be noted that several stakeholders, especially during the focus groups, gave an overarching methodological recommendation they consider crucial for the success of ROSiE in actually guiding research conduct and shaping researcher behaviour, namely: involve researchers in formulating guidelines and developing support materials and infrastructures. In other words, these stakeholders essentially recommended that forms of stakeholder engagement during the next phases of ROSiE should extend beyond the formats of information and consultation to also include involvement and collaboration. As described in more detail in deliverable D3.1, stakeholder engagement can take the following forms:

FORM OF ENGAGEMENT	STATUS OF STAKEHOLDERS
Collaboration	Stakeholders are partners of the research team and help driving the research direction or contribute resources and perspective.

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Involvement	Stakeholders provide resources or data to the research and are engaged in a significant manner.
Consultation	Stakeholders are asked for opinions and information.
Information	Information is shared with stakeholders.

Figure 2: Forms of stakeholder engagement

During the EXPLORE and ENGAGE phases of the project, ROSiE – in line with the stakeholder engagement strategy – engaged stakeholders by consulting them through interviews, focus groups and asking for their written feedback and informing them about current and future project activities. The stakeholder engagement strategy foresees several involvement- and collaboration-based activities during the second half of the project, especially in the form of co-creation workshops. The stakeholder consultation confirmed the adequacy of this strategy and emphasised its importance.

The main reason why stakeholders consider involving researchers crucially important is that researchers know best what the actual barriers to implementing responsible open science practices are and how guidance should be structured and designed to be operationally useful. Limiting their involvement could have the inadvertent effect of developing guidelines and tools on an inadequate level of granularity or full of jargon that researchers from outside the research ethics and integrity community cannot easily comprehend. Therefore, ROSiE should increase the degree of participation in the GUIDE and EQUIP phases of the project.

4.1 Recommendations on guidelines

In addition to the general issues outlined in chapter 3, the following more specific recommendations can be derived from the stakeholder consultation conducted so far:

- The scope of the guidelines should be clearly delineated. It should become clear which aspects of research ethics and integrity are covered by the guidelines and which, if any, are not.
- The guidelines should be practically useful and operational. To that end, researchers should be involved in their creation and they should have an appropriate degree of granularity. In other words, the guidelines should give practical guidance in a way intelligible for researchers from all disciplines rather than address overarching philosophical questions detached from most actual research processes.
- Stakeholders agreed that guidelines need to be differentiated to be practically useful, that is, there is no one-size-fits all approach. Yet their views differed whether a differentiation along disciplinary lines would be most useful. Some argued that the type of data used

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could actually be a more suitable criterion since many practices are specific to data types rather than disciplines. Moreover, it was emphasised that ever more research is conducted by interdisciplinary teams so that it might in some instances remain unclear which guideline should be used.

- The guidelines should help researchers translate "as open as possible, as closed as necessary" and the implications of the FAIR principles for data management into practice. This should ideally include guidance on how to balance open science and data protection and open science and intellectual property rights and similar concerns.
- Guidelines should be formulated in a way that makes open-washing (formal compliance without actually engaging in the desired conduct) difficult. They also should guide researchers in following open science practices from the very beginning of a research project as opening up data retrospectively tends to be difficult.
- If guidelines refer to data standards, they should do so clearly and on an appropriate level of field-specific or data-specific differentiation. Overall, the importance of defining standards for data management and sharing was viewed differently by stakeholders, with some considering it very important, while others expressed scepticism that generally applicable standards can be found.
- It should be considered to frame open data primarily in terms of fair (or FAIR) data to avoid misleading connotations. As explained in deliverable D3.3:

> Several interviewees recommended to refer to fair (or FAIR) rather than open data and to responsible science or good scientific practice rather than open science. In their view, such a phrasing could help decrease reluctance to engage in open science practices because it would signal that openness is meant to promote and safeguard responsibility and quality as well as that openness can, should and under certain circumstances must have legitimate limits. This recommendation shows that the expression "open science" might be viewed less favourably by some in the research community than is often apparently assumed by open science enthusiasts.
>
> (Lindemann, Häberlein and Hövel, 2022, 16)

In addition, stakeholders referred to several good practices that could be mentioned in the guidelines, such as tools to create data management plans, existing guidance on how to comply with the GDPR created by, for example some European Research Infrastructure Consortia and the PANELFIT project and guidance on the importance of gender equality in research developed by the European Institute for Gender Equality. Moreover, it was recommended to consider, if and where possible, addressing issues that go beyond what is formally defined as research, for example the interaction between research and data journalism, which, in a way somewhat akin to research, also draws on data to derive and substantiate journalistic claims.

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4.2 Recommendations on the ECoC supplement

The ECoC is the focal research integrity guidance document in the EU and is intended to serve as a term of reference for codes of conduct on the national, institutional or disciplinary level. Because of that, it is a fairly short and rather general document that by design in many ways is aspirational rather than procedural. In addition to four principles, it contains eight short chapters on good practices and two chapters on violations of research integrity.

Considering the design of the document, an open science supplement could be integrated horizontally or vertically. A horizontal integration would mean adding guidance on open science to existing chapters wherever relevant, whereas a vertical integration would mean adding a specific chapter on open science. Only one interviewee suggested adding a specific chapter on open science to the ECoC, whereas others — especially focus group participants — emphasised that the ECoC is largely adequate to also provide guidance on how to conduct open science responsibly.

However, participants of the second focus group suggested that the list of principles could be extended as described in chapter 3.3.2. There it was also already mentioned that a decomposition of the principles of the ECoC could be a plausible starting point for a more systematic analysis whether the number of principles should be extended to adequately govern open science. In that regard, the approach described by Brey *et al.* could be used as a starting point (Brey *et al.*, 2021). Insights from the analysis of the good practices listed in the ECoC and their relationship to open science could serve as a starting for co-creation activities to develop a proposal for an ECoC supplement.

4.3 Recommendations on policy advice

A recurrent topic strongly emphasised in all stakeholder engagement processes is the importance of creating a culture that promotes, supports and rewards open science. Research policy can play an important role in fostering such a culture. The following issues discussed in the stakeholder consultation seem particularly relevant to research policy:

- A policy environment conducive to responsible open science requires aligned action on the European, national and institutional level. While the EU is largely perceived as a forerunner in creating much-needed open science infrastructures, the picture is more heterogenous on the national level. For example, not all EU member states have an open science policy. While such policies are perhaps not strictly necessary, a stakeholder from a central European country without such a policy emphasised that such policies are seen as signals of what is considered important by many researchers. Thus, adopting such a policy shows commitment to open science also on the national level.

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The same heterogeneity applies to the institutional level, where the availability of support structures for researchers varies considerably. A good practice example mentioned by several stakeholders to help researchers adopt open science practices and good data management is the appointment of data stewards on the faculty or institute level. Unlike advisers based in libraries or other institution-wide bodies, data stewards often can give more specific advice because of their more detailed knowledge of research procedures. Furthermore, institutional policymakers at higher education institutions should consider integrating open science education into curricula from at least the undergraduate level onwards. As elaborated in the previous chapter, this also requires creating a sufficiently large pool of adequately qualified educators.

- Following open science practices can be mandated or incentivised. In general, most stakeholders seemed to favour a largely incentive-driven approach due to its better ability to motivate researchers to genuinely endorse and internalise open science norms. However, some stakeholders also pointed to open science mandates of some RFOs as seemingly effective, at least if sufficient funding for opening up research is provided.
- The importance of the role of RFOs was emphasised by many of the consulted stakeholders, and their current performance was viewed differently. While some stakeholders lauded RFOs as major engines of open science, others pointed out that RFO practices vary considerably. In their view, especially RFOs on the national level (unlike the EU) often do not yet focus on open science, a point corroborated in an interview with an RFO representative.
- Open science policy should consider that transitions are likely to follow uneven trajectories. Especially countries in the scientific periphery, where research environments are less well-developed and where less funding for research is available, will require more time to move to open science. Especially research not funded from flagship schemes, such as the Horizon Europe programme or the European Research Council, will take longer to open up. Thus, aims and benchmarks should be set at a realistic level and take into account that the barriers to implementing open science are higher in some settings than in others.
- Open science policy should aim to be inclusive and avoid framings that could evoke the impression to exclude the social sciences and the arts and humanities. As explained in deliverable D3.3:

> A further crucial issue policymakers should consider is ensuring open science is inclusive. Currently, open science policy and guidance, due to the terminology and concepts it uses, often risks to inadvertently exclude the arts and humanities where, for instance, the practical meaning of concepts such as reproducibility is not immediately obvious. Consequently, sensitivity to disciplinary differences is crucial to accomplish a full and genuine transition to open science.

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(Lindemann, Häberlein and Hövel, 2022, 17)

4.4 Recommendations on the knowledge hub

Knowledge hubs can be understood as local innovation systems that serve as nodes for knowledge production and exchange in existing networks. As gathering places for knowledge and stakeholder communities, a knowledge hub functions to generate knowledge, transfer it to implementation sites and pass it on to third parties (see Evers *et al.,* 2010). Knowledge hubs can thus also be seen as enablers of knowledge transfer, the importance of which was highlighted by several of the consulted stakeholders.

One interviewee (representative of an RFO) highlighted that the knowledge hub could become a crucial platform for building an open science infrastructure, with its potential explicitly identified in its usability for an innovation and technology consultancy agency. On the condition that the knowledge hub will continue to exist after the end of the project, new projects could be encouraged to use the platform, as they can benefit from an already existing and operational knowledge infrastructure.

Another interviewee with ample experience in platform development from the very conception to their long-term curation shared her experiences, and thus provided valuable insights for the development of the ROSIE knowledge hub. In the interview, the importance of sharing best practices, useful guidelines and research results with the scientific community by creating spaces of exchange was stressed, to avoid having to start from scratch. This refers to one of the most important promises of open science, namely that existing knowledge is open to all and thus links to a definition stating that knowledge hubs are places with a knowledge architecture offering a high degree of internal and external networking and knowledge-sharing capabilities. In this sense, the innovative capacity of knowledge hubs depends on the fact that knowledge is needed to use and create more knowledge. (see Evers *et al.,* 2010). But even though the research community can be described as a knowledge intensive environment, it should be kept in mind that knowledge hubs cannot provide answers to all questions.

For the development of a knowledge hub in the ROSiE project, it is important to learn from best practices. In an interview, the learning process in developing a somewhat similar platform in a different area of research was described as very difficult, yet characterised by a high learning curve, mainly through trial and error. The interviewee recommended the involvement of skilled science communicators in the development process to really understand what end users want, for example in terms of user-friendliness, getting answers to questions by just a few clicks and not having to navigate a cumbersome series of links. This seems particularly important as another interviewee (librarian) emphasised that science communication is often neglected when

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it comes to promoting open science. According to the interviewee experienced in platform development, test users who can make statements about user-friendliness are therefore indispensable. Ultimately, the information to be found in the knowledge hub should be organised in such a way that it is easy to find for the end users and useful to them in overcoming challenges in their daily work.

Therefore, an appealing presentation of the project results is recommended to achieve this goal. In this sense, ROSiE could, for instance, structure the knowledge hub around general open science topics and related challenges, as well as guidelines to overcome these challenges, thus creating a knowledge repository with a user-friendly structure that enables an easy and intuitive flow of knowledge. This was echoed in the interview with the librarian who also pointed out that the knowledge hub developed by ROSiE must be easy to use, in the sense that it must have a simple structure and make relevant topics visible at a glance.

Moreover, to address the concrete needs of knowledge hub users, a combination of knowledge hub and helpdesk could be a promising option, considering that knowledge production is always a social process that requires interaction (see Evers *et al.,* 2010). The experienced platform developer explained that they help to facilitate the transfer of knowledge by fostering a collaborative spirit and a high level of internal and external networking and knowledge sharing:

> We meet every three months and find out about the issues that are important and interesting in the national hubs, and then we calibrate together. [...] I learn from the [...] helpdesk, I choose the topics that are interesting for our community.

By contrast, a policymaker was more sceptical regarding the potential use of a helpdesk, not least because it would be difficult to maintain after the end of the project. She expounded that creating a map of the venues, forums, institutions and organisations that offer support would be "super useful" and significantly easier to maintain also in the longer term. Based on her experiences, she strongly advised ROSiE to start thinking about how the knowledge hub should look like and how it can be maintained after the end of the project as early as possible: "You need to start these conversations now".

Another possible solution to maintain interaction with the end-user community and ensure updating suggested by an interviewee would be the appointment of a knowledge hub curator. In her experience, a curator is needed to constantly reassess what the platform needs to look like to be useful for an extended period of time, how it needs to be structured and what content continues to stay relevant for users. Otherwise, it cannot be guaranteed that knowledge flows and knowledge repositories, as a crucial determinant of innovative capacity, create a sustainable knowledge architecture (see Evers *et al.,* 2010).

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4.5 Recommendations on training materials

Many recommendations were already given through direct comments on a draft of the didactic framework. These have already been considered in the work of WP7 and will not be repeated in greater detail here. However, especially the interviews yielded some interesting findings potentially relevant to the development of the ROSiE training materials.

An important point raised by an interviewee (research manager) relates to the fact that the open science discourse often uses a very specific terminology that tends to exclude researchers from certain fields, especially the social sciences and the arts and humanities. As a result, researchers from these fields sometimes do not consider themselves part of the open science discourse because they do not understand its language. In her view, the discourse on open science focuses mainly on the natural sciences and, to a certain extent, on the biomedical and computer sciences. Making this discourse more inclusive would be important because challenges, including ethics and integrity challenges, also exist in other fields of research.

Especially in the social sciences and perhaps also in the humanities, many ethical issues with a connection to open science arise with increasing frequency so that their inadvertent exclusion from at least parts of the discourse is particularly unfortunate, not least because it might result in limited awareness of the contours of problems and potentially available solutions. According to an interviewed research manager, in the past, methodological differences between disciplines were relatively strong and rather clearly demarcated, whereas nowadays the push towards interdisciplinarity tends to lead to an adaptation of methods of field A by researchers from field B, even though they were not trained in that field. This can give rise to research ethical problems when, for example, research with human participants is conducted by researchers without sufficient knowledge about how to obtain informed consent in a legally compliant and ethically appropriate manner. As succinctly pointed out by a research manager:

> Until relatively recently, and I think in many disciplines to this day, researchers have received incredibly little training in research ethics. So it's a problem for us as a [research performing] organisation to put trust in researchers who are not trained properly.

With respect to training, this concern can be related to the aspect of organisational socialisation, which refers to the scope and process by which regulations, norms, values and behaviours are learned that enable individuals to function in and become members of an organisation (Löfström 2012, 350 referring to van Maanen, 1976).

Besides differences in awareness of research ethics and integrity as well as open science questions across disciplines, the interviews with stakeholders suggest that awareness also differs between countries, not least depending on the focality of relevant topics in overall research policy. An interviewee (policymaker who also teaches) pointed out that ethics is a familiar topic

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for most PhD students, whereas open science is not. However, she stressed that in her experience, awareness of what open science is, how it works and why it is important as well as its relationship to research ethics and integrity can successfully be created via training, for example by discussing institutional guidelines or cases of research misconduct or detrimental research practice related to data management. Discussions on what “as open as possible, as closed as necessary” means in practice were particularly engaging, which concurs with recent findings from the Path2Integrity project where learning materials on FAIR data management also proved particularly successful in accomplishing ambitious learning objectives (Hermeking and Prieß-Buchheit, forthcoming). Moreover, classroom discussions on why research integrity is also important for citizens, who rely on the trustworthiness and reliability of research results in their daily life, have proven useful according to the experiences of the aforementioned interviewee. The pedagogical value of such lively exchange is systematically elaborated in existing literature that considers successful ethics training to require opportunities for students to engage with moral issues (Löfström 2012, 359, referring to Clarkeburn 2002). Also, the value of contextualising ethical questions has been discussed in the literature and it has been shown that contextualisation helps to decrease effects of prior research experience on addressing ethical questions (Löfström, 2012, 358). Thus, linking open science issues contextually to research ethics and integrity questions seems potentially promising.

Furthermore, according to the experience of a research manager, the most difficult issue in the move towards responsible open science is not primarily related to conveying knowledge as such, but to facilitate its actual implementation, especially with regard to participatory approaches:

> I think it's much easier for them [the researchers] to understand open access publishing, it's much easier for researchers to understand FAIR data, but then when we get to adopting open innovation, collaboration, participatory approaches – I think that's something that's harder. And I see a great need for training for that.

This assessment is bolstered by a survey on training needs conducted by the research performing organisation the research manager works for, which according to her indicates that researchers are interested in open science, but also see a clear need when it comes to learning how to practice it responsibly.

In the third focus group, a participant stated that according to her experience, the older generation of researchers often is doing business as usual, while the younger generation is already engaged in a cultural change that embraces open science. This impression, however, was not shared by all stakeholders. A research manager mentioned in an interview that at her institution, it tends to be the older researchers who are best trained in open science and most likely to move it forward. As regards education, assuming that the attitude and behaviour of educators convey as much as formal ethics training about what ethical standards and acceptable behaviours are (Löfström 2012, 350, following Kitchener 1992), senior researchers with in-depth

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knowledge and experience in open science practices might be suitable role models to promote a responsible open science culture. This might help to include training in research ethics, research integrity and responsible open science in the curricula at an early stage of education and to start sensitising students to ethical issues.

In the literature, reference is made, for example, to ethical sensitivity as a prerequisite for following an analytical approach to research ethics questions, which is based on skills that can be taught and learned (Löfström 2012, 350). In this context, ethical sensitivity describes the process of interpreting a situation that potentially raises ethical questions in conducting research, thereby providing the prerequisite for the ethical analysis that follows. This can be considered relevant to the extent that it seems reasonable that students are more likely to reflect on ethical issues and develop sensitivity if they can connect to the underlying questions and issues. Responses of stakeholders for preconditions for successful open science trainings overall tended to emphasise the necessity to adapt the training materials to the target group, as the following quote from an interview with a research manager illustrates:

> I think the trainings have to be well targeted. Because, I mean, just as an example, it doesn't make sense to do a training on research data management with a group of people who think that they don't process data in their work.

Consequently, knowing and understanding the needs of training participants usually is a pre-condition for successful educational interventions. As a result, creating a toolbox of materials that includes materials for a variety of different target groups seems particularly valuable. Topics stakeholders recommended to cover include examples of what responsible open science means and how research ethics and integrity and open science are linked. Some materials could, for example, focus in implementing an “as open as possible, as closed as necessary” approach in cases where doing so seems particularly challenging, for example because of the involvement of human participants in the research or the collection and processing of personal data.

When asked about how training materials should be designed and disseminated, many interviewees pointed out that several other projects already have produced materials of high quality, yet at least some suffered from the problem that the materials ended up in repositories, but largely failed to reach a significant number of educators. As a result, they recommended that ROSiE should analyse what has worked and what has not worked in other projects in order to ensure that the training materials reach educators and are put to use rather. Another question presumably meriting further analysis is assessing the extent to which users of the training materials can serve as multipliers and facilitators of institutional embedding.

In the third focus group discussion, a participant (REC member) suggested that perhaps organising open science cafés could be an unusual but innovative method to promote education in and exchange good and responsible open science practices. Guidance and training for

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members of RECs and other ethics review and appraisal bodies also was considered potentially beneficial by discussants.

5 Conclusion and next steps

This deliverable has summarised insights and recommendations from the stakeholder consultation conducted during the EXPLORE and ENGAGE phases of the ROSiE project. Unlike other stakeholder consultations on open science, for example the UNESCO consultation on the same topic, the ROSiE stakeholder consultation focuses specifically on issues related to research ethics and integrity in open science and citizen science and thus is narrower in scope. In the next phases of the project, the forms of stakeholder engagement will be expanded to also include strong co-creation elements, while consultations will continue through ugh the stakeholder forum. In these processes, the recommendations put forward will be assessed in more detail and transformed into various guidance documents, training materials and access points for a large community of stakeholders. Thus, the recommendations in many ways are an interim result that will evolve further over the course of the ROSiE project.

Overall, the stakeholder consultation has shown that open science and research ethics and integrity are largely compatible and often even share similar agendas, although some tensions persist and need to be resolved, especially in the research ethics domain where appropriate safeguards need to be defined to harness the benefits of open science without creating undue risks for research participants and the wider society. ROSiE is well-positioned to help building bridges between the relevant communities and develop proposals to support stakeholders in concretising what responsible open science means in practice and how it can reinforce ethical research conduct marked by high degrees of integrity.

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References

ALLEA (All European Academies) (2017). *The European code of conduct for research integrity, revised edition.* Available at: https://www.allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf (last accessed 10 July, 2022).

Bäckstrand, K. (2003). Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance. *Global Environmental Politics*, *3*(4), 24-41.

Balázs, B., Mooney, P., Nováková, E., Bastin, L., & Arsanjani, J. J. (2021). Data quality in citizen science. *The science of citizen science*, *139*.

Beauchamp, T.L., & Childress, J.F. (2019). *Principles of biomedical ethics,* 8th ed. Oxford University Press.

Brey, P., Dainow, B., Erden, Y.J., Matar, A., Jansen, P., Rodrigues, R., Santiago, N., Resseguier, A., Tambornino, L., Lanzerath, D, & Hövel, P. (2021): *Methods for translating ethical analysis into instruments for the ethical development and deployment of emerging technologies. SIENNA D6.3 (version 2.0).* Available at: https://doi.org/10.5281/zenodo.5541539

Brouwer, S., & Hessels, L. K. (2019). Increasing research impact with citizen science: The influence of recruitment strategies on sample diversity. *Public Understanding of Science*, *28*(5), 606-621.

Bueno, D., Casanovas, J., Garcés, M., Vilalta, J. (2019). *Higher Education in the World 7. Humanities and Higher Education: Synergies between Science, Technology and Humanities.*

Clarkeburn, H. (2002). The aims and practice of ethics education in an undergraduate curriculum: Reasons for choosing a skills approach. *Journal of further and higher education*, *26*(4), 307-315.

Desmond, H., Gastmans, C., Jegan, R.,& Dierickx, K. (2021). *A report containing all the documents ranked per member state, enforceability, level ((intra)national, PU regional, institutional) web links, etc.. EnTIRE D3.4.* Available at: https://cordis.europa.eu/project/id/741782/results (last accesses 10 July, 2022).

ECSA (European Citizen Science Association). (2015). *Ten Principles of Citizen Science*. Berlin. http://doi.org/10.17605/OSF.IO/XPR2N

Elliott, K. C., & Resnik, D. B. (2015). Scientific reproducibility, human error, and public policy. *BioScience*, *65*(1), 5-6.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Eurostat. (2018). R&D Expenditure. Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php?title=R_%26_D_expenditure#Further_Eurostat_information (last accessed 30 June, 2022)

Evers, H. D., Gerke, S., & Menkhoff, T. (2010). Knowledge clusters and knowledge hubs: designing epistemic landscapes for development. *Journal of knowledge management*, 14(5), 678–689.

Göbel, C., Agnello, G., Baïz, I., Berditchevskaia, A., Evers, L., García, D., Pritchard, H., Luna, S., Ramanauskaite, E. M., Serrano, F., Boheemen, P. v., Völker, T., Wyszomirski, P., Vohland, K. (2017). European Stakeholder Round Table on Citizen and DIY Science and Responsible Research and Innovation. Doing-it-Together Science Report. URI: http://discovery.ucl.ac.uk/id/eprint/1563626 (last accessed 30 June, 2022)

Golumbic, Y. N., Orr, D., Baram-Tsabari, A., & Fishbain, B. (2017). Between vision and reality: A study of scientists' views on citizen science. *Citizen Science: Theory and Practice*, *2*(1)

Häberlein, L., Mönig, J.M., & Hövel, P. (2021). *Mapping stakeholders and scoping involvement: a guide for HEFRCs. ETHNA System D3.1.*Available at https://ethnasystem.eu/wp-content/uploads/2021/10/ETHNA_2021_d3.1-stakeholdermapping_2110011.pdf (last accessed 10, July, 2022).

Haklay, M. (2015). Citizen science and policy: a European perspective. *Washington, DC: Woodrow Wilson International Center for Scholars*, *4*

Haklay, M., Motion, A., Balázs, B., Kieslinger, B., Greshake Tzovaras, B., Nold, C., Dörler, D., Fraisl, D., Riemenschneider, D., Heigl, F., Brounéus, F., Hager, G., Heuer, K., Wagenknecht, K., Vohland, K., Shanley, L., Deveaux, L., Ceccaroni, L., Weißpflug, M., Gold, M., Mazzonetto, M., Maciuliene, M., Woods, S., Luna, S., Hecker, S., Schaefer, T., Woods, T. and Wehn, U. (2020). *ECSA's characteristics of citizen science.* Berlin, Germany: European Citizen Science Association. https://doi.org/10.5281/zenodo.3758667

Hermeking, N., & Priess-Buchheit, J. (forthcoming). Training to be FAIR: Strategies for sustainable data management.

Knack, A., Smith, E., Parks, S., Manville, C. (2017). *Open science: The citizen's role in and contribution to research*. RAND.

Laine, H. (2017). Afraid of scooping: Case study on researcher strategies against fear of scooping in the context of open science. Data Science Journal.

Lamy Committee. (2017). *LAB – FAB – APP – Investing in the European Future We Want.* Brussels: European Commission.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Lave, R. (2012). Neoliberalism and the production of environmental knowledge. *Environment and Society*, *3*(1), 19-38.

Lekstutiene, J., Mönig, J.M., Lindemann, T., Bruegger, B.P., de Hert, P., Malgieri, G., Chomczyk Penedo, A., Ortalda, A., Rigotti, C., Čas, J., Peissl, W., Schaber, F., Tronnier, F., Lieberknecht, A., Woods, T., & Soacha, K. (2021). *Report on the governance of data protection ELI in ICT research and innovation. PANELFIT D5.3.* Unpublished. Will be available at: https://cordis.europa.eu/project/id/788039/results (last accessed 10 July, 2022).

Lindemann, T., Häberlein, L., & Hövel, P. (2022). *Report on interviews. ROSiE D3.3.* Unpublished. Will be available at: https://cordis.europa.eu/project/id/101006430/results (last accessed 10 July, 2022)

Löfström, E. (2012). Students' ethical awareness and conceptions of research ethics. *Ethics & Behavior*, *22*(5), 349-361.

London, A.J. (2022). *For the common good: philosophical foundations of research ethics.* Oxford University Press. Available at: https://doi.org/10.1093/oso/9780197534830.001.0001

Mangini, V., Tal, I., & Moldovan, A. N. (2020, August). An empirical study on the impact of GDPR and right to be forgotten-organisations and users perspective. In *Proceedings of the 15th international conference on availability, reliability and security*, 1-9.

Mejlgaard, N., Bloch, C., Madsen, E. B., Griessler, E., Wuketich, M., Meijer, I., ... & Stilgoe, J. (2018). Monitoring the evolution and benefits of responsible research and innovation in Europe: Summarising insights from the MoRRI project.

Merton, R. K. (1973). *The sociology of science: Theoretical and empirical investigations*. University of Chicago Press.

Molla, F. S., Line, B., & Harald, T. H. (2018). Practicing responsible research and innovation in a crowdsourcing project in Norway. *The ORBIT Journal*, *2*(1), 1-28.

Nature (2022). Nature addresses helicopter research and ethics dumping, editorial. *Nature,* 606, 2 June 2022. Availabke at: https://media.nature.com/original/magazine-assets/d41586-022-01423-6/d41586-022-01423-6.pdf (last accessed 10 July, 2022).

Owen, R., von Schomberg, R., & Macnaghten, P. (2021). An unfinished journey? Reflections on a decade of responsible research and innovation. *Journal of Responsible Innovation*, *8*(2), 217-233.

Penders, B., Shaw, D., Lutz, P., Townend, D., Akrong, L., & Zvonareva, O. (2018). *ENERI Manual Research Integrity and Ethics.* Available at: https://eneri.eu/reri-manual/ (last accessed 10 July, 2022).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Rask, M., Matschoss, K., Kaarakainen, M. (2017). *Final Progress Report. PE2020 D6.1.* Available at: https://cordis.europa.eu/docs/results/611/611826/final1-d6-1-final-progress-report-final.pdf (last accessed 30 June, 2022)

Rasmussen, L. M. (2019). Confronting research misconduct in citizen science. *Citizen Science: Theory and Practice*, *4*(1).

Ravn, T., Mejlgaard, N. (2015). *Public Engagement Innovations – Catalogue of PE initiatives. PE2020 D1.2.* Available at: https://tuhat.helsinki.fi/ws/portalfiles/portal/156529598/Public_Engagement_Innovations_H2020.pdf (last accessed 30 June, 2022)

Resnik, D. B., Elliott, K. C., & Miller, A. K. (2015). A framework for addressing ethical issues in citizen science. *Environmental Science & Policy*, *54*, 475-481.

Riesch, H., & Potter, C. (2014). Citizen science as seen by scientists: Methodological, epistemological and ethical dimensions. *Public understanding of science*, *23*(1), 107-120.

Ruphy, S. (2019). Public participation in the setting of research and innovation agenda: Virtues and challenges from a philosophical perspective. In *Innovation beyond technology* (pp. 243-263). Springer, Singapore.

Schütz, F., Heidingsfelder, M. L., & Schraudner, M. (2019). Co-shaping the future in quadruple helix innovation systems: uncovering public preferences toward participatory research and innovation. *She Ji: The Journal of Design, Economics, and Innovation*, *5*(2), 128-146.

Shamoo, A., Resnik, D. (2015). *Responsible conduct of research,* 3rd ed. Oxford University Press.

Soranno, P. A., Cheruvelil, K. S., Elliott, K. C., & Montgomery, G. M. (2015). It's good to share: Why environmental scientists' ethics are out of date. *BioScience*, *65*(1), 69-73.

UNESCO (2020). *Towards a global consensus on open science: report on UNESCO's global online consultation on open science.* Available at: https://unesdoc.unesco.org/ark:/48223/pf0000375217?posInSet=5&queryId=28473ea4-beb9-4029-9e75-fb5421b8f4a2 (last accessed 10 July, 2022).

Vohland, K., Weißpflug, M., & Pettibone, L. (2019). Citizen science and the neoliberal transformation of science–An ambivalent relationship. *Citizen Science: Theory and Practice*, *4*(1).

Warin, C., & Delaney, N. (2020). Citizen science and citizen engagement. Achievements in Horizon 2020 and recommendations on the way forward. *Directorate-General for Research and Innovation Science with and for society*.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under GA No 101006430

Wehn, U., & Almomani, A. (2019). Incentives and barriers for participation in community-based environmental monitoring and information systems: A critical analysis and integration of the literature. *Environmental Science & Policy*, *101*, 341-357.

Ziman, John (2000). *Real Science: What it is, and what it means.* Cambridge University Press.

Appendix

Interview guide

Section 1: Background information and building rapport

- **Can you please tell me about the institution (or company, if interviewee is working in industry or journalism) you're working for? What are the main objectives and activities of the institution/company?**

Probes:

- When was the institution (or company) founded?
- Have the objectives of the organization shifted over time?

- **What is your current position and what are your main tasks?**

Probes:

- Is that position primarily academic or more related to (research) management?
- What is your (academic) background?

Interviewer notes

Section 2: Open science – conceptions and tasks

- **What does open science mean to you?**

Probes:

- Do you view open science rather as a promise or rather as a problem?

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- Who do you think will benefit most from open science? *(if open science is viewed as a promise)*
- Who do you think faces the biggest challenges? *(if open science is viewed as a problem)*

- **What, if any, role does open science play for your institution?**

Probes:

- Does your institution promote open science and, if yes, how?
- Does your organization promote open science also with technological solutions / normative instruments, like policies and guidelines?

- **Are any of your tasks related to open science and, if yes, what are these tasks?**

Probes:

- Which open science issues are most relevant in your work?
- How often do you work on these tasks, and for how long?
- If answer to initial questions is “no”: Did you have any contact with open science so far? If yes, what kind of contact?
- Do you have colleagues who work on open science-related tasks? If yes, do you know what they’re working on?

- **In your view, has open science improved the work of your institution or has it rather created problems and challenges? / In your view, could open science help improve the performance of institution or do you think it would rather create new challenges?**

Probes:

- Which aspects of open science have helped/will help the most?
- Which aspects of open science have created/will most likely create problems and challenges?
- If issues discussed are technical or legal only, ask about ethical challenges
- Does open science facilitate engaging stakeholders in research? Is stakeholder engagement beneficial to research (outcomes)?

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Interviewer notes

<u>Section 3: Open science, ethics and integrity</u>

- **Are any of your tasks related to research ethics or research integrity and, if yes, what are these tasks?** *(only ask this question if it was not already de facto answered before)*

Probes:

  - Can you describe these tasks in more detail?
  - Does open science play any role in these tasks? Is open science discussed in your ethics committee/research integrity office/etc.?

- **How would you describe the relationship between open science and responsible conduct of research?**

Probes:

  - Overall, do you think research ethics, research integrity and open science are mutually supportive or do you see more pitfalls than promises?
  - Can you anticipate new challenges for research ethics and research integrity that are either created or reinforced in an open science context?
  - How would you address these challenges?
  - How could the promises be realized?
  - Do you see ways how open science could support the work of RECs and RIOs?

Interviewer notes

<u>Section 4: Towards responsible open science</u>

- **What are the main ethical challenges of open science?**

Probes:

  - Are these challenges primarily technical or normative? Or both?

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- Are challenges also related to policy, education etc.?

- **What strategies are you aware of that could mitigate these challenges?**

Probes:

- Do you think trainings in open science should explicitly cover ethical issues? If yes, which? If not, why?
- What added value could training in responsible open science have? Are there any preconditions that need to be in place for training to be successful?

- **What tools could facilitate the move towards open science for you and your institution?**

Probes:

- Could you also benefit from technological /normative tools (e.g. open science ethics guidelines)? If yes, which and how? If no, why not? Do you know if any of these tools already exist?
- If core tools ROSiE will produce are not mentioned: Could you imagine XY being useful for you and your institution?
- How should these tools ideally be made accessible? How could a knowledge sharing platform ideally look like?

- **Are there any examples of good open science practices you would like to share with us?**

Probes:

- Can you explain what it is that makes this practice good? Why has it been so successful?

Interviewer notes

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