M-ERA.NET guidelines for Responsible Research and Innovation (RRI) in the context of materials science

Version 1.0

as of 15-02-2022

Contents

These guidelines (i) introduce the idea of Responsible Research & Innovation (RRI), (ii) explain how M-ERA.NET supports RRI, (iii) offer practical advice for operationalising RRI in projects and (iv) provide sources of further information for applicants.

M-ERA.NET hopes this document will also help you to prepare proposals to other materials science programmes that include RRI-related aspects, for instance Horizon Europe.

This is a 'live document' developed by M-ERA.NET's RRI Lead (RCN) and RRI advisors (Ellen-Marie Forsberg, NORSUS and Robert Smith, University of Edinburgh) in conversation with materials scientists and all R&I funding organisations from the M-ERA.NET community.

M-ERA.NET 3 has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958174.

1. What is RRI and why do we need it?

In the broadest terms, governments fund research to deliver benefits for society. However, these benefits are often slow to accrue, occur unexpectedly and will be distributed unevenly. It is often hard to correct the downsides of innovations once they have become embedded in society. Science and innovation are built gradually through a series of decisions made by funders, scientists and policy makers. Social scientific research has drawn attention to how values are embedded in these decisions – in seemingly mundane and foundational work such as the choice of reagents or analytical equipment, the use of lab animals, through to questions about what research funders choose to prioritise or how a new technology should be regulated.

Acknowledging that science is not separate from society but part of it confers a social responsibility on science. It is important, therefore, that funders, researchers and other key groups involved in the development of science, technology and innovation think about: (i) the potential directions of research being taken; (ii) who might benefit and who might not from new inventions; and (iii) how consideration of the potential social, ethical and environmental issues can be considered *throughout* the science and innovation process. Responsible research and innovation (RRI) is not about adjudicating what is 'good' or 'bad', 'positive' or 'negative', or 'responsible' or 'irresponsible'. Instead, RRI offers techniques, tools and frameworks to think about questions of social responsibility and ensure scientists, funders and technologies don't lose sight of the social context in science, technology and innovation.

2. M-ERA.NET's approach to RRI

M-ERA.NET's approach to RRI builds on previous frameworks published by the UK's EPSRC, the Research Council of Norway, the European Commission and funding programmes such as ERA CoBioTech and ERA EuroNanoMed III. It highlights the need to address the social, ethical, political, environmental or cultural dimensions of the proposed research and offers four dimensions that researchers, funders and technologists should engage with to maintain focus on the social context of their work:

- ***Anticipation*** suggests that actors should map the plausible intended and unintended effects of their work. Anticipation is not about exhaustively predicting all outcomes but about building a sense of preparedness so that potential downsides can be addressed as they are foreseen and arise.
- ***Inclusion*** encourages researchers, funders and developers to engage with future users, interest groups or potentially concerned groups to gain insights about the application contexts and what desirable trajectories would be. Engagement here should move beyond dissemination or outreach to pursue a two-way engage of information. It should be pursued with the understanding that knowledge might not be 'scientific' in the traditional sense but could still be valuable.
- ***Reflexivity*** asks researchers, funders and developers to create specific opportunities to consider the underlying assumptions and values driving their funding programmes and projects.

- ***Responsiveness*** reminds us that science and innovation are processes of exploration and learning. It urges scientists, funders and developers to change course if any of the above dimensions (anticipation, inclusion or reflexivity) generate new knowledge, identify public concerns, or reveal potential harms.

As the involvement of societal groups is essential in RRI it is often connected to co-creation, co-design and co-production – methodologies in which R&I projects are structured to include stakeholders from the beginning (e.g. users or interest groups) – and is related to the general Open Science agenda, prominent in Horizon Europe.

M-ERA.NET emphasises that RRI is not a one-size-fits-all approach, but must be adapted to the actual social and ethical issues raised by the R&I activities funded in the programme. Foundational, exploratory research will require a different approach to applied, high-TRL research. Disruptive, pathbreaking research, may require a more substantive approach to RRI than tentative, incremental research. And the specific issues raised by the biological sciences differ to those raised by the physical sciences. This means that *the commitment* to RRI is clear and fixed in the programme, but there is an openness about the issues addressed and the specific ways to practice responsibility – these must be adapted to each project.

Finally, there are other fundamental value commitments in M-ERA.NET, most prominently related to sustainability and the UN Sustainable Development Goals. RRI complements this commitment to sustainability by emphasising *how* research and innovation should be carried out in order to ensure that we achieve the sustainability goals in an open and inclusive way.

3. How can you include RRI in your proposal?

Recalling the above explanation, the diversity of material science and the range of local contexts engaged within M-ERA.NET means that there cannot be a one size fits all approach. The text below therefore provides overall ideas and advice but cannot give a recipe that all potential applicants may use. In general, your approach to RRI should be proportionate to your proposal – disruptive, ground-breaking or high-TRL work is likely to require a more substantive engagement with RRI. If the research is exploratory then RRI components can also be exploratory – teasing out the potential visions, goals and end uses of a project.

While RRI may focus on broadly recognised issues, the approach taken should be specific to the project. Nevertheless, these three points provide general principles from which to develop your approach to RRI:

1. M-ERA.NET's philosophy is to have **RRI as an integrated part of the project** involving all project participants.
2. Developing a **shared understanding of the project's RRI aspects** as early as possible is important. With 'RRI aspects' we mean implications or characteristics of your research that touch up societal and ethical values. This implies having conversations about their importance and potential actions to address RRI aspects. Such understanding will evolve in a learning process that should be encouraged throughout the project.

3. Considering RRI related issues and acting upon them, must be done as a cross-cutting part of the project or a separate work package. RRI in the project needs to be **coordinated**.

The following list provides examples of different RRI perspectives applicable for materials science research projects. Please be aware that these guidelines and reflections neither represent the only RRI approach nor a complete list of examples of measures when implementing RRI in materials proposals. You should identify the points relevant for your project.

1. Address **environmental impacts and sustainable solutions**, in line with the **Do No Significant Harm principle**[1]**,** by including, for example:
    a. lifecycle analysis (LCA)
    b. ecotoxicology studies
    c. recyclable by design methodologies
2. Involve **relevant stakeholders in the project at the earliest stage as possible**, and provide opportunities for them to contribute to your work.
    a. Co-design methodologies are important to generate trust and **allow stakeholders to contribute knowledge** of the social, environmental or commercial problem you are trying to address in your project.
    b. Think also about the appropriate **timing** of different stakeholders' inclusion: certain kinds of knowledge may be more useful than others at different points of your project.
    c. It will likely be valuable (but not obligatory) to include **expertise beyond the natural and physical sciences** – such as lawyers, social scientists or philosophers – to provide anticipatory and reflective methodologies or to address key challenges.
    d. Think about **how** the involvement of such researchers and their knowledge can be formalised within your project. Are they best placed as scientific collaborators, as members of an advisory board, or as consultants to deliver only specific tasks? Please check if your approach is in line with the national/regional funding rules before designing your proposal.
3. **Create good deliberative spaces** for a range of partners, stakeholders and participants to anticipate, discuss and reflect on the social, political, ethical or environmental context of your research. RRI experts may be able to help you with

Web resources for including RRI in your project:

www.rri-tools.eu provide numerous resources for practical RRI.

https://thinkingtool.eu/ The Societal Readiness Thinking Tool guides you through the steps of including RRI in a project.

The Digital Life Centre has also compiled a range of resources that may help develop your approach.

Further examples specific to material science will in the future be provided on the RRI webpage of M-ERA.NET.

[1] For more information on this principle see Horizon Europe's Programme Guide, page 37: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/programme-guide_horizon_en.pdf

this in project design and implementation. A number of different approaches are possible, e.g.:

   a. Focusing on your day-to-day research work ("philosopher in the lab approach")
   b. At bi-annual/annual consortium meetings
   c. By using stage-gate approaches where explicit decisions about technological choices are taken.

4. Consider **who will benefit** and who may experience new risks from your project.
   a. Does your project address a specific societal or environmental problem or need?
   b. Does your framing of the problem fit with other people's understanding of it? Can you gain access to these alternative framings?
   c. In addition to societal benefits, also consider benefits to the research community through the generation of knowledge, access to infrastructure, the creation of networks and funding.
   d. Reflect on the most the appropriate form of intellectual property (IP) to suit your project goals. Do classical IP strategies deliver the broadest benefit? Can new strategies (e.g. Open Material Transfer Agreements) be adopted at certain points of the research process?
   e. Could commercial or non-commercial organisations benefit from your research? How?
   f. Consider also the risks and ways that these can be ameliorated. For instance, what are the risks of potential risks of data being released? How can you take care to ensure these data are interpreted appropriately?
5. Reflect on/consider adapting **your choice of research methods** regarding, for example:
   a. ethical issues,
   b. in vivo/in vitro experiments,
   c. use of new approaches such as "Safe(r) by Design".
   d. Are there ways that your project can advance common practices on these issues?
6. Engage with important aspects of **your research environment** such as:
   a. gender, ethnicity and intersectional equality, diversity and inclusivity
   b. Open Science and other publication practices
   c. career progression and precarity
   d. equity between partners in your research consortium
7. Show how the project (and product) satisfy requirements for **production safety** and efficiency.

4. How does M-ERA.NET support and evaluate RRI?

RRI requires a multi-level approach that pays attention to the different sites of research and innovation (e.g. universities, companies, policy arenas), different stages of research (i.e. across the TRL spectrum) and different research cultures. Responsibility must be shared, and RRI is therefore a cross-cutting issue for M-ERA.NET. It is considered in development of the annual work programme and the resulting funding calls. The programme will also facilitate a dialogue among stakeholders in materials research about the sustainable development goals, circular economy perspectives, and RRI.

At the level of research projects, ***M-ERA.NET requires that all proposers explain how their projects demonstrate a commitment to investigating and addressing the social, ethical, political, environmental or cultural dimensions of the proposed research***. Integration of RRI should lead to an improved awareness of the possible benefits, risks, and uncertainties of material science across a broad cross-section of society. This may include (but is not limited to) any of the approaches described in the next section.

RRI should not be thought of as 'distinct from the science', but central to it. ***RRI components will therefore be evaluated by experts as integral components within the scope of all evaluation criteria (Excellence, Impact, and Implementation)***. RRI does not detract from the overall scoring but contributes to it: Proposals that explicitly aim to advance processes of anticipation, reflection, inclusion and responsiveness by developing new analyses or methodologies will be rewarded in the review process and the scores will be adjusted accordingly. The kinds of questions the reviewers will ask regarding RRI are:

- Is the RRI approach proportionate to the content of the scientific proposal?
- Is there appropriate RRI expertise in the project?
- Is RRI work adequately resourced? Is it clear *how* the objectives will be achieved?
- Does RRI extend across the lifespan of the project? (e.g. as a sub-project, an advisory board or to be considered in annual meetings)
- Is it clear how the work is organised? (e.g. as a WP, a cross-cutting issue, outsourced etc.)
- Is it clear who is doing the work?
- Are there clear opportunities for the RRI work to shape scientific trajectories?
- Does the work advance RRI scholarship or generate new knowledge of the social, political, ethical or environmental dimensions of material science?