

# A New Bet for Scientists?

## Implementing the Responsible Research and Innovation (RRI) Approach in the Research Practices

Alba L'Astorina<sup>1</sup> - Monica Di Fiore<sup>2</sup>

<sup>1</sup> CNR-IREA, Milan

<sup>2</sup> CNR-RSI, Rome

DOI: <http://dx.doi.org/10.7358/rela-2017-002-last>

lastorina.a@irea.cnr.it  
monica.difiore@cnr.it

---

### ABSTRACT

*In last years, the European Commission has promoted an approach that seeks to anticipate and assess potential implications and societal expectations with regard to research and innovation, with the aim to foster the “design of inclusive and sustainable research and innovation”. The approach, called Responsible Research and Innovation (RRI), has become a crosscutting theme of Horizon 2020, the most important European research funding system. RRI has its roots in a longstanding debate on the sense of techno-scientific innovation and its power to produce both benefits and harm, producing risks, arising ethical dilemmas and controversial questions. It proposes a framework for governing the innovation process asking all actors to become mutually responsible and responsive in order to reach “socially desirable” and “acceptable” innovation goals. Years after its emergence as a policy concept, studies and reports have evaluated the efforts to mainstream RRI in the national policies, revealing that questions still remain open to discussion. In this paper we will give a brief overview of RRI approach, what it is, why and how it emerged and developed within the policy discourse in the European context. We will then review some key lessons concerning opportunities and challenges embedded in this approach, focusing on the role of science.*

**Keywords:** Responsible Research and Innovation, Horizon 2020, science and society, governance, innovation, responsibility, ethics, science and technology studies, postnormal science.

## 1. INTRODUCCION

We wrote this paper as a contribution to the Summer School “Food: shared life”<sup>1</sup>, designed to review and discuss, in a critical perspective, the socio-cultural aspects underlying the system of Food in contemporary society, the potential of new technologies and the constraints they induce, impacts and possible conflicts of perspective they generate.

In particular, the School aims to bridge the “knowledge gap between production and consumption as a key moment in the construction of a new and deeper understanding of the relationships of dependence and power that tie, so mutual though not equal, human beings to other living beings”. Reducing the distance between “our food” (consumption) and “its origin” (production) is here proposed as a way to develop responsible processes, to anticipate the “possible conflicts of perspectives” and to avoid the “break between the human environment and the rest of the natural world that the modern system can generate”. This process can so facilitate “the transition from *moral private concerns* about the world we live in towards a dimension of *social concern*”.

Questions concerning responsibility, not only in the modern Food system, are at the center of a longstanding debate on the sense of technoscientific innovation in our contemporary societies and its power to produce both benefits and harm, producing risks, arising ethical dilemmas and controversial questions.

Taking cue from the premises and objectives of the School, we will describe here a recent approach promoted by the European Commission in order to anticipate and assess potential implications and societal expectations with regard to research and innovation in different areas. The approach, called Responsible Research and Innovation (RRI) suggests a framework for governing the innovation process asking all actors to become mutually responsible and responsive in order to reach *socially desirable* and *acceptable innovation goals*.

In this paper we will give a brief overview of RRI, what it is, why and how it emerged and developed within the policy discourse in the European context. We will then review some key lessons from empirical and academic studies, showing a multiplicity of views concerning opportunities and challenges embedded in this approach.

Our perspective is that of social researchers interested in understanding RRI as part of wider debates on the relations between science, society and governance and the role that science communication can play towards

---

<sup>1</sup> <https://users.unimi.it/lavitacondivisa/index.html>.

a deeper awareness of all actors. Reducing the distance between those who “make” science, and those who “reflect” on it, is here proposed as a way to develop responsible processes, to anticipate the “possible conflicts of perspectives” and to avoid the “break between the human environment and the rest of the natural world” that the modern system of innovation can generate.

## 2. THE RRI AS A WAY TO REFRAMING THE RELATIONS BETWEEN SCIENCE AND SOCIETY

In last years, the European Commission (EC) has promoted an approach that seeks to anticipate and assess potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation (von Schonberg 2013). The approach, called Responsible Research and Innovation (with its acronym RRI), has become a crosscutting theme of Horizon 2020 (Sis.net 2016), the biggest European research and innovation program, that funds “sustainable solutions to the challenges of the 21<sup>st</sup> century, such as global warming, energy, water and food, ageing societies, public health, pandemics and security” (Svedin 2009).

RRI emerged from a wide debate – still ongoing – addressing the social, ethical and epistemological nature of techno-science, its implications for society and the role of governance in this framework. The discussion involved scholars, particularly active in Science and Technology Studies and Humanities, and experts at the Science and Society domain at the European level.

The context in which the discussion developed is one facing with the “limitations of extant policy approaches to managing ethical-problematical areas of science and innovation” (Owen, Macnaghten, and Stilgoe 2012) pervading society, such as genetically modified organisms (Grove-White, Macnaghten, and Wynne 2000), synthetic biology (Bhattachary, Calitz, and Hunter 2009), geoengineering (Royal Society 2009) and ICT (von Schonberg 2011).

Dilemmas on the difficulty to control uncertainty, unpredictable emergent technologies in the complexity (Funtowicz and Ravetz 1985) were also accompanied by a crisis of trust in Britain (House of Lords 2000) and elsewhere concerning the relations between science, politics, economy and society, that called for a radically different approach. The BSE scandal in

the mid 1980s to mid 1990s<sup>2</sup> is often reported as a watershed in the change of direction of this relations, setting the scene for a “civic dislocation”<sup>3</sup> (Jasanoff 1997) and opening up to a long season of experimentation models of publics’ involvement in science, varying from deficit to dialogue, upstream public engagement, knowledge co-production, civic epistemologies (Jasanoff 2004, 2005, 2006; Pereira 2009), which is still ongoing.

The debate is strongly intertwined with the longstanding discussion about responsibility in science, integrity and autonomy of research, arisen as topics of interest alongside the period of Enlightenment in the 18<sup>th</sup> and 19<sup>th</sup> centuries, with the emergence of a bourgeois society in France, where citizens would have rights and duties. The development of a “language of responsibility” was necessary in order to discuss the evolving social order, where also the relations between (emergent) science and society were changing (Rip 2014).

Some aspects related to responsibility also have roots in previous historical periods, if we consider the process of institutionalization and professionalization of science started with the emergence of modern science in the 17<sup>th</sup> century. The mechanistic “Cartesian dream” (Pereira and Funtowicz 2015), with its view of a dualistic separation of facts and values, of “Men as masters and possessors of Nature”, and the illusion of a quantitative understanding, prediction and control of the world, was associated with an ideal of progress as unlimited growth<sup>4</sup>.

During the 20<sup>th</sup> century, the debate had an acceleration due to the transformation of the system of knowledge production, especially in relation to the transition from “Little” to “Big Science” and its impact on society and governance. In 1960 Alvin M. Weinberg had warned of the risks of such a transition (Weinberg 1961), which would lead scientists to persuade

---

<sup>2</sup> The BSE scandal refers to the behavior of UK government ministers who promoted a campaign (asking support from the scientific committee of advisers) to reassure the public that the bovine spongiform encephalopathy (BSE) disease could not be transmitted to humans through the consumption of beef from infected animals. Days after it became clear that there was indeed a risk and that people were dying of BSE.

<sup>3</sup> Jasanoff calls “civic dislocation” the unprecedented breakdown of communication that citizens and their public institutions experienced during the BSE crisis: a mismatch between what governmental institutions were supposed to do for the public, and what they actually did. Due to a fall down of trust in government, people looked elsewhere for information and advice demonstrating that, in uncertain times, the distance between citizens and experts decreases and the lay public is almost as well positioned as the experts to make sensible decisions about how to avoid risks such as the BSE.

<sup>4</sup> For a critical journey of the “Cartesian dream” through the evolution of different disciplines (such as biomedicine, geoen지니어ing, ICT), and its impact on the way technological innovation is narrated today see Pererira and Funtowicz 2015.

political and public opinion of the need for big money for research. Weinberg had also predicted that, with fewer financial constraints, scientists would be under less pressure to reduce the complexity of the problems and have less reasons to reflect on purposes and effects of their research. Some years later de Solla Price identified the dangers of saturation and senility attendant on the exponential growth of science (de Solla Price 1963), while in the 1970s Jerome Ravetz described science as a social process with all the failing and imperfections of human endeavours, highlighting the moral and ethical impact of the industrialized science (Ravetz 1971).

The “myth of science” and its privileged role in contemporary society addressed by scholars (Feyerabend 1975) and a certain narrative of scientists as a self-organizing community devoted to the pure pursuit of knowledge (Polanyi 1962), of science as separated from other domains of human activity, not subject to society’s rules in the name of its internal ethics (Tallachini 2009), inaugurated a process that would, in following years, exacerbate the perception of a separation between science and society.

Questions concerning the integrity of research and the ability of techno-science to adequately respond to the challenges of modernity, have to face now with a complex context, characterized by uncertainty (Funtowicz and Ravetz 1985), where innovations hardly have a single author who can be held responsible for its use or misuse and consequences are often neither foreseeable nor intentional (Owen 2011).

Environmental disasters such as Seveso, Chernobyl, Fukushima, Bhopal address the unsustainability of a development system that requires growing consumption in a finite world of limited resources and an increasingly saturated market. In this scenario some scholars address the limits of consequential approaches, such as the quantitative risk assessment and management, and propose to recognize the contribution and the role of all relevant stakeholders (“extended peer community”) in the search for democratic solutions to modern challenges (Funtowicz and Ravetz 1994)<sup>5</sup>.

---

<sup>5</sup> The authors argue that, in all situations with a high level of uncertainty and where the evidence itself is contested due the diverging norms and values of the actors, the right to access and to create knowledge, to formulate research questions and to take decisions cannot be the prerogative of a few members of the scientific community recognized as experts on a given subject. This right should rather be extended to all stakeholders: including holders of minority perspectives, scientists and experts from other relevant sectors, and citizens with informal knowledge not recognized by normal science, who can moreover contribute with socio-political options.

## 2.1. *The emergence of RRI in the European context: principles and milestones*

Despite the longstanding debate on responsibility, the emergence of the concept of RRI in the EU policy discourse is considered a recent phenomenon, dating, for some authors, 2011. In this year a selected group of experts both from policy and academia were involved in a series of debates aimed at developing a shared understanding of RRI and formulating policy recommendations to support the development and implementation of a policy inspired by the concept of RRI across the European Research Area (ERA). The attempt was “to address the growing tension between ‘innovation’ as the driver of jobs and economic growth, and ‘innovation’ as finding socially and environmentally responsible ways to provide for Europe’s basic needs” (de Saille 2015).

In the same year the concept of RRI as a form of participatory engagement was incorporated into the key proposal establishing the legal framework for Horizon 2020<sup>6</sup>. The approach of RRI emerged in this framework considers as central the necessity to *anticipate* and gain knowledge of possible consequences and building a collective capacity to respond to them (van den Hoven, Lokhorst, and van de Poel 2012).

In order to reach this goal, theory and practice of RRI recommend all societal actors – researchers, citizens, policy makers, business, third sector organizations, etc. – to work together during the whole research and innovation process in order to “better align both the process and its outcomes with the values, needs and expectations of society”<sup>7</sup>, in the prospective of a reciprocal responsibility. Even if a single definition is not univocal, many scholars agree with following formulation of RRI as:

A transparent, interactive 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 (in order to allow a proper embedding of scientific and technological advances in our society). (von Schonberg 2011)

In a short informational leaflet (European Commission 2012), a further articulation of RRI in practice is said to comprise six key dimensions: inclu-

---

<sup>6</sup> For a review of the processes through which RRI has been incorporated into Horizon 2020 as a policy framework for the ERA which promises that technological innovation would be shaped towards social goods, see de Saille 2015 and Stilgoe, Owen, and Macnaghten 2013.

<sup>7</sup> <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society>.

sive Public Engagement; a commitment to Gender equality; more Science Education; Ethics, defined as shared values reflecting fundamental rights; Open Access to data, and developing new models of Governance.

Many of these keys are not new as governance concerns in the EU policy discourse. Their origins go as far back as the 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> EU Framework programs (Archibugi et al. 2014) as a result of the collaboration among scientific disciplines in addressing the wider dimensions and implications of science and innovation in society. In a recent paper for the OECD, aimed at monitoring the evolution and benefits of RRI through a set of indicators, the keys have been reframed extending their meaning (Meijer et al. 2016).

*Public Engagement* refers to the activities aimed at fostering the collaboration among all societal actors during the whole research and innovation process in order to “align its outcomes to the values, needs and expectations of European society”.

*Science Education* aims at enhancing the current education process to better equip citizens with the necessary knowledge and skills that allow them participate in the debate on research and innovation, and to motivate students towards scientific careers.

*Open Access* aims at making research results freely available to anyone who wants to access and re-use them. The topic, maybe the most sensitive for researchers, has become a public concern due to the copyright rules imposed by the academic publishing market that hinders free access to publicly funded research results and knowledge transfer. In the framework of RRI, openness should apply to all components of the research process, and not be restricted to the outcomes only. More recently, the EC is moving from OA to Open Science, including also topics such as infrastructure, intellectual property rights, content-mining and alternative metrics, inter-institutional, inter-disciplinary and international collaboration among all actors in research and innovation.

Also the topic of *Gender* balance in science and research is present since time, having changed its focus intensively during the years. Initially, underrepresentation of women and policies against inequalities were treated as a question of social justice; more recently they were justified on the basis of economic reasons, in order to make Europe able “to achieve a competitive knowledge-based society, requiring an increase in the number of researchers” (European Commission 2003). In 2007, the EC changed its policy approach from “fixing the women” to “fixing the institutions” in line with the process related approach of gender mainstreaming (Lipinsky 2014). This includes both the provision of specific career support for women as well as institutional measures.

*Ethics* in RRI focuses on research integrity: the prevention of unacceptable research and research practices, and on the ethical acceptability of scientific and technological developments in the society.

*Governance*, more than a key dimension of RRI, is considered as a “horizontal dimension” affecting all the other ones as it is concerned with how knowledge is produced and how it is disseminated (2015).

In the Rome Declaration of 2014 (European Commission 2014), RRI approach is linked to “the principles on which the EU is founded: i.e. respect of human dignity, freedom, democracy, equality, the rule of law and the respect of human rights, including the rights of persons belonging to minorities”. The Declaration stresses “the need for early and continuous engagement with all stakeholders as science should not only be regarded in terms of conducting ground-breaking research, but should also encompass principles of openness, responsibility and co-production of knowledge”.

An “ideal” RRI process should “help scientists and innovators to identify four dimensions in their activities: anticipation, reflexivity, inclusion and responsiveness” (Stilgoe, Owen, and Macnaghten 2013). This means that they should be able to understand (*anticipate*) how the current processes will effect and define future needs; examine and *reflect* on actions and consequent effects concerning all aspects of research and innovation: from daily routines, planning assumptions and personal interactions, all the way up to institutional values and strategies. A wide range of stakeholders should be involved in an *inclusive* way throughout the whole research process, in order to generate diverse perspectives and expertise. Finally, activities should be flexible and open to adapt existing organizational structures in *response* to evolving environments, values and insights.

The definition of these dimensions originate from questions emerged within public debates about new areas of innovation, considered as “the kind of questions that public typically ask scientists, or would like to see scientists ask of themselves”, such as: *Which values should lead innovation in Europe? What are the right impacts that innovation should be directed towards and how should these be arrived at? And, more: Why doing innovation? For what purpose? Are their goals desirable? Who could benefit and how? Who remains excluded?* (Stilgoe, Owen, and Macnaghten 2013). Their inclusion as aspects of societal concern and interest in RRI are intended to “embedding deliberation on these questions within the innovation process”.

In this formulation, RRI would go beyond balancing risks and benefits and become a “departure point” to answer in an inclusive, democratic way, the question *What sort of future do we collectively want?* in order to reach *socially desirable and acceptable innovation goals* (Owen 2011).

## 2.2. *Some examples of promoting RRI in Europe*

Since its first formulation in the European context, many attempts have been made to make formal policy commitment to RRI. The approach is increasingly present in funding calls, both explicitly and implicitly, to foster the ethical acceptability, sustainability, and social desirability of research and innovation outcomes. It is a growing presence within the EU's Horizon 2020 Framework Programme (SiS.net 2016), as well as in some national schemes both of public and private funders of research and innovation (Angelaki 2016).

It is particularly diffused in some North European countries, such as in the UK, where the Engineering and Physical Sciences Research Council (EPSRC)<sup>8</sup> have created a framework for RRI used to select projects and monitor their progress. The Dutch Research Council NWO<sup>9</sup> also has a dedicated funding program MVI (Societally Responsible Innovating), now often referred to as RRI, which started earlier than the emergence of the concept at the European level. In Norway the ELSA Norway network<sup>10</sup> project, financed by the Research Council, aims at coordinating a research network having Ethical, Legal and Social Aspects of science and technology as its research topic. In Denmark, even if the term RRI is not widely used, the Danish Board of Technology is famous for developing dialogue based methods at local level for discussion public concern in science and technology and for finding sustainable and interdisciplinary solutions engaging all actors.

Italy contributed to the EU discussion on RRI with the Rome Declaration 2014 (European Commission 2014), even if a national RRI strategy does not exist. In 2015, the Italian Association for Industrial Research (AIRI) and the National Research Council (CNR) signed an Agreement to develop policy recommendations to promote RRI in Italy (AIRI 2015) while private funders supporting innovation, among them Cariplo<sup>11</sup> and Bassetti Foundations<sup>12</sup>, explicitly require scientists to follow the RRI approach in their research proposals. Recently CNR has promoted an initiative aimed at bringing the debate on responsibility in research in the scientific arena starting from the RRI platform. While writing this article, a book on the event is on preparation, but first results reveal challenges and opportunities of RRI perceived by scientists that will be partially discussed here.

---

<sup>8</sup> <https://www.epsrc.ac.uk>.

<sup>9</sup> <https://www.nwo.nl/en/research-and-results/programmes/responsible+innovation>.

<sup>10</sup> [http://www.forskningsradet.no/en/Strategy\\_plans/1185261825593](http://www.forskningsradet.no/en/Strategy_plans/1185261825593).

<sup>11</sup> <http://www.fondazionecariplo.it/it/index.html>.

<sup>12</sup> <http://www.fondazionebassetti.org/tags/RRI>.

RRI is not only on the agenda of the EU. Even if the US does not have a RRI programme, various legal, ethical and social implications have been raised in various programmes, named ELSI (ethical, legal and social implications). For example, implications that would fall under the term RRI have been included in the *Human Genome Initiative and the National Nanotechnology Initiative* (Guston 2014). RR similar approaches are also being taken under different labels, such as the *US NSF Broader Impacts*<sup>13</sup> and the *Australian Research Council's Responsible Conduct*<sup>14</sup>, or under the values expressed in the *Daejeon Declaration on Science, Technology, and Innovation Policies for the Global and Digital Age*<sup>15</sup>. More resources on RRI practices in the different European countries can be found on the website of the RRI tools Project<sup>16</sup>.

### 2.3. RRI: opportunities and challenges

The role of EC in the diffusion of RRI concept in the scientific domain has been crucial. Introducing it as a crosscutting theme of Horizon 2020, policy officers have “pushed” research teams to plan a RRI strategy in their funding proposal and to carefully consider the peculiarity of each key action of responsibility. Today, every researcher who wants to apply for a European funding program must demonstrate that her/his way of producing knowledge is compliant with RRI requirements. However, questions still remain open to discussion and debate, among these, how to implement RRI in the practices of the scientific procedure considering the current system of knowledge production.

It is beyond the scope of this paper to exhaustively report the richness of the debate on RRI which is still ongoing. We will only report some key lessons from empirical<sup>17</sup> and academic studies in the field, showing a multiplicity of views.

For Leo Coutellec, “RRI does not require the introduction of new departments within existing scientific institutions”, whereas values present in RRI, such as impartiality, fecundity and diversity are “intrinsic part of science itself”. However, scientific knowledge and concrete innovations participate in “a greater ecosystem of causes and effects” which goes

---

<sup>13</sup> <https://www.nsf.gov/pubs/2007/nsf07046/nsf07046.jsp>.

<sup>14</sup> <https://www.arc.gov.au/policies-strategy>.

<sup>15</sup> <http://www.oecd.org/sti/daejeon-declaration-2015.htm>.

<sup>16</sup> <https://www.rri-tools.eu/homepage>.

<sup>17</sup> <https://www.rri-tools.eu>.

beyond the scientific field into the social one. All actors have to be aware not only of potential risks of techno-science application, but also of the implications of such interactions (Coutellec 2016).

According to Ulrike Felt, while the ideals underlying RRI seem self-evident, integrating social actors, their values and ways of knowing is more complex. Felt identifies implicit and explicit tensions and resistances from the world of research, such as pressures on scientists to produce excellence research, and the lack of a “shared understanding of the research process” among actors. Also, a “tacit hierarchy between science and society”, bearing the idea that “certain kinds of knowledge are better than others” makes *on par* relationship still difficult. Last but not least, the research agenda is mainly dictated by scientists and a participation in the framing also of the questions to be addressed is still a chimera. All this can limit the potential for change of RRI and calls for a cultural shift where “research cultures and practices have to be reconsidered” (Felt 2016).

Arie Rip argues that “RRI has all the trappings of a fashion”, developing “a secondary industry of RRI conferences and workshops, building on the funding available through Horizon 2020”. In some areas, actors like to refer to RRI as a “legitimation to their activities”, strengthening their “social license to operate”. However, even as a passing fashion and a “dynamic open-ended concept” (Rip 2014; 2016a; 2016b), RRI has created spaces where the division of moral labour among scientists and citizens can be discussed and negotiated. In this sense he considers RRI “a promising field of a science policy for the 21<sup>st</sup> century”.

One of RRI main weak points seems to be the implementation process, challenged by the multilevel dimension of the *Governance*. While scientists traditionally manage how knowledge is produced, certified, made credible and communicated, RRI *Governance* of innovation goes beyond concerns about technology and its regulation and requires a shared management among science, society and governance. This principle collides with the fact that scientists, citizens, industry, at various level, hold their own interests, expectations, values, strategy and motivations, often conflicting each other. The *multilevel Governance* aspect of RRI (Randles et al. 2016) and scholars’ reflections call for inter and trans-disciplinarity, where aspects concerning “how the different role and responsibilities of various actors are attributed and how these operate” (Rip 2016b), and their “social, political and cultural visions” can be negotiated.

Empirical studies (Macnaghen et al. 2016) show that social and cultural factors affect the whole innovation process. Analysing them from a cross-cultural perspective beyond Europe, scholars identify these factors as barriers. Religious beliefs, for example, could be impending factors for the

Gender balance and for Ethics issues as they are not fully grasped by RRI European political regulatory framework (Macnaghten et al. 2016).

RRI approach in the making could also question the automatism whereby goals of innovation process are mainly “growth and jobs” (European Commission 2013), and innovation and technology innovation coincide. It is necessary to reflect on their socially shared visions: “[...] such reflexivity requires acknowledging that stakeholders may adhere to paradigms in which innovation and possibly also the problem at hand are conceptualised differently” (de Hoop, Pols, and Romijn 2016). Co-production of knowledge will make explicit other possible framings of issues, coherent with a specific context. Political, technological and economic development, cultural and social economic issues “can obstruct, divert or hijack alternative options and different innovation trajectories” (Macnaghten et al. 2016).

RRI definition “is firmly anchored in European policy processes and values” (Meijer et al. 2016). Being focused mainly on responsible innovation (RI), some scholars emphasize that it is a “northern political artefact [...] in terms of culture, politics, economy, demographics, governance and power structures, institutional arrangements, science and society relationships” (Macnaghten et al. 2016). This poses challenges in terms of its diffusion in the rest of Europe and beyond European borders. How were they addressed so far?

With the aim to promote a political change, European Commission financed a study for monitoring evolution and benefit on RRI and in order to mainstream RRI concept, as its diffusion is “so far, quite modest” (Meijer et al. 2016). The project developed a set of RRI indicators that allows comparison in time, simplifying a complex concept into 6 indicators for each of the RRI keys, even being aware of the bias connected to the use of indicators. However, attempts to monitoring and evaluating the state of art, such as this project does, risk to privilege the EC concerns to “accountability and evaluation of public spending on higher education and research” (Meijer et al. 2016) and to overlook other sides of this multifaceted process, more sensitive to an actual social change.

### 3. RRI: THE ROLE OF SCIENTISTS

Studies show that shifting to RRI framework entails a legacy effect between the previous knowledge production model and the new one under the umbrella of RRI frame. This implies a transition process, during which social, political and scientific changes need to be aligned: it requires sci-

entist to recognize a new category of peer, citizens to bring their social claims into the world vision framing process, industry to negotiate its role into society as innovation carrier and, finally, policy makers to facilitate the *institutional change* expected by RRI helping all actors share its framework.

However the transition process towards knowledge co-production means that each of these actors have to make a *cultural change*, bridging the gap of a “shared understanding of the research process” among all of them (Felt 2016). Reinforcing informal science communication at all levels can be a way of “reducing the distance”.

While the social and political implications of change have been widely faced with in many projects, the conditions for the engagement of one of the main actors of RRI frame, that is the scientists, are still debated. Efforts to “mainstream” RRI across the European research area have been modestly successful (Meijer et al. 2016) and studies indicate significant obstacles at both organizational and individual levels.

In the modern system of knowledge production researchers’ strategy, interests and expectations are strongly affected by research and innovation policies. While high impact publications are considered “a core academic activity clearly carrying merit”, engaging in public outreach or stakeholder dialogues “might easily be considered peripheral activities without straightforward value for the individual scientists” (Meijer et al. 2016). This different behaviour can be considered as a trade-offs among policies: if RRI science and research innovation policies do not share the same vision, they trigger that a *competing effect* among them transform the whole process RRI into a matter of protocol, a new bureaucratic fulfilment among others.

Furthermore, asking scientists to be compliant with RRI framework, means shifting from curiosity driven research to compliancy driven research and this requires scientists also to break a taboo at individual level. Are scientists, producing “truth and facts”, disposed to open their work to public scrutiny? Do they confer legitimacy to “extended peer community”?

Recognizing that the call for mutual responsibility also has roots in a certain crisis of science (Benessia et al. 2016) and in the “participatory turn” of modern societies (Jasanoff 2003), can allow understanding the RRI keys as opportunities rather than only constraints. Discussing the possibility to develop alternatives to the centrality of risk discourse (not only in RRI), scholars suggest a revision of the concept of *responsibility*, “decoupling it from the desire for control over Nature and the future and re-coupling it to its relational dimension: that of how humans ask and respond to each other and more fundamentally live together” (Funtowicz and Strand 2011). Paraphrasing the authors, if experiments with RRI keys within research projects “are not the result of a deep self-conscious analysis”, they might

actually become “a way to reinforce existing technocratic structures”. If we take “Ethics” (but also *Open Access*, *Public Engagement* or *Science Education*) away from the democratic political process that generated it, we risk to “normalize” it as another objectified expert discipline (Funtowicz and Strand 2011) or, as we would add, another bureaucratic duty to fulfill with.

Assuming this viewpoint, for example, a researcher who is required in a proposal to “keep a balanced Gender gap” can stop considering it as a question of “social justice” and allow it as a chance to introduce alternative perspectives in facing societal challenges; behaving according to “Ethical” norms, can transform from just applying moral norms and codes to put in place a different conversation, or more equitable relations, with other beings and our planet as a whole.

#### 4. CONCLUSIONS

We wrote this paper within the context of the Summer School “Food: shared life”, designed to review and discuss, in a critical view, the socio-cultural aspects underlying the system of Food in contemporary society, impacts and possible conflicts of perspective they generate.

Our intent was to bring in this context some aspects of the ongoing debate, both in the academia and in the European institutions, on responsibility in modern complex societies, describing a recent approach promoted by the European Commission, called Responsible Research and Innovation (RRI).

We have started by encompassing RRI as part of wider discussions on the sense of techno-scientific innovation and its power to produce both benefits and harm; we have briefly outlined the history of RRI and its milestones in Europe and beyond.

We have, finally, reviewed some key lessons from empirical and academic studies, showing a multiplicity of views concerning opportunities and challenges embedded in this approach, focusing on the role of science in this framework.

We want now conclude with a general consideration on RRI as a “departure point” to reach a *socially desirable* and *acceptable innovation*, and a way to answer, in an inclusive and democratic way, the question *What sort of future do we collectively want?*

If RRI is a “open-ended” concept, whose meaning and practice have to be co-constructed in an interactive and iterative way among all actors, then these questions call for an open discussion of possible alternative nar-

ratives of *responsibility*, in which the political, ethical and social dimensions of innovative processes are accorded as much importance as the scientific and technological ones.

This implies to rethink the dominant positivistic narrative, that presents techno-scientific innovation – supposed to extend indefinitely the boundaries of human existence and agency through the creative manipulation of matter, energy and life – as the only solution to the systemic crises that we face (Benessia and Funtowicz 2016).

More “conversations” (Waltner-Toews 2015) – among the species, among sciences and humanities, among cultures, among different ways of knowledge production – seems to be the formula to think of future as an inclusive project affecting all dimensions of being.

## REFERENCES

- AIRI. 2015. “Responsible-Industry: a Framework for Implementing Responsible Research and Innovation”. *Nanotec*. Accessed July 10, 2017. [http://www.nanotec.it/public/wp-content/uploads/2016/03/Responsible\\_Industry-RRI\\_Framework.pdf](http://www.nanotec.it/public/wp-content/uploads/2016/03/Responsible_Industry-RRI_Framework.pdf).
- Angelaki, Marina. 2016. “An Introduction to Responsible Research and Innovation”. *Pasteur4oa*. Accessed July 10, 2017. [http://www.pasteur4oa.eu/sites/pasteur4oa/files/resource/RRI\\_POLICY%20BRIEF.pdf](http://www.pasteur4oa.eu/sites/pasteur4oa/files/resource/RRI_POLICY%20BRIEF.pdf).
- Archibugi Daniele, Ilaria Ampollini, Carla Basili, Massimiano Bucchi, Tommaso Castelani, Rossella Palomba, Emanuela Reale, Angela Taraborrelli, Brian Trench, and Adriana Valente. 2015. *The Contribution of the European Commission to RRI: a Review of the Science and Society (FP6) and Science in Society (FP7) Programmes*. Roma: CNR edizioni.
- Benessia, Alice, and Silvio Funtowicz. 2016. “Never Late, Never Lost and Never Unprepared”. In *The Rightful Place of Science: Science on the Verge*, written by Alice Benessia, Silvio Funtowicz, Mario Giampietro, Ângela Guimarães Pereira, Jerome Ravetz, Andrea Saltelli, Roger Strand, and Jeroen van der Sluijs, 71-114. Tempe, AZ - Washington, DC: Consortium for Science, Policy & Outcomes.
- Benessia, Alice, Silvio Funtowicz, Mario Giampietro, Ângela Guimarães Pereira, Jerome Ravetz, Andrea Saltelli, Roger Strand, and Jeroen van der Sluijs. 2016. *The Rightful Place of Science: Science on the Verge*. Tempe, AZ - Washington, DC: Consortium for Science, Policy & Outcomes.
- Bhattachary, Darren, Juliet Pascall Calitz, and Andrew Hunter, eds. 2009. *Synthetic Biology Dialogue*. London: Sciencewise.
- Coutellec, Léo. 2016. “Responsibility Means Answering to and for Science”. *EuroScientist*, Special Issue on *RRI Implementation*. Accessed July 10, 2017. <http://www.euroscientist.com/rri-implementation>.

- de Hoop, Evelien, Auke Pols, and Henny Romijn. 2016. "Limits to Responsible Innovation". *Journal of Responsible Innovation* 3 (2): 110-34. doi: 10.1080/23299460.2016.1231396.
- de Saille, Stevienna. 2015. "Innovating Innovation Policy: the Emergence of 'Responsible Research and Innovation'". *Journal of Responsible Innovation* 2 (2): 152-68. doi: 10.1080/23299460.2015.1045280.
- de Solla Price, Derek. J. 1963. *Little Science Big Science ... and beyond*. New York: Columbia University Press.
- European Commission. 2003. *Women in Industrial Research The Wake-up Call for European Industry*. Accessed July 10, 2017. [http://ec.europa.eu/research/science-society/women/wir/pdf/wir\\_final.pdf](http://ec.europa.eu/research/science-society/women/wir/pdf/wir_final.pdf).
- . 2012. *Responsible Research and Innovation: Europe's Ability to Respond to Societal Challenges*. Accessed July 10, 2017. [http://ec.europa.eu/research/science-society/document\\_library/pdf\\_06/responsible-research-and-innovation-leaflet\\_en.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf).
- . 2013. *Investing in European Success – HORIZON 2020 Research and Innovation to Boost Growth and Jobs in Europe*. Accessed July 10, 2017. <https://ec.europa.eu/programmes/horizon2020/en/news/investing-european-success-horizon-2020-research-and-innovation-boost-growth-and-jobs-europe>.
- . 2014. *Rome Declaration on Responsible Research and Innovation*. Accessed July 10, 2017. <https://ec.europa.eu/digital-single-market/en/news/rome-declaration-responsible-research-and-innovation-europe>.
- Felt, Ulrike. 2016. "Associating Citizens with the Scientific Process from the Start". *EuroScientist*, Special Issue on *RRI Implementation*. Accessed July 10, 2017. <http://www.euroscientist.com/rri-implementation>.
- Feyerabend, Paul. 1975. "'Science': the Myth and Its Role in Society". *Inquiry* 18 (2): 167-81.
- Funtowicz, Silvio O., and Jerome Ravetz. 1985. "Three Types of Risk Assessment: a Methodological Analysis". In *Risk Analysis in the Private Sector*, edited by Chris Whipple and Vincent T. Covello, 217-32. New York: Plenum Press Miller.
- . 1994. "Uncertainty, Complexity and Post-normal Science". *Environmental Toxicology and Chemistry* 13 (12): 1881-5.
- Funtowicz, Silvio, and Roger Strand. 2011. "Change and Commitment: beyond Risk and Responsibility". *Journal of Risk Research* 14 (8): 995-1003.
- Grove-White, Robin, Phil Macnaghten, and Bryan Wynne. 2000. *Wising Up: the Public and New Technology*. Lancaster, UK: CSEC, Lancaster University.
- Guston, David H. 2014. "Giving Content to Responsible Innovation". *Journal of Responsible Innovation* 1 (3): 251-3. doi: 10.1080/23299460.2014.972085.
- House of Lords. 2000. "Science and Technology: Third Report". *UK Parliament Website*. Accessed July 10, 2017. <https://www.publications.parliament.uk/pa/ld199900/ldselect/ldsctech/38/3801.htm>.
- Jasanoff, Sheila. 1997. "Civilization and Madness: the Great BSE Scare of 1996". *Public Understanding of Science* 6 (3): 221-32. doi: 10.1088/0963-6625/6/3/002.

- . 2003. “Technology of Humility: Citizen Participation in Governing Science”. *Minerva* 41: 223-44.
- . 2004. “The Idiom of Co-production”. In *States of Knowledge: the Co-production of Science and Social Order*, edited by Sheila Jasanoff, 1-12. New York: Routledge.
- . 2005. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton - Oxford: Princeton University Press.
- . 2006. *States of Knowledge: the Co-production of Science and the Social Order*. New York: Routledge.
- Lipinsky, Anke. 2014. “Gender Equality Policies in Public Research”. *Publications Office of the European Union*. Accessed July 10, 2017. [http://ec.europa.eu/research/pdf/199627\\_2014%202971\\_rtd\\_report.pdf](http://ec.europa.eu/research/pdf/199627_2014%202971_rtd_report.pdf).
- Macnaghten, Phil, Richard Owen, Jack Stilgoe, Brian Wynne, Adalberto Azevedo, André de Campos, Jason Chilvers, Renato Dagnino, Gabriela di Giulio, Emma Frow, Brian Garvey, Chris Groves, Sarah Hartley, Marcelo Knobel, Elizabete Kobayashi, Markku Lehtonen, Javier Lezaun, Leo Mello, Marko Monteiro, Janaina Pamplona da Costa, Camila Rigolin, Bruno Rondani, Margarita Staykova, Renzo Taddei, Chris Till, David Tyfield, Leo Velho, and Sara Wilford. 2014. “Responsible Innovation across Borders: Tensions, Paradoxes and Possibilities”. *Journal of Responsible Innovation* 1 (2): 191-9. doi: 10.1080/23299460.2014.922249.
- Meijer, Ingeborg, Niels Mejlgaard, Ralf Lindner, Richard Woolley, Ismael Rafols, Erich Griesler, Angela Wroblewski, Susanne Buehrer, Jack Stilgoe, Lena Tspouri, Nikos Maroulis, and Viola Peter. 2016. “Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): a Preliminary Framework for RRI Dimensions & Indicators”. Paper for the OECD Blue Sky Forum 2016 (Final Version), July 15, 2016. Accessed July 10, 2017. [http://www.oecd.org/sti/105%20-%20Meijer\\_MoRRI\\_paper\\_%20OECD\\_bluesky\\_16ul16\\_def.pdf](http://www.oecd.org/sti/105%20-%20Meijer_MoRRI_paper_%20OECD_bluesky_16ul16_def.pdf).
- Owen, Richard. 2011. “Responsible Research and Innovation: Options for Research and Innovation Policy in the EU”. *Publications Office of the European Union*. Accessed July 10, 2017. [https://ec.europa.eu/research/innovation-union/pdf/expert-groups/Responsible\\_Research\\_and\\_Innovation.pdf](https://ec.europa.eu/research/innovation-union/pdf/expert-groups/Responsible_Research_and_Innovation.pdf).
- Owen, Richard, Phil Macnaghten, and Jack Stilgoe. 2012. “Responsible Research and Innovation: from Science in Society to Science for Society, with Society”. *Science and Public Policy* 39 (6): 751-60.
- Pereira, Ângela Guimarães. 2009. “Post-normal Relationships between Science and Society: Implications for Public Engagement”. In *Science, Society and Sustainability, Education and Empowerment for an Uncertain World*, edited by Donald Gray, Laura Colucci-Gray, and Elena Camino, 27-50. New York: Routledge.
- Pereira, Ângela Guimarães, and Silvio Funtowicz, eds. 2015. *Science, Philosophy and Sustainability: the End of the Cartesian Dream (Routledge Explorations in Sustainability and Governance)*. Florence, KY: Taylor and Francis.
- Polanyi, Michael. 1962. “The Republic of Science: Its Political and Economic Theory”. *Minerva* 1: 54-73.

- Randles, Sally, Jakob Edler, Clair Gough, Pierre-Benoit Joly, Niels Mejlgaard, Nina Bryndum, Alexander Lang, Ralf Lindner, and Stefan Kuhlmann. 2016. "Governance Framework for Responsible Research and Innovation Res-AGorA Policy Note#1". *Res-AGorA*. <http://www.res-agora.eu>.
- Ravetz, Jerome. 1971. *Scientific Knowledge and Its Social Problems*. Oxford: Clarendon Press.
- Rip, Arie. 2014. "The Past and Future of RRI". *Life Science, Society and Policy* 10 (1): 1-15. doi: 10.1186/s40504-014-0017-4.
- . 2016a. "The Clothes of the Emperor: an Essay on RRI in and around Brussels". *Journal of Responsible Innovation* 3 (3): 290-304.
- . 2016b. "The Many Lives of Responsible Research and Innovation". *EuroScientist*, Special Issue on *RRI Implementation*. Accessed July 10, 2017. <http://www.euroscientist.com/rri-implementation>.
- Royal Society. 2009. "Geoengineering the Climate: Science, Governance and Uncertainty". *The Royal Society Website*. Accessed July 10, 2017. [http://royalsociety.org/uploadedFiles/Royal\\_Society\\_Content/policy/publications/2009/8693.pdf](http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/publications/2009/8693.pdf).
- SiS.net. 2016. "RRI Opportunities in Horizon 2020: Science with and for Society Relevant Topics in the Horizon 2020 Work Programme 2016-17". *Publications Office of the European Union*. Accessed July 10, 2017. [https://www.euresearch.ch/file-admin/redacteur/H2020/RRI\\_opportunities\\_in\\_Horizon\\_2020\\_151208.pdf](https://www.euresearch.ch/file-admin/redacteur/H2020/RRI_opportunities_in_Horizon_2020_151208.pdf).
- Stilgoe, Jack, Richard Owen, and Phil Macnaghten. 2013. "Developing a Framework for Responsible Innovation". *Research Policy* 42 (9): 1568-80. doi: 10.1016/j.respol.2013.05.008.
- Svedin, Uno, ed. 2009. *New Worlds - New Solutions: Research and Innovation as a Basis for Developing Europe in a Global Context, Lund 7-8 July 2009, Sweden*. Accessed July 10, 2017. [https://www.vr.se/download/18.29b9c5ae1268d01cd5c8000631/New\\_Worlds\\_New\\_Solutions\\_Report.pdf](https://www.vr.se/download/18.29b9c5ae1268d01cd5c8000631/New_Worlds_New_Solutions_Report.pdf).
- Tallacchini, Mariachiara. 2009. "From Commitment to Committee". *Seminar* 597: 2-6.
- van den Hoven, Jeroen, Gert-Jan Lokhorst, and Ibo van de Poel. 2012. "Engineering and the Problem of Moral Overload". *Science and Engineering Ethics* 18 (1): 143-55.
- von Schonberg, Rene. 2011. "Prospects for Technology Assessment in a Framework of Responsible Research and Innovation". In *Technikfolgen abschätzen lehren. Bildungspotenziale transdisziplinärer Methode*, edited by Marc Dusseldorp and Richard Beecroft, 39-61. Wiesbaden: Springer.
- . 2013. "A Vision of Responsible Research and Innovation". In *Responsible Innovation*, edited by Richard Owen, John Bessant, and Maggy Heintz, 51-74. Chichester, UK: John Wiley & Sons.
- Waltner-Toews, David. 2015. "The Tower of Babel, Pentecostal Science and the Language of Epidemics". In *Science, Philosophy and Sustainability: the End of the Cartesian Dream (Routledge Explorations in Sustainability and Governance)*, edited by Ângela Guimarães Pereira and Silvio Funtowicz, 26-44. Florence, KY: Taylor and Francis.
- Weinberg, Alvin. 1961. "Impact of Large-scale Science on the United States". *Science* 134 (3473): 161-4. doi: 10.1126/science.134.3473.161.