Chapter 2
Responsible Research and Innovation (RRI) and Research Ethics

Giovanna Declich, Maresa Berliri, and Alfonso Alfonsi

Abstract The case study presented in this chapter concerns the policy adopted by the European Commission for better management of the relationship between science and society, with a focus on the ethics of scientific research. This policy, since 2011, has been based on the notion of responsible research and innovation (RRI). We discuss the RRI strategy as an attempt to include ethics within a broader policy framework to respond to the challenges emerging in the European research and innovation landscape. To do so, we examine the origins of the RRI idea, its incorporation into Commission policy, as well as its effectiveness and its impacts. We further discuss whether it has served its purpose in light of the fact that the terminology associated with RRI has been progressively downplayed in more recent years. Positive impacts exist, but also difficulties as RRI aims to take root and enhance and strengthen its ethical aspects. In conclusion, some lessons learned from this ten-year policy effort are presented, exploring the potentialities and limits of such an approach for the renewal of research ethics, and discussing what can be the theoretical and practical legacy of RRI for contemporary scientific and technological innovation policies.

Keywords Responsible Research and Innovation (RRI) · Research ethics · Anticipation · Reflexivity · Inclusion · Responsiveness · Evidence-based policymaking

2.1 Introduction: RRI as a Policy Response to the Ethical Challenge of the Changing Relationship Between Science and Society

The case study examined in this chapter explores responsible research and innovation (RRI) as a European Union (EU) policy that has strong ethical motivations and implications. We consider the whole arc of the RRI approach in EU policies about

G. Declich · M. Berliri (✉) · A. Alfonsi
Knowledge and Innovation, Rome, Italy
e-mail: berliri@knowledge-innovation.org

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science intended here as a case of a peculiar organised and policy-oriented reaction of the EU to the changes in scientific production and to the uncertainty this change generates in the research systems itself and in society as a whole. In a nutshell, RRI can be seen as an ambitious challenge for the formulation of research and innovation policies driven by the needs of society and engaging all societal actors via inclusive participatory approaches.

Our chapter examines the attempt made through the RRI strategy to include ethics within a broader policy framework, with the aim of responding in policy terms to the problem of the inadequacy of traditional research ethics in dealing with the challenges emerging at various levels in the European research and innovation landscape. A rapid analysis of the idea and practice of RRI is conducted to understand how best (and first of all whether) the concerns about research ethics and integrity can be incorporated into decision-making. To do so, the origins of the RRI idea, its incorporation into Commission policy, the effectiveness of the idea and its impacts are examined, and whether it has actually served its purpose is discussed, not least in light of the fact that the conceptualisation associated with RRI has been progressively downplayed in more recent years. There have been positive impacts, but also difficulties for RRI to take root and to enhance and strengthen its ethical aspects.

In the last part of the text, the lessons learnt from this ten-year policy effort are discussed, exploring the potentialities and limits of such an approach for an effective renewal of research ethics, both in theoretical terms and in terms of practices and tools, in the framework of a more general reflection on the theoretical and practical legacy of RRI for contemporary scientific and technological innovation policies.

We wish to disclose at the outset that the authors of this chapter have been and still are involved in EU-funded projects concerning RRI, both where RRI is the subject of study and where RRI is an approach proactively promoted in scientific institutions. In writing the chapter, we have tried to make use of the "insider" perspective gained through our experience, while at the same time distancing ourselves enough to provide a frank and realistic assessment of its strong points and drawbacks, and of its overall effectiveness.

2.2 The Context: The Transformations of Science and Society at the Turn of the Twentieth and Twenty-First Centuries

In order to understand the drivers that brought about RRI, it is necessary to situate them within the broader context of the transition phase that science and innovation are going through, which, in turn, is part of a broader shift from modern to post-modern society, which also affects and to some extent weakens the main social institutions of modernity.

The changes occurring in science and technology offer many new opportunities but are also exposing research organisations and researchers to tangible risks, such as

diminishing authority, increasing uncertainty about procedures and standards, and/or a declining and more difficult access to resources.

Moreover, such changes have transformed the way in which research is conducted and disseminated. Research is now more open and its results more easily accessible to citizens, but at the same time, it is receiving increased public scrutiny, while public distrust and disaffection towards science appear to be on the rise (House of Lords Select Committee on Science and Technology 2000; Eurobarometer 2010 and 2013), often correlated to an equal lack of trust towards the government (Wellcome Global Monitor 2018).

The formulation and saliency of the notion of responsible research and innovation should be seen against such a background, which involves a profound restructuring of the relationship of science with the rest of society.

The term "responsible innovation" could be considered as having been introduced in Europe in its current usage in 2009 after being proposed by the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO), the Dutch Research Council, during a series of events and projects (Stahl 2013). However, there are several antecedents that show how such a notion had already been in circulation in the European discourse on science and innovation. For instance, the European Research Advisory Board had already published in 2005 a document in preparation for the EU FP7 on Science and Society, in which the idea of a "responsive and responsible European Science" was proposed (European Commission 2006).

Going back to the late 1980s and early 1990s, we can single out as antecedents of the issues addressed by RRI the insertion of ethical, legal, and social aspects (ELSA, in Europe) or implications (ELSI, in the USA) in the research agenda (Chadwick and Hub 2013), especially in relation to such cutting-edge research as genomics and nanotechnologies, with the launch of research programs aimed at anticipating and addressing the effects generated by the development of such research and technology fields.

A further antecedent of RRI can be found in the widespread debate on the so-called "Public Engagement with Science and Technology" (PEST) approach, based on a public dialogue with scientists about the aims, methods, and results of science (Wynne and Felt 2007; Gumeirães Pereira et al. 2013). Other precursors can be considered the reflection on technology assessment (TA) (Grundwald 2011) and, in the USA, on the responsible development (Stahl 2013) and the responsible conduct of research (RCR), the latter mainly focused on research integrity issues (Kalichman 2013).

The growing concern for gender and gender equality in science, in particular those initiatives and policies oriented at activating institutional change to promote gender equality in research institutions, such as the establishment in the USA of the ADVANCE Programme of the National Science Foundation[1], can be also considered

[1] Established in 2001, the NSF ADVANCE program can be considered the first national funding scheme aimed at activating institutional change processes in research organisations to favour gender equality in science and innovation.

as antecedents of the RRI strategy. To this can be added the funding schemes for structural change in the European Commission Framework Programmes[2].

Finally, even the approaches advocating open access to scientific production and promoting science education for the citizenry can be viewed among the strands of concern that converged in the conception and promotion of RRI.

RRI then appears as an approach aimed to modify the consolidated social model of producing and reproducing science—often expressed with the image of the "Ivory Tower"—towards a model for science that is fully embedded in society and strongly connected and sensitive to societal expectations, needs, worries and problems.

In this frame, responsibility is intended not only as a desired outcome of a process but also as a guiding principle that should inform all the domains of science as a social institution, its actors and its structures.

2.3 An Attempt to Enhance the Ethical Dimension of RTD: Theory and Practice of RRI

On the basis of the brief narrative of the previous paragraph, we can suggest, as also argued by Stahl (2013, 709), that Responsible Research and Innovation appears to originate and develop as an attempt to cope with the so-called grand challenges which include "questions of employment, economic wellbeing and growth, issues of social coherence, and the resilience of democratic societies, demographic developments, social innovations and other topics," thus taking on the responsibility towards the society that many see as a weakness of science and scientists. An idea of "responsibility" which, as noted by d'Andrea et al. (2017) is currently being applied to many life domains, thus generating concepts like "responsible politics", "responsible eating", "responsible consumerism", "responsible religion" or "responsible lifestyle". In this sense, RRI appears grounded in substantive social processes and "resonates with the ongoing concerns related to the role of science, particularly in society" (Rip 2016, 3).

As we have seen, RRI refers to a series of meanings that have evolved over time. It has to be noted, in this regard, that such notions are by no means exactly defined nor its contents and dimensions always consistently delimited. As a matter of fact, several definitions, which are sometimes very dissimilar from the other, have been formulated by scholars and policymakers, alternatively meaning, as highlighted by Job Timmermans and Bernd Stahl (2013): something which is external to the research and innovation process, as a governance principle (von Schomberg 2012; Owen et al. 2013); a requirement to be embodied in the research and innovation process (Geoghegan-Quinn 2012); a part of the research and innovation process or even a

[2] The Seventh Framework Programme and the subsequent Horizon 2020, through the SiS and the SWAFS work programmes, have included funding for gender equality action plans individual research institutions and universities.

different way to make research and innovation (Stahl 2013; the Expert Group on the State of Art in Europe on RRI 2013).

One of the definitions[3] that has gained much currency is the one provided by von Schomberg in 2011: "The process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products" (von Schomberg 2011, 6). Notwithstanding this conceptual indetermination, or even thanks to its "interpretive flexibility", RRI has addressed widely felt needs in the science community and has been playing an important role in framing part of European research policies. Thus, RRI has served as an "umbrella concept" which includes and tries to coordinate different sets of drivers, by defining some general ordering principles meant to better align the research and innovation process with the needs and expectations of the whole of society.

In the case of the European Union policies, RRI started to inform the discourse on research and innovation with a series of high profile meetings, such as the Brussels workshop on "responsible research and innovation" convened in May 2011 by the Directorate-General (DG) for Research of the European Commission (EC). In the following years, the notion increasingly permeated EC science policies, and towards the end of the VII Framework Programme for Science and Technology, the Science and Society program adopted the RRI notion. Thereafter, the first calls making explicit reference to RRI started to be launched. This process culminated with the eighth Framework Programme, Horizon Europe, where RRI was included as a cross-cutting issue, and as an overarching frame for the Science with and for Society program (SwafS)[4]. In Horizon 2020, the SwafS program based, among other themes, on RRI had a budget of €462 million; received more than 2,000 proposals in its various calls; and funded around 200 projects, with around 50 in the SwafS last call (Delaney et al. 2020).

While the RRI approach was somehow being institutionalised at the European level, there was a drive to "solidify" into some actionable indications what had been so far a rather broad and open process. As Owen and his co-authors (2021) point out, this occurred mainly by the introduction of the so-called "keys": gender equality in science, open access to research data and publications, research ethics and integrity, citizen engagement, and science education, integrated in the beginning with governance as a sixth key (European Commission 2014). Those keys were included in the "Rome Declaration on RRI" (November 2014) and later on identified as the founding pillars of the RRI approach. According to Owen et al., the keys were introduced because they reflected as many action lines existing in the Science in Society program prior to the notion of RRI and were expected to support the mainstreaming of RRI in the Horizon 2020 Program. In this way, however, the dynamic process of

[3] An outline of the different definitions of RRI can be found in d'Andrea et al. (2017) "Report on the literature Review. FIT4RRI Deliverable D.1.1", pp. 50–51.

[4] An interesting account of and reflection on these passages can be found in the paper "An unfinished journey? Reflections on a decade of responsible research and innovation, written by three leading figures in the RRI story: Richard Owen, René Von Schomberg and Phil Macnaghten.

RRI runs the risk of becoming synonymous with the keys and being subject to a sort of "reification" (Owen et al. 2021).

In this light, some authors prefer to focus on what they consider four dimensions rather than on the RRI keys.[5] These dimensions can be seen to present in a more flexible and dynamic way the exercise of responsibility towards research and innovation (Burget et al. 2017).

- Inclusion mainly refers to the engagement of different stakeholders from the early stages of research and innovation to give voice to all the concerned interests, values, needs, and beliefs.
- Anticipation refers to the capacity of envisioning the outcomes of the processes of research and innovation and understanding how current dynamics help design the future in order to prevent risks and to lead research to desirable impacts.
- Responsiveness concerns the capacity to develop proactive management of new technologies so as to identify risks and develop an ethically adequate response. According to Burget et al. (2017), responsiveness also relates to transparency (responses should be open to public debate) and accessibility (scientific results about risks and responses should be openly accessible to everyone).
- Reflexivity is mainly seen as the capacity of the research system to keep control of its own activities and assumptions, to be aware of the limits of the knowledge produced as well as to reflect on values and beliefs connected with research and innovation. Reflexivity is linked to public dialogue and collaborative approaches in science.

With the arrival of the new Framework Programme, Horizon Europe, RRI remains an operational objective of the Strategic Programme, but its visibility and also its strategic placement are reduced if compared with its role in Horizon 2020. The new program has the notions of Open Science and mission-driven innovation as its strategic drive.

This tendency to attenuate the impact of RRI is further corroborated by the answers of a panel of experts and stakeholders interviewed during a round of consultation in Summer-Fall 2020 in the framework of the Project PRO-RES[6]. Notwithstanding the fact that all the interviewees were active, in various forms, in the European research area, almost one third of them were not aware of RRI contents and objectives or showed only a very superficial knowledge thereof. Other interviewees argued that such a notion was too wide and subject to different interpretations, so generating confusion and less impact than expected for ethical aspects. Those who thought that referring to RRI could be useful for reinforcing the ethical dimensions of science tended to do so in an instrumental perspective, such as leveraging the "brand RRI" for reaching a larger audience or addressing the younger generations of scientists

[5] Also the dimensions of RRI can be defined in different manners. See among other Owen et al. (2012); Stilgoe et al. (2013); Lubberink et al. (2017).

[6] In the framework of PRO-RES project - PROmoting Ethics and Integrity in all Non-Medical RESearchtwo rounds of consultation were carried out, by thematic workshops, online interviews to 63 European experts and stakeholders. For more information, see Declich and Alfonsi (2020).

that (in the view of some interviewees) are likely to be increasingly challenged to go beyond the confines of academia and engage with society at large (Declich and Alfonsi 2020).

It must be noted, however, that despite their degree of scepticism about the usefulness of explicitly connecting research ethics with RRI, the research actors consulted showed awareness of the increasing demand on scientists and research institutions to be concerned with the social and political implications of their research.

So there can be a more substantive case for the contribution of RRI to the renewal of ethical discourse on science, based on the understanding that ethical issues are now strongly connected with the governance of science in the context of profound transformation. This entails managing continuous tensions between different levels of problems for institutions and individual scientists.

More importantly, as we will see in more detail in the next section, research ethics is challenged by the current evolution of science, which more and more requires a closer interaction between researchers and stakeholders, also reiterated by the EC presentation of the Horizon 2020 results (Monachello et al. 2020).

All in all, although RRI is not widely recognised and its use as an overarching label including research ethics is at least controversial, there seems to be a growing perception among research actors that the social status and role of science are changing, and radical transformations are affecting how science works and is organised, with important consequences for research ethics. This leads them to at least recognize that the issues and instances RRI is grounded on are real and, to some extent, shareable.

2.4 Analysis: A Policy Response to the Transformational Changes in Science and Society Relationships

In this section, based on the main elements presented in the previous paragraphs, some considerations will be proposed about the extent to which RRI may influence the discourse and practice of research ethics and integrity.

Quite paradoxically the potential relevance of RRI for research ethics should not be found in the inclusion of research ethics in the RRI conceptual structure as one of its structural components (the RRI keys). As discussed in the previous paragraphs, the simplistic incorporation of ethics in the RRI discourse might not be beneficial for strengthening research ethics, at least at a policy level. Rather, the connection between RRI and research ethics is deeper and more substantial: the same transformations affecting science that RRI intends to manage are inevitably also challenging the ethical dimension of research with equal force. In this sense, RRI starts being perceived not as a strategy to incorporate or replace research ethics, but as a support for ethically managing, from both a theoretical and methodological point of view, the multiple issues emerging from the rapid transformations of the research and innovation landscape.

The consulted literature, integrated with the results from the consultation, also allows the development of a first, although incomplete, picture of the challenges for research ethics arising from the transformations occurring in science and in science-society relationships. For the sake of simplicity, we can distinguish three types of challenges, respectively pertaining to major changes that are currently underway in the domains of research practices, research subjects, and research actors.

- Changes in research practices. Science is more and more globally interconnected, under continuous scrutiny and pressure by authorities and the public, hypercompetitive, and challenged by the shrinking of available funds and the growing demand for knowledge that is usable for policymaking and innovation.
- Changes in research subjects. ICTs and other emerging technologies combined with profound social transformations are giving birth to emerging phenomena leading to new socio-technical configurations. The emergence of radically new research fields, or the profound modification of existing ones, leads to new ethical implications.
- Change in the research actors. Finally, the types and number of players involved in the production of scientific knowledge are changing, with the growing involvement of non-scientific organisations. This is having an impact on research ethics (e.g., new conflicts of interest) or posing new issues susceptible to ethical consideration (e.g., the democratisation of the research process, responsibility for the research outputs, and the ethical soundness of research as a basis for evidence-based policies).

It is worth noticing that a growing awareness of the new ethical problems raised by the ongoing changes is emerging among researchers, research organisations, private companies, and policymakers, even if at different levels, depending on sectoral, geopolitical, and cultural differences. At the core of the ethical challenges, there seems to be an increasing uncertainty generated by the changes described above, which produces instability in the ways ethical issues emerge and are addressed. However, this process is at its very first stages. The analysis of the different sources used in this chapter suggests that research actors are well aware that the transformations occurring in science have a strong impact on the ethical sphere, but they are still far from developing a comprehensive view of the many issues involved.

Despite this, we have identified three priorities which are related to some of the four dimensions that appear as the more productive interpretation of the RRI approach (inclusiveness, anticipation, reflexivity, and responsiveness), respectively pertaining to the need to properly socially embed the research activity, to timely recognise and anticipate the implications of research, and to constantly find new and more appropriate ethical practices in research-related processes and outputs.

- **Contextualisation.** Effective research ethics needs to focus on research issues, which refer to different groups and interests. Science is more and more emerging as a societal enterprise which is increasingly called to orient evidence-based policies. This calls into question two dimensions of RRI, namely inclusiveness (asking for the involvement of all the concerned stakeholders) and reflexivity (claiming to

constantly focus on the aims and results of ongoing activity so as not to lose their consistency).

- **Timely recognition and anticipation**. As emerged in the studies of new technologies, but not only limited to them, ethics is called to imagine uses and consequences of research and innovation for different social groups, as well as for society at large. This concept of ethics combines with three dimensions of RRI, i.e., anticipation (the need for anticipating the future implications, both positive and negative, of any new scientific output), inclusiveness, and responsiveness (calling on science to adopt strategies that detect risks early and develop ethically appropriate responses). Such dimensions are also very relevant for decision-makers and policymakers.
- **More effective ethical practices.** The third priority is that of constantly looking for more effective ethical ways to treat research-related processes and outputs. This means enlarging the scope of research ethics to encompass the entire research and innovation process, developing—when necessary—new methodologies and tools besides the traditional ones, on a case-by-case basis, and incorporating the practices adopted by all the relevant stakeholders, in a constant dialogue. This process of updating and innovating mainly relates to two RRI dimensions, i.e., reflexivity and responsiveness.

2.5 Lessons Learned

On the basis of the reasoning conducted in the previous paragraphs, we would like to draw some lessons from the rise of RRI in European policymaking up to Horizon 2020 and its apparent loss of centrality in the Horizon Europe Programme[7].

Of course—as we pointed out in the previous paragraphs—this experience has shown many drawbacks: the conceptual indetermination of the very concept, the risk of reification in turning RRI into just another label or a tick box exercise, and its limited currency among researchers and innovators. All this notwithstanding, some significant insights can be proposed.

The first lesson concerns the ability to mobilise resources—not only economic but also human and intellectual—that the RRI policy has produced in Europe, mainly through the Horizon 2020 programme (but also since the FP7 programme and through national initiatives, such as those of the United Kingdom Research and Innovation Council, or the Dutch Research Council), and outside Europe (e.g., in India, China, the USA, Brazil, etc.).[8] In this regard, RRI can be considered a powerful notion,

[7] In this we join other researchers that have been engaged in this field and are similarly reflecting about the RRI experience and making recommendations about its future (e.g., Owen et al. 2021; Stahl 2020; von Schomberg 2021).

[8] Numerous research organisations outside Europe have participated as partners in numerous FP7 and Horizon 2020 RRI projects. In addition, some countries have also launched RRI-inspired programmes (see Wittrock et al. 2021 and Owen et al. 2021).

thanks to its interpretive flexibility, its capacity to encompass other similar concepts (d'Andrea et al. 2017), and its capacity to mobilise actors of different types.

Secondly, the deployment of RRI policies produced a stock of knowledge and practices, including guidelines, roadmaps, and tools, able to capture the ongoing changes. As mentioned before, such stock of knowledge has been utilised to promote RRI-inspired institutional change[9] in universities and research organisations, as well as in local and regional public administrations, by activating societal actors, providing new frames and cultural inputs, and also, inevitably, meeting resistance and obstacles. Attempts to apply RRI have been tried out also in SMEs and industries,[10] especially in the fields of emerging technologies (ICTs, biotechnologies, etc.).

All these experiences contributed—and this is the third lesson—to the establishment of a community of practice, involving thousands of people that in recent years have been involved in studies, experiments, research projects and a myriad of reflexive initiatives (workshops, social labs, meetings, seminar, webinars, etc.).

The fourth lesson concerns the inspiration that the four dimensions of RRI can provide to the governance of science in the context of ongoing changes affecting both science itself and society. In this framework, RRI can be recognised as a regime of change, helping research institutions, researchers and other relevant actors to address changes affecting science (d'Andrea et al. 2017). Through this approach, attempts can be made to go beyond the logic of risk management in research towards a more comprehensive and effective governance of science.[11]

Furthermore, from the point of view of research ethics, these 10 years[12] have shown the need for a more dynamic, approach, to be able to navigate the uncertainty inherent in the contemporary research and innovation landscape, where new ethical dilemmas emerge as science and technology advance, and where a myriad of everyday big and small ethical problems emerge from research activities. Thus, the fifth lesson concerns research ethics as such. In this view, research ethics can no longer be developed only by scientists for scientists or prevalently based on deductive, top-down, and normative procedures. In this context, RRI (and in particular its four dimensions) could help to develop more proactive, flexible, anticipatory, inclusive, and exploratory ethical practices. This does not affect the entire picture of research ethics, but only part of it. In particular, it is possible to identify three main domains (Declich and Alfonsi 2020).

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[9] See, for example, among others, the projects ACT, FIT4RRI, FOTRRIS, GRACE, JERRI, NUCLEUS, ORION, RESBIOS2, RRI PRACTICE; STAGES, SISCODE. Many projects were focused on gender equality.

[10] See for example, the projects Liv-In; ORBIT; New HoRRIzon; PRISMA; Responsible Industry; Responsible Innovation Compass; ROSIE; Smart Map.

[11] See for example, the projects DEEPEN, GREAT, FIT4RRI, RES-AGORA, SATORI.

[12] During these 10 years, several projects on ethics dealt with the complex issue to implement standards and provide regulatory framework for ethical research in field such as ICT, AI, robotics, HET, etc. and deepened the issues of ethics of emerging technologies, also making reference to RRI. See the projets ENERI, I-CONSENT, PANEFILT, PRO-RES, PRINTEGER, SIENNA, SHERPA, SOP4RI, TRUST, VIRT2UE.

The first domain includes the many research areas which are ethically stable, i.e., areas in which both ethical principles and ethical procedures are consolidated and still effective.

The second domain includes research areas which are more ethically unstable, i.e., areas in which the ethical principles are quite clear although the ethical procedures are partially or totally unclear. Think, for example, of areas such as research in public spaces, research in conflict and disaster areas, or internet-based research. In all these areas, the ethical principles are quite clear but the procedures for applying them are uncertain, since the traditional ones are increasingly ineffective.

The third domain includes research areas which are ethically new, i.e., areas for which neither the ethical principles nor the ethical procedures are clear. We are referring to cutting-edge research and technological domains, such as those related to AI, nanotechnologies, or human enhancement technologies, which are creating new social meanings, situations and configurations which need ethical interpretation.

Having identified these three areas, we can consider that often the research areas whose results are more acutely needed are those where the degree of uncertainty is higher**.** These areas are still under-socialised, i.e., they are not yet "filled", if perhaps partially, with those social meanings, contents, or experiences to make them socially manageable. The first to penetrate these areas are researchers and technicians, building their "social meanings" to interpret them. However, other players contribute to the socialisation process, including public authorities, experts, the different types of stakeholders involved and, eventually, ordinary citizens. It is in these frontier areas, where the relationships between science and society are more uncertain and problematic, that an approach to research that is proactive, anticipatory and inclusive can better ensure the quality of the results and their reliability for policymaking.

This consideration introduces the last lesson learned that, in our view, concerns the complex relationship between science and policymaking. Policymakers have been involved in RRI projects as stakeholders only to a small degree, but these 10 years have shown the need to deploy a system of mediation and hybridisation between policymakers and researchers with the involvement of dedicated figures. This implies that proper evidence-based policymaking should be seen as a transactional, multifaceted effort. In fact, even the best scientific evidence cannot be mechanically translated into policy. What is required is a complex, non-linear process that involves contextualisation, reflexivity, capacity to consult and interact with relevant actors and stakeholders, and anticipating risks and opportunities; in a word, the ability to consider those dimensions that are part and parcel of RRI.

2.6 Implications and Recommendations

On the basis of the path described so far, we would like to make some recommendations, based on the persuasion that even if RRI seems to be downplayed by the EU and losing its centrality in the governance of the relationship between science and society some elements of these 10 years should be, so to speak, "saved".

1. There is a need for a proactive, explorative and dynamic research ethics approach (or "ethics of future"[13]—EGE 2021) based on the practices and experimentation of the four dimensions of RRI in innovation and research activities. Such a proactive ethics approach can allow for more effective ethical management of the more unstable and newer research areas (the third and partially the second domain mentioned in the previous section).
2. As also suggested by others[14], there is a need for a scaling-up of the reflection on RRI (and its contents and challenges) from the level of individual research institutes to that of national and European research and innovation programmes. In this regard, there is the need to devise actual mechanisms for dialogue and co-creation involving researchers, stakeholders and policymakers.
3. Ethical reflexivity must be incorporated more into the mission-oriented innovation lines of Horizon Europe to help define their content and approaches. In this context, the space that RRI has provided over the past ten years, for debate, reflection, negotiation, and even dispute on the relationship between science, technology, responsibility and society, must be preserved, promoted and sustained (Owen et al. 2021).
4. The research centres, universities, industries, groups of researchers and stakeholders that have been mobilised over the years within the broad perspective of responsible research and innovation should be cared for, so that their valuable energy is not lost. There is a need to promote networking, synergies and platforms for the RRI communities of practice to continue their reflection and exchange of experiences (Owen et al. 2021). In this context, it is also appropriate to continue to experiment on how and under what conditions to promote institutional change in universities, research centres and industry for responsible, open and inclusive research and innovation.
5. There is a need for places and processes that allow researchers and policymakers to interact in order to address the socialisation of those areas of scientific and technological research that are progressing at a very fast pace so that their embeddedness in society is still weak, developed with scant interaction with the different stakeholders and with insufficient public control and assessment of their impacts, including considerable heterogeneity in the evaluation instruments. It is in this framework that evidence-based policymaking should be pursued as a transactional, multifaceted and interactive endeavour.

[13] In this regard, the European Group on Ethics in science and new technologies in its document "The role of ethics in European and global governance" underlies the need to a global engament of stakeholders, to use and practice ethics by design, to promote democratic deliberations and to involve ethics "in shaping the agenda".

[14] This is one of the element proposed during the New HoRRIzon Final Conference Session 7: H2020 to Horizon Europe: from ethical guidelines to democratic processes, held online on May 25, 2021.

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