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EXECUTIVE SUMMARY

This report is devoted to the contribution that the conceptualisation and practice of Responsible Research and Innovation (RRI) can provide to the PRO-RES Guidance Framework, which aims to foster the highest standards of research ethics and scientific integrity in non-medical sciences. The Framework, resulting from the project WP3, is built as a complex, multi-layered effort of deliberation, testing, and engagement with stakeholders, including policymakers.

The analysis is based on different sources, referring to activities carried out by all the PRO-RES partners in 2019 and 2020, namely the thematic workshops conducted in 2019 under the Work Package 2 “PRO-RES Consultation”; a second round of consultations for WP2, conducted in the Summer and Fall of 2020 in the form of online interviews to 63 European experts and stakeholders and a review of the literature about RRI and the context of its formulation and application.

Apart from the introduction, the report contains 4 sections. Section 2 summarise the origins and antecedents of RRI, dating back to the 80s, and the motivations underlying it, emerging from the changing landscape of research and technology worldwide and the related transformations in the relationship between science and society, with the increasing importance, within and outside the scientific systems, of new constellations of actors.

Section 3 describes the formulation and scope of application of RRI, mainly seen as an attempt to cope with the huge transformations ongoing in science and its environment, having at the core the idea that science and technology actors should be responsible for processes, results, and effects of their actions. A focus is made on the four dimensions characterising RRI: reflexivity, inclusion, anticipation, and responsiveness.

Then, in section 4, the added value of the RRI approach for research ethics is presented. Such added value does not refer to the mere incorporation of research ethics among the RRI keys, but rather to substantive aspects, related to the governance of the whole system, thus allowing science and technology and their ethics to cope with the challenges of a rapidly transforming environment. Huge changes in the internal mechanisms of science production (e.g., hypercompetition, increased research staffing, and labour insecurity, progressive move towards open access and open data), the relationship between science and society (with the growing role of different kinds of actors, including a demand of usable knowledge from policy-making), the development of new research sectors and the related changes in research methodologies, all call for a new approach to research ethics. Change is required as for the capacity a deeper and broader contextualisation of research ethics, a timely recognition and anticipation of new ethical issues, and more effective ethical practices.

Finally, section 5, recapitulating the arguments for a deep renewal of the ethics of non-medical sciences, focuses on the potential contribution of the RRI approach to the PRO-RES Framework. RRI, which is more and more perceived as a stock of knowledge and practices able to capture the ongoing changes and already available to be used, can help research ethics to address its changed priorities, to navigate the uncertainty characteristic of the contemporary research and innovation landscape and to contribute to manage old and new ethical issues, thus helping research to produce good evidence for decision making.

TABLE OF CONTENTS

Version Log	2
Executive Summary	3
Table of Contents	4
Abbreviations	5
1. Introduction.....	6
2. Background and origins of RRI	7
3. What RRI is	9
4. Added value of RRI	11
4.1. Research ethics as a part of RRI	11
4.2. A substantive added value for research ethics	13
4.3. Transformations challenging research ethics.....	15
4.4. Towards a new approach to research ethics.....	20
5. Managing ethical issues: using an RRI-related approach.....	25
5.1. RRI and the transformations in science and technology.....	25
5.2. RRI and research ethics	26
5.3. Articulating and enlarging the ethical view of science.....	26
5.4. Perceived priorities for research ethics.....	28
5.5. Next steps forward: ethical and policy implications	29
References.....	31
Annex 1 Overview of the experts consulted in summer-fall 2020.....	35

ABBREVIATIONS

AcSS	Academy of Social Sciences
EC	European Commission
ELSA	Ethical, Legal, and Social Aspects (of research)
ELSI	Ethical, Legal, and Social Implications (of research)
EU	European Union
K&I	Knowledge and Innovation srls
OECD	Organisation for Economic Co-operation and Development
RCR	Responsible conduct of research
RRI	Responsible Research and Innovation
Steinbeis	Steinbeis 2i GmbH
TA	Technology assessment
UN	United Nations

1. INTRODUCTION

This report is part of the project PROMoting ethics and integrity in non-medical REsearch (PRO-RES), funded by the European Commission in the framework of Horizon 2020, SwafS 21-2017. The project is carried out by a consortium of 14 partners, coordinated by the European Science Foundation (France).

The aim of the project is to develop a guidance framework fostering the highest standards of research ethics and scientific integrity, covering all non-medical sciences.

In the project's architecture, Work Package 3, led by the Academy of Social Sciences (United Kingdom), is specifically devoted to the construction of such a framework as a complex, multi-layered effort of deliberation, testing, and engagement with stakeholders, including policymakers. Task 3.5 is meant to consider the Framework in the context of the principles and practices of Responsible Research and Innovation (RRI). The task is led by Knowledge and Innovation (Italy). Steinbeis 2i GmbH (Germany) contributed to its implementation.

In accordance with the definition of Task 3.5, the purpose of this report is to discuss the kind of contribution that the conceptualisation and practice of RRI can provide to PRO-RES Framework and its dissemination and adoption.

The report will start by analysing the nature of RRI, the motivations underlying it, and how such motivations contributed to its formulation and scope of application (Sections 2 and 3). Then, it will focus on the added value of the RRI approach and propose how it could be contributing to PRO-RES Framework for non-medical sciences (Sections 4 and 5).

To prepare the report the following sources have been utilised, referring to activities carried out by all the PRO-RES partners:

- The results of the series of thematic Workshops conducted in 2019 under the Work Package 2 “PRO-RES Consultation” and presented in the deliverable D2.1. One of the Workshops, held in Brussels in June 2019, was focused on RRI.
- The results of the second round of consultations for WP2, conducted in the Summer and Fall of 2020 in the form of online interviews with 63 European experts and stakeholders (hereinafter referred as “the interviewees”). The interview grid included a question about RRI in relation to the Framework. A synthetic overview of the interviewees is included in annex 1.
- A review of the literature about RRI and the context of its formulation and application.

This report has been drafted by Giovanna Declich and Alfonso Alfonsi, with the collaboration of Maresa Berliri, all of Knowledge and Innovation.

2. BACKGROUND AND ORIGINS OF RRI

In order to understand the drives that brought about RRI, it is necessary to put it into the broader context of the transitional phase which science and innovation are undergoing (which, in turn, is part of a broader shift from modern to post-modern society, also affecting and somehow weakening the main social institutions of modernity, such as government, religion, family, and public administration).

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, also related to globalisation and the spread of new digital technologies, 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 scientific and research activities are also put under increased public scrutiny, while public distrust and disaffection towards science appear to raise.

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 (Stahl, 2013). However, there are several antecedents that show how such a notion had already a certain currency 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 80s and early 90s we can single out as antecedents of RRI the insertion of ethical, legal, and social aspects (ELSA, in Europe)¹ or implications (ELSI, in the USA) in the research agenda, 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, which was prompted by the perceived crisis of the “Public Understanding of Science” (PUS) launched over 30 years ago. The discussion veered on the idea of the need to transition from an approach aimed at simply providing to the public a better understanding of science (according to the so called “deficit model”²) to a public dialogue with scientists about aims, methods, and results of science, promoting a two-way communication at

¹ See Chadwick, R. and Zwart, H. (2013) Editorial: From ELSA to responsible research and Promisomics. *Life Sciences, Society and Policy* 2013, 9:3

² The deficit model is based on the largely questionable assumption that public scepticism about science is mainly caused primarily by a lack of knowledge and that transferring scientific knowledge to the public increases the public’s appreciation of science. See for instance Wynne B. (1995) Public understanding of science, in: *Handbook of science and technology studies*, (pp. 361-389). London, Sage.

different stages of the research process. Other antecedents to RRI can be found in the reflection on technology assessment (TA) (Grundwald, 2011) and, in USA, on the responsible development (Stahl, 2013) and the responsible conduct of research (RCR³), this latter mainly focused on research integrity issues.

An additional important tendency that had a bearing in paving the way to RRI can be considered 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 Foundation⁴, or the funding schemes for structural change in the European Commission Framework Programmes⁵.

Finally, also 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.

As pointed out at the beginning of this section, all these tendencies can be seen as ways to respond to the transformations occurring in the way in which scientific knowledge is produced, disseminated, and exploited.

In fact, in the same period, different scholars were developing a series of **interpretive models or approaches** focusing on such transformations. Among these, we can mention here the Mode 1/Mode 2 model (Gibbon et al., 1994), the Post-academic science (Ziman, 2000), the Triple Helix approach (Leydesdorff and Etzkowitz, 1998), or Post-normal science (Funtowicz and Ravetz, 1993).

In varying measure, all these models capture significant aspects of the transformations occurring in science and innovation, including:

- The transformation of science as a multi-actor process, involving a wide range of players besides the scientists, up to encompassing the public at large
- The increasing tendency toward political steering of scientific research, especially through the mechanism of competitive access to public funds
- The increasing accent to the social and economic benefits of scientific research, which is now favouring investments in applied research rather than in fundamental research
- The increasing tendency toward trans- and inter-disciplinary research also accompanied by a growing specialisation within the different scientific disciplines
- The decreasing authority of and the increasing people's distrust in science and scientific institutions, which is leading to a growing demand for accountability and public scrutiny of research process and products, also in view of minimizing risks and undesirable impacts.

³ See, among other Kalichman (2013) and, for the use of RCR in the European context, the project education integrity <http://h2020integrity.eu/online-course-responsible-conduct-of-research/>.

⁴ 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. See <https://www.nsf.gov/crssprgm/advance/>

⁵ The Seventh Framework Programme and the subsequent Horizon 2020, through the Science in Society (SiS) and Science with and for Society (SWAFS) work programmes respectively, have included funding for the implementation of gender equality action plans aimed at institutional change in individual research institutions and universities.

Thus, all the interpretive models, with a different accent, show both the opportunities and risks connected to these changes, all seen as capable of profoundly modifying the social position and status of science in society and making all dominant strategies (those based on a one-way scientific communication) as increasingly ineffective.

The trajectory and outputs of this transition are still unclear, but at least, besides altering science relations with other sectors of society, they seem also to modify its most basic and intimate mechanisms, related to the very production of “scientific knowledge”. This entails the perception by key science actors of the need to revise and modernise the usual mechanisms for the governance of science to anticipate or put under control emerging risks and opportunities.

The need to provide guidance to the whole system of research which is currently morphing into a new configuration and to manage the impact of this transformation on the rest of society is bringing to the forefront the issue of how not only researchers but all actors present in the European research space can exercise their responsibility about science development and outcomes.

Thus, we could say that RRI emerged as an issue in the last decade (as we have seen with some antecedents that can be traced back to the last decades of the twentieth century) just because of the development and consolidation of these new interpretive frames which provided RRI with a solid theoretical background, in turn reflecting broader transformations affecting contemporary societies.

With this in mind, the rise of RRI can be interpreted as one among the many organised and policy-oriented reactions of the European Union to the transition of science and to the uncertainty this latter generates in the research systems and in the society as a whole. In a nutshell, it 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.

3. WHAT RRI IS

Responsible Research and Innovation (RRI), launched in 2009 by the EU as a specific policy approach aimed at managing science and science-society relations, refers to a series of meanings that have evolved over time. It has to be noted, in this regard, that the notion of RRI is by no means exactly defined nor its contents and dimensions are always consistently delimited. As a matter of fact, several definitions, which are sometimes very dissimilar one from each other, have been formulated by scholars and policymakers, alternatively meaning, as highlighted by Job Timmermans and Bernd Stahl (Timmermans and 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 different way to make research and innovation (Stahl, 2013; the Expert Group on the State of Art in Europe on RRI, 2013).

However, although the current formulations do not provide a unitary picture of RRI in itself, they allow one to perceive the major expectations underpinning RRI, i.e., going beyond the “Ivory Tower” model

of science which has for a long time been dominant in producing and reproducing science as a social institution.

Notwithstanding these limits or even thanks to its “interpretive flexibility”, RRI addresses widely felt needs in the science community and has been playing an important role in framing part of European research policies. Thus, RRI serves as an “umbrella concept” which includes and tries to coordinate different sets of practices, measures, and tools, more specialised in nature, through defining some general ordering principles (the so-called 5 keys of RRI) i.e., gender equality in science, open access to research data and publications, research ethics and integrity, citizen engagement, and science education, integrated in some cases with governance as a sixth key (European Commission, 2012).

Besides the “5 keys”, according to Burget, Bardone, and Pedaste (2017), there is a convergence among authors on four main dimensions of RRI⁶.

- **Inclusion.** It mainly refers to the engagement of different stakeholders from the early stages of research and innovation onward to give voice to all the concerned interests, values, needs, and beliefs.
- **Anticipation.** It refers to the capacity of envisioning the future of R&I and understanding how current dynamics help design the future in order to prevent risks and to lead research to desirable impacts.
- **Responsiveness.** It concerns the capacity to develop proactive management of new technologies so as to identify risks and develop an ethically adequate response. According to Burget, Bardone, and Pedaste, responsiveness also relates to transparency (responses should be open to the public debate) and accessibility (scientific results about risks and responses should be openly accessible to everyone). Responsiveness may be seen to partially overlap with the dimension of anticipation.
- **Reflexivity.** It 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 and of the framing processes connected to the identification of the issues to be addressed as well as to reflect on values and beliefs connected with R&I. Reflexivity is linked to public dialogue and collaborative approaches in science.

So, we can say that at the core of RRI there is the idea that science actors should be responsible, in close interaction with other societal actors, of the (ethical) acceptability, sustainability, and societal desirability of the scientific knowledge they produce, as well as of the innovation process and marketable products that such scientific knowledge makes it possible to develop.

In this regard, by grouping common elements from several definitions and approaches to RRI, at least three elements appear to be salient in RRI as a driving factor in European science policies:

- **Leading science to take more responsibilities over its own potential benefits and risks**, especially in relation to the “societal challenges” human societies have to face

⁶ Many authors define the dimensions of RRI in different manners. See among other Owen et al, 2012; Stilgoe et al 2013; Lubberink et al, 2017.

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- **Aligning the research process and its outcomes to values, needs, and expectations** of European society
 - **Leading science to cooperate with the relevant actors and stakeholders**, including laypeople.

The points discussed so far can allow us to conclude that the major expectation underpinning RRI appears to be to **modify the consolidated social model of producing and reproducing science** – often expressed, as we said above, 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** appears not only as a desired outcome of a process, but also as a **guiding principle** that should inform all the domain of science as a social institution, its actors and its structures.

This key role recognised to responsibility in science and technology – rather than the simple inclusion of research ethics into RRI, as one of its keys – represents the main bridge connecting RRI to ethical issues in science and technology.

4. ADDED VALUE OF RRI

Following the considerations made in the previous sections, it is now necessary to identify what added value the strategy of responsible research and innovation could produce for a renewal of research ethics in non-medical fields.

To this aim, in this section, an analysis will be made on the relationships which can be established between RRI and research ethics on the basis of the different sources consulted.

4.1. RESEARCH ETHICS AS A PART OF RRI

The first point to be highlighted is the reluctance of the interviewees and participants in the thematic workshops conducted under PRO-RES to see research ethics merely as one of the RRI components or keys.

To explain this attitude, **historical consideration** is needed. As previously pointed out (see Sect. 2.), the focus on ethical aspects of research (along with legal and social aspects), especially in cutting-edge research sectors, has been an integral part of ELSI and ELSA studies since the late 1980s. These studies can be considered a precursor of RRI. Therefore, RRI is a legacy, at least partially, of the ELSI/ELSA studies and not vice versa.

Moreover, **RRI is largely unknown or known only superficially** in its contents and objectives. As also shown by the panel of experts and stakeholders interviewed during the second round of the PRO-RES consultation in Summer-Fall 2020, as many as one third thereof were not familiar with such a concept.

However, the main argument used against an approach framing research ethics within RRI is that **connecting research ethics with the other RRI keys does not necessarily reinforce its message.**

Some interviewees stated that **RRI is not to be mentioned as such**, resulting as even counterproductive in some cases (according to one interviewee) and for some audiences, as in the case of business.

RRI in my field is not a priority (Research administrator).

Suggestion to mention Open Science defined broadly, (rather than RRI) in framework, and bring the topic of opening science (open data, access to data) to other stakeholders (Policy advisor).

If you want to change something at the institutional level, don't talk about RRI. RRI important for people in research and interested in it, but not so useful/nearly dissuasive to approach other stakeholders (i.e. business, policymakers) with the concept, as they would shy away from it. Suggestion not to reference RRI, as concepts are anyway embedded in the framework (Researcher).

Other interviewees, instead, while in some cases recognising the **RRI strategy** as very relevant for European research, argued that it is **too wide, so generating confusion and a lesser impact** than expected as for ethical aspects.

RRI is important but also very broad. (...) Including it would be too broad, with the risk to lose impact. (I suggest) to keep the focus on promoting ethics and integrity, without broadening it (Representative of a researcher umbrella organisation).

It seems better to have a standalone framework rather than try to link it with another concept, in order to maintain simplicity (Researcher, policy advisor).

I would suggest to keep things more to the point. If there are too many details it may lose consistency and impact. "If you want too much, you reach too little". Some principles of transparency and "do no harm" are already rich in contents and there is no need for further details, which would be eventually ignored (Representative of a university association).

There were anyway interviewees who reckoned that a connection with **RRI could be beneficial to research ethics**, albeit mainly for instrumental rather than for substantive reasons (e.g., extending the outreach of research ethics, better influencing the new generations of researchers, etc).

Perhaps it would be worthwhile to link the effort to an already established approach. This would only help reach a greater audience (Policy advisor, researcher).

It might be useful to link to this concept. The young generations of researchers will be dealing with this issue and more and more scientists are requested to go beyond the confines of academia and deal with society at large (Researcher, policy advisor).

The [PRO-RES] toolbox needs to include some of these norms, although not necessarily in the language of RRI. (Researcher, national representative of research ethics committees).

At least needs to have some links – “if you have gone through our recommendations, you have de facto covered RRI principles”. It might not be necessary to explicitly cover RRI but an indication (especially for politicians) that if you follow the Accord then you also cover X, Y aspects from RRI concepts would be very useful. It is suggested for this to be automated in the toolbox (Researcher, policy advisor).

4.2. A SUBSTANTIVE ADDED VALUE FOR RESEARCH ETHICS

Despite a certain scepticism about the usefulness to explicitly connect research ethics with RRI, there can be a more substantive case for the contribution of RRI to the renewal of the ethical discourse on science.

In particular, RRI shows that **ethical issues are now strongly connected with the governance of science** in a context of transformations. This entails managing continuous tensions between different levels of problems for institutions and individual scientists.

This increased awareness can be partially attributed to the COVID-19 pandemics, which showed how much research ethics is today facing processes of change unprecedented in scope and speed, as it was pointed out by two interviewees by PRO-RES in 2020.

Because of the digital ethical stuff I've been invited on, we're just rewriting ethics in the context of COVID19. It'll have lasting impact I imagine about ethics online, they're giving much more thought, people are much more aware of platform issues, data compliance, how data is generated be that implicitly or explicitly through the platform. They have frameworks in place but this is a big update, I've spent a lot of time with ethics governance and information people at QUB trying to thrash that out (Researcher).

Issue put in light with COVID now: need to include other stakeholders in providing advice, including the public. Issue which was left aside in making of OECD report: communication and public engagement of science advice (Policy advisor).

More importantly, as we will see in more detail below, **research ethics is challenged by the current evolution of science**, as it is also reiterated by the EC presentation of the Horizon 2020 results (European Commission, 2020), which more and more requires a closer interaction between researchers and stakeholders.

Artificial intelligence, robotics, human genomics, and human enhancement offer benefits for both individuals and society. However, they also raise complex ethical issues that need to be addressed at the EU level.

There is a pressing need to provide ethical responses and practical options which support innovation, the research community, facilitate the work of ethics committees and take into consideration the expectations of society. Guidelines are currently being developed taking into account the ethical implication of these domains with the active involvement of relevant stakeholders (European Commission, 2020).

As emerged from the interviews, researchers and research actors are also more aware of the **increasing demand for scientists and research institutions** to be concerned with the social and political implications of their research. This aspect is well exemplified by the excerpt below.

Another issue (...) is the participation of scientists to dialogue with the society. Often scientists are reluctant to (become) involved in political issues/topics and thus will refrain from talking to citizens about sensitive topics, but it should be the exact opposite! They have to be ready to do so (Policy advisor).

This is modifying how scientific knowledge is produced and how ethical issues are managed. For example, one interviewee highlighted how research quality and management of ethical aspects of research are practically connected.

The question of science quality is relevant. (...) There are cases where the calls for research are the reason why things are not done well, because if we want applied research to be done ethically, it will be slower and costlier. The latter is especially true for our University, because overheads will be added to the offer, but in many cases cheaper proposals win (Researchers, Research Integrity Advisors).

Greater involvement of researchers and research institutions with the social implications of their own research also increases their visibility up to generate risks for them, as highlighted in the excerpt below.

Risks to individuals and participants are important, but also have reputational risk for the organisation. (...). This is why background checks are important and making sure there are not conflicts of interest with academic partners or even perception risk. Also important to stress the risks on local research teams. Those working in their own culture, own community. A final publication where the researchers are named could bring risk of harm to those people (Funder).

All in all, although RRI is not well known and its use as an overarching label also including research ethics is at least controversial, there seems to be a **growing perception among the research actors** that the social status and role of science are changing as well as 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.

4.3. TRANSFORMATIONS CHALLENGING RESEARCH ETHICS

It is now necessary to better understand which factors modifying the research landscape have a relevant impact on ethics.

On the basis of the consultation of the different sources mentioned in the introduction, they can be grouped into **four main categories** that refer to:

- Internal science production mechanisms
- Relationship between science and society
- New research sectors
- Research methodologies.

These four groups of factors, which are interrelated with each other and have been isolated for the sake of clarity, will be shortly described here below.

4.3.1. Transformations in the internal science production mechanisms

The first set of factors are related to the **transformations affecting the internal mechanisms of science** in the post-modern context (d'Andrea et al., 2017).

Some of them have very relevant effects on research integrity and research ethics. Three examples (hypercompetition, increased staffing, and move towards open data/open access) may clarify the issue at stake.

Hypercompetition. A first mechanism is the skyrocketing increase in the competition to access funds and resources, particularly tough especially in high-growth sectors, referred as “hypercompetition” by some authors (Alberts et al., 2014; Schatz, 2014; Fochler, Felt and Müller, 2016). Such heavy competition strongly impacts the lives of research institutions and individual researchers, pushing them to modify their strategy, forcing them to rapidity, early publication and any possible stratagem to gain better opportunities over concurrency (both at the institutional and individual level). This may favour in some cases questionable research practices (see “Questionable research practices” and “Misconduct”, PRO-RES Project - Glossary of terms and concepts), especially in some countries and in certain institutional conditions. According to some (for example, Kaiser, 2014), hypercompetition is one of the main factors fostering scientific malpractice (plagiarisms, data fabrication or manipulation, etc.), thus producing a decrease in the integrity of science and its quality. Furthermore, in such conditions, research ethics procedures are often perceived by individual researchers and, in some cases institutions, as controllers (van den Hoonaard and Hamilto, 2016), rather than facilitators of effective and ethical choices in research. These aspects were also debated during the first round of the PRO-RES workshops in 2019, mainly the one devoted to RRI (see PRO-RES deliverable D2.1.).

Increased research staffing and labour insecurity. The diminishing availability of research funds and resources is making it more difficult to enlarge research staff through the hiring and promotion schemes science institutions used in the past. This has brought, especially in the last decades, to a growth in contingent staff, i.e., doctoral students and postdocs, involved in research processes, and mainly paid with “soft money”, i.e., with funds from research projects. The **unfair treatment of young and precariously employed researchers**, as debated during the first round of PRO-RES workshops (see

PRO-RES deliverable D2.1.) and also pointed out by an interviewee by PRO-RES in Summer 2020, is an **ethical problem of the research institutions.**

Perhaps another focus of concern, which (...) I consider to be ethically relevant, could be the indication to check how the young researchers have been treated in the research team, whether they were correctly contracted, adequately remunerated, and fully acknowledged in their contribution to the study. In Italy too often young researchers are offered precarious rather than permanent job positions, resulting in forms of unduly exploitation (Entrepreneur, policy advisor and policy maker).

In such a situation, as also discussed during the first round of PRO-RES workshops, young researchers are often alone in some crucial choices, being sometimes pushed to shortcuts to solve problems related to the research implementation and the individual conduct to be kept. This picture has been drawn, among other, in the first PRO-RES workshop on disaster and conflict settings, a sector where research is performed not only by universities and research institutions, but also in-house by humanitarian bodies.

For the issue of ethics in disaster and conflict settings the ethical discussions focused on the integrity of the researchers (and) the imminent saturation of the researched community, overwhelmed by many researchers coming to the areas (...) – which may require greater flexibility on ethics protocols and sensitivity to the setting (PRO-RES, Deliverable D2.1).

Move towards Open Access and Open Data. Even the move towards open Access and Open Data increases the pressure on the standard approach to research ethics. This point is well described by László Fesüs.

The advent of open access has been a confusing, de-centralised enterprise with an absence of regulations and guidelines, leading to a number of ethical issues faced by those active in the scientific endeavor (ALLEA, 2018).

Again, in the first round of the PRO-RES workshops several issues related to the ownership of research data, the risks of overuse and/or secondary use of research data was debated by data scientists and researchers using social media.

In terms of Data Science and Social Media, the questions pointed to understanding the ownership of the data, how to publish critical results and how data could be perceived differentially based on cultural backgrounds and uses (PRO-RES, Deliverable D2.1).

Similar concerns were also expressed by experts in privacy issues, surveillance, and covert research, where problems in managing the ownership of the collected data and their use were spelled out by the participants. In this regard, a proposal was made to promote an ethical peer review on the use of information and personal data.

4.3.2. Transformations in science-society relations

A second set of factors modifying science which have an impact on research ethics relates to the **science-society relationship**.

These factors are mainly connected to the presence of new actors coming into play in the scientific arena, the increasing involvement of stakeholders in the science process in its different stages, and the consolidation of a public opinion much more sensitive and proactive on scientific issues. As a consequence, a social pressure on science is growing, as argued by some interviewees in 2020. An example is given in the excerpt below.

It is not just about informing the citizens and make sure they have the “right” information from science. Trust in research cannot be blind and citizens have the right to express their frustrations, their opinions and legitimate criticisms. (...) there are some aspects of the relationship between science and society and RRI that need to be well understood at the policy levels (Civil Society representative).

Producing good and understandable evidence represents a growing responsibility for research, while, at the same time, recognising and acknowledging it emerges as a growing responsibility for policy.

All this transforms ethics, making more urgent traditional issues such as the transparency of the research process, or the procedures for requesting and obtaining ethical approval, for which a renewed vision is increasingly necessary.

This changed social configuration of science actors also **raises new ethical issues**, such as the introduction of ethical standpoints different from the researchers’ one in the identification of the ethical standards and the acknowledgment, also in ethical terms, of the position and role of new actors in the research arena. An example is represented by the **ethics of citizen science**, as it emerges from the experience of the project CitieS Health, aimed to develop participatory citizen science pilot studies of environmental epidemiology.

The active involvement of a variety of stakeholders is also an opportunity for reflecting on the variety of elements that are necessary to build qualitatively new relationships between researchers and citizens as equal partners in a scientific investigation. (...) Moreover, participatory research designs require a renewed attention to ethical approval procedures to accommodate the new role of citizens, which are not mere research subjects but provide an active contribution to the research endeavour (CitieS Health Project, 2020).

A relevant source of ethical issues is also related to **social science research in non-western cultures and diverse groups** (Mertens and Ginsberg, 2009; Section V: Ethics within diverse cultural groups; PRO-RES Project – Glossary of terms and concepts, “Diversity”), as also pointed out by one interviewee by PRO-RES in 2020.

Our institution is a global one and from that point of view I may suppose that some questions that we don’t ask to Westerners could probably emerge in a process that is explained in a different context. (...) I don’t know if a researcher in a more challenging context would have

different kind of comprehension and also different ethics thresholds (Policy advisor, United Nations official).

4.3.3. New research sectors

Another set of factors having a strong impact on research ethics can be found in the capacity of science to **open up new research sectors**.

Highly advanced research fields and technologies such as artificial intelligence – AI, robotics and human enhancement technologies – HET (Sienna, 2020), as well as genomics and genetics, are in fact creating **new “social areas”**, i.e. spaces of action and opportunities previously unknown to society, which are generating (already at present or in a near future) new social situations, such as:

- In HET, the possibility to extend the life duration, to significantly enhance cognitive abilities, to improve the body through advanced prosthetics (Sienna, 2020)
- In robotics and AI, a wide range of services (which in the future will encompass holographic companions for senior citizens; predictive policing; self-driving; AI powered education) performed by intelligent machines, potentially able to learn, which become progressively more autonomous with respect to the scientists and companies which created them, thus generating legal and social uncertainty related to responsibilities over their actions (UNESCO, 2017; Sienna, 2020; Sherpa, 2020).

These areas are still under-socialised, i.e., they are not yet “filled”, if perhaps partially, with those social meanings, contents, or experiences at any level (cognitive, emotional, economic, political, ethical, etc.) that would contribute to become part of the social life and 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.

This process of social signification (Veltri, 2016) entails interactions and often tensions between different actors who have their own opinions, interests, skills, and strategies.

The opening up and consolidation of these new research sectors and their incorporation into the social life inevitably has an important ethical component, which primarily challenges the research sphere and progressively society at large. In this regard, it is useful to present how an interviewee for PRO-RES in Summer 2020 expressed his concerns in this regard.

Still ethics in research is always evolving also in the sense that groundbreaking research and the use of new technologies constantly raise new questions. For instance, what is the frontier between the development of biomedical interventions or technologies to improve motor disorders and the pursuit of human enhancement? Or how can the decisions made by AI systems be understood by users, regulators or researchers, that is, how can we ensure the principle of explainability when faced with autonomous and complex running of such systems? (Funder, Ethics unit).

4.3.4. Methodological transformations of research

Another important change taking place in scientific research and generating new ethical issues relates to the **evolution of methodologies and techniques**. This process is mainly connected with:

- The enhancement of quantitative research connected to big data
- The presence of new kinds of data to be analysed
- The rapid innovations occurring in the qualitative analysis.

Big data. A huge change derives from the acceleration given by information technology (IT) to the possibility of collecting, stocking, and quickly analysing enormous quantities of data, thus giving a strong impulse to quantitative research with machine learning techniques such as sentiment analysis and natural language processing tools. This situation raises both traditional and new ethical dilemmas (Tiidenbergh, 2018; UREC, Sheffield University, 2018), as, for example, the distinction between human and non-human research subjects (Markham and Buchanan, 2012), or, as also discussed during the PRO-RES workshops in 2019 (see PRO-RES, Deliverable D2.1.), the commodification of data as well as the monetization of personal data and the whole research process (also related to the monopoly of giants of the digital sector), or the actual possibility to anonymise data avoiding their tracing back, especially in situations which risk harming the involved people, as in the case of refugees and migrants from countries at war or ruled by dictatorial regimes (Moreno et al., 2013).

New kinds of data. Another transformation occurring in the methodological domain is also connected to the existence of new kinds of data to be analysed through qualitative methods (e.g., netnography, which studies social interaction in contemporary digital communications contexts, see Kozinet, 2015). Again, old and new ethical issues emerge, e.g., whether online forums are to be considered a private or a public site, and if and how to apply the informed consent in cyberspace (Warrell and Jacobsen, 2014)⁷.

Innovations in qualitative analysis. Finally, there are different forms of methodological innovation in qualitative research (e.g., child-led research⁸ or creative research methods), connected to other social transformations occurring worldwide, which are also in tension with traditional research ethics (Crow et al., 2012). The problems of integrity and ethics in qualitative research were widely discussed during a devoted meeting of the first workshop round in 2019, including a variety of topics about research in general and the various qualitative methodologies (conventional ethnography, arts-based research, digital data, data analysis, etc.).

The issues discussed included informed consent, the understanding of visual elements, emotional impact, the management of digital data from access, publishing, the boundaries of public/private space, confidentiality, intellectual property, the secondary uses of data, language use and the contextual factors for interpreting/making sense of data, etc. (PRO-RES Deliverable D2.1).

⁷ In this sense, netnography offers ethics guidelines. For a full discussion on ethics specifically see: Woodfield, K. The Ethics of Online Research, (*Advances in Research Ethics and Integrity, Volume 2*) Bingley: Emerald Publishing Limited.

⁸ Research led by children and young people is the process of learning about and doing research into something that is relevant to their own lives.

4.4. TOWARDS A NEW APPROACH TO RESEARCH ETHICS

Whatever be the label used, it is important to recognize how, in such a context, an approach purely deductive to ethics, although necessary, is to be complemented with other approaches allowing ethical issues to be managed more effectively, in terms of 1) contextualization 2) timely recognition, and 3) practice.

4.4.1. Contextualisation

The **first component** is that of a **deeper and enlarged contextualisation of research ethics**. This means understanding what is at stake with the research activities, which in turn entails recognising and considering the interests and needs of the different socio-economic groups concerned with the research process and research products.

RRI could be helpful in this regard. It shows that scientific research is a “societal enterprise”, involving various stakeholders at all levels and phases of the scientific process. This is something referred to as “societal alignment” of research and innovation, which is presented by some authors like a dilemma (Kusma and Roberts, 2018; Ribeiro et al., 2018) to be addressed through an enhanced contextualisation of RRI.

Thus, ethical issues involving science and scientists can no longer be managed by science and scientists alone; incorporating in the ethical considerations external viewpoints and practically involving extended configurations of social actors becomes, therefore, necessary.

Some interviewees by PRO-RES in 2020 highlighted the importance for contemporary research to involve as far as possible all the diverse actors affected by the innovation it produces. These include, as said before, decision takers and policy makers, whose demand for science need to be correctly defined and qualified

Concerning responsibility, it comes to my mind the discussion on scientists’ social responsibility as Albert Einstein framed it, when he became president of the special mission on nuclear disarmament. His idea was that physicists, and scientists in general, have a single major responsibility, which is not that of deciding on behalf of the citizens, but to make aware the rest of society of risks and possible outcomes, so that society as a whole can democratically make its own choices. So, among the ethical principles guiding researchers I would put that of establishing a close dialogue with the rest of society providing the knowledge necessary for the citizens to democratically express their leanings and take the appropriate actions. For instance, the Aarhus convention on the environment (...) affirms the right of the citizens to know the status of the environment at the best level of scientific knowledge in the field. A similar principle should apply also beyond environmental sciences (Science communicator and policy advisor).

The final goal of RRI is for and with society. The most visible part of RRI for society is innovation, this is what society sees. Society doesn’t give the same weight to a research announcement, but they will see the importance once they use it (as an innovation). It is innovation that brings back science to society. (...) It is important to use the vocabulary of society (Researcher, policy maker).

For what concerns responsibility in scientific research and innovation, I think that first of all research is in its essence free: it starts from an intuition based on a background of knowledge and aims at advancing the frontiers of knowledge. Having said this, I must add that many researchers risk forgetting that they are supported by public funds and have a responsibility towards the public (Entrepreneur, policy maker).

Public engagement and involvement is something I am committed to, but it has problems. Can be done in a tokenistic way. (...) This means engagement has little influence. But these approaches have real opportunities to influence the relevance of research and for whom. Can also get crucial insights from the participant groups. Can enhance the way you collect and manage data without getting to the point of bias. On this spectrum, especially with qualitative research, the importance is to be transparent (Researcher).

Similar points of view are expressed, among others, by Ferrari in a specific research on additive bio-manufacturing or bioAM (the use of 3D printing for medical purposes or non-therapeutic “human enhancement”) committed by the EP-STOA (Ferrari et al., 2018), by Fisher in an introductory article to a special issue on RRI (Fisher, 2019) and by Ruggiu, in a paper presenting two approaches to the RRI framework (Ruggiu, 2019).

The impacts of bioAM are uncertain, and it is not clear which actions may be required to foster responsible development of the technology. This study responds to these gaps in our knowledge by describing the state of the art and future development prospects, analysing their wide-ranging impacts - including social, ethical and economic aspects – and identifying key policy challenges along with options to respond to them. (...) The European RRI approach could provide a useful platform for responding to these challenges, emphasising inclusiveness and co-creation by a wide variety of stakeholder groups, including public participation (STOA, 2018).

Frameworks and approaches for responsible innovation seek to ensure that the social and public values that underwrite science and technology (...) are effectively aligned with the institutions and practices that shape their outcomes. Whether one thinks of concerns around currently emerging technosciences (...) or over looming slow disasters such as increasing social vulnerability to climate change, governance approaches that can address inevitable regulatory gaps by building and exercising anticipatory, participatory, and integrative capacities are needed as much as ever (Fisher, 2019).

Two approaches can be addressed within the RRI framework: a socio-empirical one, which tends to underline the role of the democratic processes, aimed at identifying values on which governance needs to be anchored (bottom-up); and a normative one, which stresses the role of EU goals (among which are fundamental rights) as ‘normative anchor points’ in governance (top-down). These two approaches also address two different models of anticipation: one based on the construction of shared pathways for reflexivity on the purposes of innovation (visions), the other based on the progressive implementation of constitutional goals in risk assessment and management tools (Ruggiu, 2019).

4.4.2. Timely recognition and anticipation of new ethical issues

The second component of a renewed ethics is that of **timely recognition of new ethical issues**. This leads to the idea of **anticipatory ethics**, especially in the field of new technologies, which has begun to take root in literature also in relation to studies conducted in the framework of RRI.

Anticipatory technology ethics is the practice of analyzing how emerging technologies will be built, imagining how they might be used, and interpreting what their consequences might be. (...) In particular, the paper focuses on the problem of at what layer ethical issues can be found in technology design, and the ways that the material realities of design impact developers' willingness and readiness to participate in anticipatory ethics (Shilton, 2015).

In recent years, emerging technologies have become a major topic of study in the ethics of technology, which has increasingly focused its attention on early-stage intervention in technology development. A number of specific approaches and methods have now been developed for the field, which in many ways is still in its infancy. The main problem for the ethics of emerging technology is (...) how to deal with the uncertainty of future products, uses and consequences, and associated ethical issues that will result from an emerging technology. (...) Special attention will be paid to anticipatory approaches, which combine foresight analysis with ethical analysis. (...) Anticipatory approaches are the only ones that promise comprehensive, future-oriented ethical assessments of emerging technologies (Brey, 2017).

We use the expression Ethical Foresight Analysis (EFA) to refer to a variety of analytical strategies for anticipating or predicting the ethical issues that new technological artefacts, services, and applications may raise. This article examines several existing EFA methodologies currently in use. (...) The conclusion is that a new kind of foresight analysis on the ethics of emerging technologies is both feasible and urgently needed (Floridi and Straith, 2020).

Anticipation is also a need reported by one interviewee by PRO-RES in 2020.

The notion of anticipation in the long term is also important for us, since we tend to refer to the notion of giving directionality to technological change so that countries and communities are not passive, but can actually have some influence in determining the direction of the changes that the development of science and technology bring into social and economic life (Policy advisor, United Nations Official).

This anticipatory attitude, anyway, is problematic, as argued by Nordmann (2019), when creating an illusion of anticipated governance. This issue has relevant implications also for policymakers, who share the need to forecast the effects of policies based on liable scientific information.

One can learn to anticipate what can happen in the world as we know it. But emerging technologies are thought to change the world in relevant ways which is why the question of the future is raised in the first place. Though anticipation does not reach as far as a changed world in the future, this is not necessary for anticipatory governance (...) One can make sense of anticipatory governance and the art of anticipation as a precautionary approach that promotes a regime of vigilance, that is informed by historical experience, and that requires imagination for what might happen in the world as we know it – without anticipating impacts or requiring knowledge of what the future might hold.

4.4.3. Effective ethical practices

The third component where RRI may contribute is that of **the practices for treating ethical issues**.

As also seen before, some well-established mechanisms (such as the creation of institutional ethical committees, the establishment of ethical protocols, or the application of informed consent in all relevant kind of research activities) are no longer applicable in many research contexts, such as research in emergency and warfare situations, or the study migratory processes.

The need to improve the methodologies and practices is discussed by Reijers et al. (Reijers et al., 2017), which review and classify 35 current methods for practising ethics in research and innovation and list pros and cons of each type (ex ante, intra and ex post), highlighting some common limits in all the methodologies reviewed.

Thus, new practices are required, as in the case of innovative research methodologies, and even more where the research outcomes are resulting in innovation, especially in the context of business, which logic is quite different from the academia.

As for **new research methodologies**, document how some innovators in the field of social research methodologies have been very careful in identifying the potential ethical issues generated by their activity, also by proposing handbooks and new practices to deal with such problems as they emerge during operation.

The culture of ethics regulation further adds to the need to manage the riskiness of methodological innovation. Interestingly, Gauntlett, and to a greater extent Kozinets and Kellett, have sought to codify their methods, creating step-by-step guides. These may not conform to notions of innovators being creative, but perhaps instead reflect the cultures in which these academics are operating; the ESRC Framework for Research Ethics is emphatic: 'Risks should be minimised'. The innovators communicate to others that their innovations are contained, not too dangerous, and definitely not ethically risky (Crow et al., 2012).

Coming to how **companies cope with the ethical problems emerging in the management of research and innovation results**, an interviewee by PRO-RES in Summer 2020 highlighted the need to know better what is going on in companies, taking into consideration that ensuring a full transparency is not always possible.

The reference to new/changing nature of who does science (i.e. private companies) is very crucial, you have to link to these sectors. There is the need to also consider the implications of science with the aim to increase European competitiveness. You should address the science/industry collaboration, a situation when you can't be fully open/transparent. Science is also a driver of competitiveness for industry. What happens with this kind of research? This research cannot be open/transparent. How does this fit in 'ethical evidence'? Very useful to explicitly add that Accord also applies to innovation and not just scientific research sector or see how it is relevant there. In fact, for certain fields, one can claim that the main issues/funding go to non-academia, so you can't leave this part out (Policy advisor).

It is worth noting that also a growing literature, both scientific and business-oriented, is now available (see among other, Floridi and Straith, 2020; Van de Poel et al., 2017; Fraaije and Flipse, 2019; Jakobsen et al., 2019) on the ethical and social management of research and innovation in the private sector.

For example, the PRISMA project dealt with such an issue in a RRI perspective, with a particular attention **to mitigate the social impacts of disruptive technologies**.

The PRISMA experience suggests that RRI could help companies that deal with disruptive technologies improve the societal impacts of their innovative products. But to do so, RRI needs to be implemented from the early stages of development onwards and should be considered as a medium- to long-term investment. (Porcari, 2020).

Deloitte, one of the world's largest audit and advisory services companies, has also developed a point of view on ethics in technology, highlighting the **need of a careful attitude all along the innovation process**, to identify and solve the new situations as they show up, involving all the concerned players.

The notion of ethical tech refers to a set of values governing the organization's approach to its use of technologies as a whole (...). It is a multifaceted concept that can encompass a wide variety of issues, from data privacy to bias in algorithms, from replacing humans with machines to a commitment to not manipulating data or human responses (...) Deloitte's research suggests that leaders' biggest social and ethical concerns brought about by digital innovation apart from privacy are related to cybersecurity risks, job replacement, and the unethical use of data. (...) It is not limited to general compliance-related issues or questions of legality; it is neither a stand-alone, siloed effort nor a black-and-white set of blanket policies that dictate strict right and wrong answers to every scenario. Ethical situations are unique and varied, and a robust ethical tech program allows leaders and employees to apply a decision framework to each situation to make the most appropriate judgment (Deloitte, 2020).

As reported by many (see among other Wessel and Helmer, 2020; Wakunuma and Stahl, 2014), **engaging the actors of the technological innovation system with ethics is not an easy task**. Ethics indeed is generally seen as something entailing a bureaucratic procedure preceding the actual beginning of the research or something not falling under the remit of researchers and technology developers. Instead, it should be conceived, according to some authors (see Ethics Canvas Manual 2017), as a reflective practice on the impacts of the technologies while they are designed and along the process, to "(1) show others that you act responsibly and that your work can be trusted. (2) To make sure the quality of your activities will improve and that you will create better products and services. (3) To make sure to do the right thing, paying attention to the common good and the good life."

How to effectively involve the relevant stakeholders, according to Reijers (Reijers et al. 2017), is a **key problem** of almost all the R&I ethics methods and practices. Indeed, all the methods classified by the authors in three categories according to the phase of the R&I process in which they take place, i.e. ex ante, intra or ex post, reveal difficulties in this sense.

A possible way out is a **constant multidisciplinary and multilevel dialogue between actors**. Introducing the proceeding of a symposium on Business and the Ethical Implications of technology, mainly focused on the new digital economy, Kirsten argues that the ethics of technology is analysed

across different disciplines, while less attention is paid to the role that firms and managers play in the design, development, and dissemination of technology across communities and within their firm, making associated value judgments around its use.

We first identify themes the symposium articles share and discuss how the set of articles illuminate diverse facets of the intersection of technology and business ethics. Second, we use these themes to explore what business ethics offers to the study of technology and, third, what technology studies offers to the field of business ethics. Each field brings expertise that, together, improves our understanding of the ethical implications of technology (Kirsten, 2019).

According to the author, in conclusion, the ethical challenges presented by new information technologies are likely best understood through continued cross-disciplinary conversations with engineers, legal theorists, philosophers, organizational behaviourists, and information scientists.

Von Schomberg proposes a reform of ethics underlining the importance of the **ethics of normative design of systems and technologies**, which should cooperate to construct, rather than to hinder the development of new technologies, in dialogue with users, as it already happens in ICT, as exemplified by the practice of the “privacy by design”, also relying on the codes on conduct of the involved actors.

There is an important role for the ethics of normative design of systems and technologies. Ethics has to move beyond an ethics of constraints (e.g. focussing on what should be prohibited or limited) to an ethics of construction. Normative design in open interaction with users is already practiced in ICT and should now be extended to the sectors in which they will operate. Codes of conduct embraced by both public authorities and the private sector are also important. Codes of conduct have the advantage over legislative action since they can already be operational in a context where the technology is still in development and can equally steer its direction by facilitating proper self-regulation and enabling and assigning responsibilities to all stakeholders (Von Schomberg, 2019).

5. MANAGING ETHICAL ISSUES: USING AN RRI-RELATED APPROACH

As said in the introduction, this report is aimed at providing some orientations to better understand the contribution of RRI to the PRO-RES Framework, as it emerges from the consultation of multiple sources, including scientific literature and, especially, the interviews and workshops conducted under the project.

In this final section, we will try to highlight some key points about the nature of RRI and its relationships with research ethics and integrity on the ground of the main elements presented in the previous sections.

5.1. RRI AND THE TRANSFORMATIONS IN SCIENCE AND TECHNOLOGY

The first aspect to single out is the **context** in which RRI emerged.

As highlighted above (Sect. 2.), RRI represents the last phase – and others will follow – of a long process through which research institutions and research systems are reacting to and trying to manage the profound and rapid transformations affecting science as a social institution, well depicted by different interpretive models elaborated in the 1990s (Mode1/Mode2 model, Post-academic science, etc.). More specifically, RRI is an attempt to shape a general policy framework for the governance of European science through the incorporation and coordination of different experiences matured in the past decades in the field of research ethics, gender equality in science, public engagement, open access, and science education and communication.

The key idea underlying this policy framework is that all the concerned actors (from scientists to the public at large) work together to anticipate and manage benefits, consequences, and risks related to scientific knowledge. Hence the principles RRI is grounded on (see Sect. 3.), i.e., anticipation, reflexivity, responsiveness, and inclusiveness.

5.2. RRI AND RESEARCH ETHICS

The second aspect is the **high potential relevance of RRI for research ethics**.

Quite paradoxically, this relevance 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 emerged from the interviews and workshops carried out under PRO-RES (see point 4.1.), the incorporation of ethics in the RRI discourse might not be beneficial for strengthening research ethics, at least at a policy level. RRI is still little known in many important scientific sectors; it is vague in its contents; its boundaries are perceived as too blurred; it is subject to different interpretations; in many cases, communicating RRI is viewed as difficult since it is too wide and may generate confusion. Those who think that referring to RRI can be useful for reinforcing the ethical dimension of science tend to adopt an instrumental or tactical perspective, such as leveraging on the “brand RRI” for reaching a greater audience or influencing the young generations of scientists, more sensitive to the post-academic discourse.

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 as a **stock of knowledge and practices already available** to be used, 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.

5.3. ARTICULATING AND ENLARGING THE ETHICAL VIEW OF SCIENCE

The consulted sources also allow developing 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 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, challenged by the shrinking of available funds and the growing demand of knowledge to be spent on policymaking and innovation. Scientific research methodologies are also changing in many sectors. Changes in research practices are posing new ethical questions (for example, related to the increasing use of AI and big data in research) or altering the way in which old ethical issues are now showing up (for example, hypercompetition is increasing the risk of plagiarism, the growing demand for a quick application of new scientific knowledge is increasing the possibility of inadequate control over the risks of new science-based products).
- **Changes in research subjects.** ITs and other emerging technologies combined with profound social transformations are giving birth to new emerging phenomena leading to new socio-technical configurations. The list of new research subjects is increasing, connected to, for example, the development of nanotechnologies, the increasing societal relevance of digital behaviours, the spreading of IT-based surveillance systems, and the many impacts of AI in many social sectors, like education, tourism, or cultural relations. The emerging of radically new research fields or the profound modification of the existing ones leads to new ethical implications. For example, new ethical principles should be defined (typically, those pertaining to the virtual environment) while established ethical principles can get into conflict with each other (for example, the right of privacy and the right of self-expression in the digital world) or established ethical practices cannot be implemented in the same way as it was in the past (for example, the informed consent in the context of big data).
- **Change in the research actors.** Finally, also the types and number of players involved in the production of scientific knowledge are changing, with the growing involvement of non-scientific organisations and actors (policymakers, professionals, private companies, NGOs, local communities up to the public at large) in the different stages of the research and innovation process. This is having an impact on research ethics (for example, an increased risk of conflicts of interest) or posing new issues susceptible of an ethical consideration (for example, the democratisation of the research process, the attribution of responsibilities on the research outputs, the ethical soundness of research as a ground for evidence-based policies).

5.4. PERCEIVED PRIORITIES FOR RESEARCH ETHICS

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 of 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 report 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 that fact, on the basis of the interviews, the workshops and the literature analysed (see point 4.4.) three priorities have been identified which are related to some RRI dimensions, respectively pertaining to the needs to properly contextualise the research activity, to timely recognise and anticipate the implication 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 consideration 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 not to lose their consistency).
- **Timely recognition and anticipation.** As has 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 categories and social groups, as well as for the 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 (claiming science to adopt an attitude to early detect risks and develop ethically appropriate response). Such dimensions are also very relevant for decision takers and policymakers.
- **More effective ethical practices.** The third priority is that of constantly looking for more effective ethical ways to treat ethically 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 innovation mainly relates to two RRI dimensions, i.e. reflexivity and responsiveness.

5.5. NEXT STEPS FORWARD: ETHICAL AND POLICY IMPLICATIONS

The analysis conducted reveals a very dynamic landscape, where new ethical dilemmas emerge as science and technologies advance, and where a myriad of everyday small and big ethical problems emerge from the research activities.

In order to identify the potential contribution that RRI could make to the PRO-RES framework, we could say that RRI could strongly help **research ethics to become more dynamic, reactive, and anticipatory** in the face of rapid changes in practices and contents of the scientific research, as well as the continual modification of relations between science and the rest of society. Such an approach can also contribute to properly respond to the demands for reliable evidence from decision takers and policymakers, which is a major focus of PRO-RES framework. The RRI perspective can help in approaching evidence-based policymaking as a complex, transactional process, whose results come from the interaction of diverse actors with their different experiences, knowledge, and points of views.

In this perspective, the four RRI dimensions, i.e., anticipation, reflexivity, inclusion, and responsiveness, as well as the many practices and knowledge related to RRI, can be extremely helpful. As we pointed out above, his attitude should characterise not only the research teams, but throughout the research system, including funders, research institutions, industry, policymakers, and the large public.

In fact, research ethics can be no longer, developed only by scientists for scientists or prevalently based on deductive, top-down, and normative procedures. RRI could help develop more proactive, flexible, anticipatory, inclusive, and exploratory ethical practices that are up to the challenges arising from the rapid changes taking place in science and science-society relations as well as those produced by scientific and technological discoveries themselves.

This does not affect the entire picture of research ethics.

There are many **research areas which are ethically stable**, i.e., areas in which both ethical principles and ethical procedures are consolidated and still effective. For example, a large part of social research is conducted following well-established methodologies and not sensitive issues, entailing some sort of risk.

However, there are other kinds of **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, in areas such as research in public spaces, research in conflict and disaster areas, or the internet-based research, e.g., research using automated natural language processing tools. In all these areas, the ethical principles are quite clear (for example, the principle of privacy protection or the non-harm principle) but the procedures for applying them are uncertain since the traditional ones are increasingly ineffective.

Finally, to a smaller extent, there are 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 HET, which are creating new social meanings, situations and configurations which need ethical interpretation. Especially these domains, research ethics is required to be proactive, explorative and anticipatory.

The identification of these three areas of increasing ethical uncertainty to be approached proactively, has also implications in terms of PRO-RES main concern to **ensure that decision takers and policymakers are provided with scientific evidence that is reliable and trustworthy and ethically generated**. This can be seen both for what concerns the quality of the research results and for what concerns the process by which the evidence is put to use for formulating better, more effective policies.

For what concerns the first aspect, we can consider that often the research areas whose results are more acutely needed are those where the degree of uncertainty is higher. It is 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.

As for the second aspect, we can highlight that research conducted according to RRI principles is well equipped to participate in that transactional, multifaceted effort that is implied by a proper **evidence-based policymaking**. In fact, even the best scientific evidence cannot be mechanically translated into a policy. What is required is a complex, non-linear process that involves contextualisation, reflexivity, capacity to consult and interact with relevant actors and stakeholders, anticipating risks and opportunities, in a word, to consider those dimensions that are part and parcel of RRI.

The approach inspired to a **responsible and open science and innovation** – whatever the future label used will be – could be extremely helpful in providing research ethics with concepts, ideas, practices and knowledge allowing a more effective ethical management of the more unstable and newer research areas, especially considering that, in the future, it will be precisely these areas to increasingly weigh within both scientific and technological research and society. At the same time, these ideas and practices can foster the use of good quality, ethically sound **scientific evidence to support policies** able to address the wicked problems of contemporary societies.

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ANNEX 1 OVERVIEW OF THE EXPERTS CONSULTED IN SUMMER-FALL 2020

