Enterprise and Work Innovation Studies

Responsible Research and Innovation: a Global Perspective [1]

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Abstract

Responsible Research and Innovation (RRI) is a normative concept that has captured considerable attention on the Science and Technology (S&T) policy level, but also in academic discourses. It represents a new approach to how science, innovation and research can be shaped in accordance with societal values that builds directly on the concepts and methodologies of Technology Assessment (TA). The definition and operationalization aspects of RRI remain still unclear although key ingredients such as ethical acceptability are well-established in S&T debates and embrace a spectrum of standard methodological approaches. In this paper we review the conceptual debate on RRI with a focus on its constituent parts. We then present a functional comparison between RRI and TA that proves the considerable conceptual overlap in the two approaches. We argue that TA methodologies and precepts should be employed as key operationalisational features in RRI. Finally we argue for a global perspective on RRI by describing a case study on global ethics in S&T that introduces an analytical framework for ethics debates.

Key-words: Responsible Research and Innovation, Technology Assessment, Science and Technology, Ethics

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Responsible Research and Innovation on the Rise

Responsible Research and Innovation (RRI) is a novel concept dealing with how to (re-)shape the interactions between science, society and technology. In the past, research concepts such as "Mode 2 knowledge production" (Gibbons et al. 1994) or "post-normal science" (Funtowicz and Ravetz 1993) have focused on "the mobilization of a range of theoretical perspectives and practical methodologies to solve problems" (Nowotny et al. 2003, p. 186). Here, new technological developments are understood as processes that are shaped socially, not just occurring linearly in a separate sphere. Also with concepts such as "Citizens Science" (Irwin 1995, Hand 2010) the increasing demand for involvement of stakeholders and citizens within technology development processes is becoming an important part of political programs. As a result, a new form of science ("Mode 2") towards "socially distributed, application-oriented, trans-disciplinary, and subject to multiple accountabilities" (Nowotny et al. 2003, p. 179) knowledge production has emerged.

With the growing number of engagement events, especially regarding science and technology, some have called out for a "participatory turn" (Jasanoff 2003a, p. 235), taking into account the increasing political role of deliberative initiatives and how "policy-makers and the public inevitably focus on the accountability of science" (Jasanoff 2003a, p. 236). As Jasanoff states:

> "The pressure for accountability manifests itself in many ways, of which the demand for greater transparency and participation is perhaps most prominent." (Jasanoff 2003a, p. 236)

In this context RRI appears as the up and coming concept to describe normative changes in the relationship between science and technology *in* society. It aims to reshape the ways in which research and innovation are done, opening up these processes to include all relevant actors. One of the most commonly used definitions of RRI is provided by von Schomberg:

> "Responsible Research and Innovation is 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 Schomberg, 2012, p. 50)

On a policy level RRI has had a large influence. In the official documentation of the European Union, RRI is seen as a key concept in its Horizon 2020 Research and Innovation program and it is understood as:

> "an inclusive approach to research and innovation (R&I), to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of R&I with the values, needs and expectations of European society." (EC 2013)

The EU aims to foster RRI and its implementation, but also to identify the various barriers that hinder it. To help develop a framework for RRI activities in Europe, the European Commission (EC) wants an improved coordination with the Member States without a legally binding initiative, which involves actions such as setting incentives for RRI, national and disciplinary Codes of Conduct for RRI activities and development of standards on RRI. RRI can therefore be regarded as a fundamental and cross-cutting theme for research policies in Europe. In this context, the RRI framework provided by the EC sheds light on its main aspects. These are divided into different key dimensions or pillar that, despite the fact that there is no standard definition of RRI, offer clarity about the dimensions and activities related to the concept. Of course even though RRI is a fairly new term, each of the constituent pillars has its own specific history, some longer than others. Taking into account the policy debate on RRI the following operational dimensions or pillars can be identified[2]:

- Engagement (citizen engagement and participation of societal actors on R&I)
- Governance (responsible governance of R&I)
- Anticipation (science foresight, anticipatory TA, risk assessment and impact assessment)
- Ethics (ethics of research and innovation)
- Science education (science literacy and scientific education)

[2] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society

- Gender equality (gender equality in R&I, and gender dimension in R&I content)
- Open Access (open access to scientific knowledge, research results and data)

In general, RRI is beginning to shape interactions between science and society, but also in relation to policy-making. There is no doubt that its application necessitates changes in institutional processes from the current business-as-usual. RRI aims big, wanting to fundamentally change innovation processes and how technologies are developed and shaped, according to actual societal demands.

The concept of RRI has also gained academic attention, especially regarding its conceptual clarity. Even though we find several conceptualizations and descriptions of RRI (Von Schomberg, 2011; Stilgoe, Owen, Macnaghten 2013; Grunwald 2011, 2014; European Commission, 2013) it remains still blurry and unclear. The first outline provided by Stilgoe and colleagues (2013) frames it according to anticipation, reflexivity, inclusion and responsiveness, with different techniques and approaches as well as implementations assigned to each of these dimensions.

Then, Owen and colleagues (2012) identify three emerging feature of RRI within the academic discourse which themselves can be regarded as innovations: 'Science for society' deals with the actual purposes of science and innovation and how RRI democratically opens up new areas for public values on science and innovation, making RRI an inherently political program; 'Science with society' means the integration and institutionalization of reflection, anticipation and deliberation as a framework for RRI; 'Reframing responsibility' explicitly links research and innovation to responsibility which includes a collective approach to issues of responsibility.

Furthermore, Owen et al. also point out that the clarification of purposes and motivations for RRI must become clear on a policy level and therefore the on-going discussions on its aims are necessary, otherwise "RRI risks becoming a new label for business-as-usual, it also risks being used instrumentally, to smooth the path of innovation in society, and/or to achieve pre-committed policies" (Owen et al. 2012: 757).

If RRI is implemented thoroughly in different contexts, it can have far reaching effects. As Macnaghten and colleagues argue:

> The "impact may be achieved only when disruption has taken place to establish institutional, scientific and governance habits and routines. This is important in terms of maintaining and enhancing a reflexive and critical

disposition, both in science and technology studies of RI and more broadly as RI begins to move across borders" (Macnaghten et al. 2014: 197).

If RRI is followed through ought, there would have to be fundamental shifts, e.g. in institutions and among main actors towards an openness in relation to uncertainty and plurality and other 'ways of doing business'. This would in turn mean that the responsiveness of individuals or institutions is based on the acceptance of uncertain and unclear solutions or 'ways forward'. Thus, the question remains on how spaces for experiments and reflection can be created especially within established institutions or processes?

As an emerging concept, which has more and more actual implications, it therefore seems important to reflect conceptually on RRI especially regarding how it can be operationalized and what are its implications in policy. This includes aspects such as the understanding of innovation and responsibility within RRI but also the meaning and implementation of participatory elements as well as conditions of transferring RRI into economic milieus.

The Relationship between RRI and TA

Many concepts and disciplinary fields can be regarded as informing RRI, none more than TA as it also deals with the governance of technologies, research and innovation. TA emerged in the 1970s and today forms an interdisciplinary research area oriented towards providing knowledge and options for better shaping (new) technologies and innovation. Various motivations for TA, such as prevention or resolution of technology conflicts, integrating social values and shaping technology accordingly, innovation systems or debates on visions and metaphors in new and emerging science and technology (Grunwald 2011) can be identified. In general, TA has been and still is about "providing knowledge for better-informed and well-reflected decisions concerning new technologies" (ibid.).

Several lines of methodological focus within TA can be identified that can be relevant for RRI, not only as ways for its implementation and use, but also for providing insights into problems and cruxes of the relationship between science and society. For example, constructive TA is based on the assumption that TA should be integrated into the seamless web of technology

development. This is made up of very heterogenic social, cultural, economic, technical and scientific factors in which permanent course setting takes place. TA should therefore accompany this process by informing and reflecting to actively processes of technological development with the goal of achieving "better technology in a better society" (Rip et al. 1995).

Within RRI this reflects the key aim of intervening in the development and innovation processes also by including the perspectives of stakeholders. Regarding the links between science and society, another stream of TA can provide useful insights: real-time TA (Guston and Sarewitz 2002) aims at closely integrating natural sciences and engineering with social sciences and policy research from the very beginning. With this its "communication and early warning components [real-time TA] helps assure awareness about innovation among researchers and the public, and its technology assessment and choice component provides a mechanism for such awareness to be reflexively incorporated into innovation" (ibid: 109).

Perhaps most important for RRI are participation and engagement methods and processes employed in TA. Here, a wide range of formats with different actors dealing with issues surrounding science and technology can be found that have been conducted for more than 20 years. Regarding the thematic and spatial aspects of participation, TA can offer insights that rely on experiences through implementation. Participation in the context of planning processes, often regionally and locally grounded, is often regarded as successful. In contrast, cases of participation dealing with new materials (e.g. Nano) or more general topics of (future) technologies are often difficult to conduct (Grunwald 2010). A motivation within TA regarding the shaping of technology according to social values seems to be a main source of RRI. The assumption that "if technology could be designed according to social values […] problems of rejection or conflict would no longer occur at all" (Grunwald 2011: 14) is one that finds its expression in the use of participatory processes.

TA has developed many approaches that range from involvement of citizens, consumers and users, civil society, stakeholders, the media and the public throughout the different stages of technology development and governance.

The reasoning is that by including these actors in the decision-making process, the results provide an improved knowledge basis according to dominant values, ethical considerations and how different groups frame issues. For this TA has a set of interactive, participatory or dialogue based methods that organize and facilitate these social interactions (ibid: 15). From its beginning TA has included participation as "not simply some arbitrary method […] but an essential part of its conception […] as an attempt to implement or step toward democratic governance of technology policy" (Hennen 2012: 30).

It is important to note that participatory TA is conducted as a way of gaining knowledge rooted in social values and interests in a wider context of policy consultation and not as political participation in decision making itself (ibid: 39). Because of this, high expectations regarding the use of participatory TA methods for the democratization of science and technology policies cannot be fulfilled. This can result in a 'sobering up' of actors involved in these processes (e.g. citizens, stakeholders but also initiators and organizers) regarding their expectations of actually changing or influencing decisions. This is an important factor for RRI since it aims to shape technology according to social values and therefore wants to, if necessary to alter policy making towards more socially desirable outcomes.

This conflict also shows in the critique of participatory processes that includes lack of impact, instrumentalization or the pushing through of acceptability. Yet, as in any form of consultation, it is practically impossible to find direct links between the outcomes of participation and political decisions, as they only support political decision-making. Further, any kind of assessment can be framed or understood differently by "power and justification strategies" (ibid: 35) and therefore is in danger of being instrumentalized. As a consequence, "studies on participatory TA [should] distinguish between the shortcomings of project management and the structural limits or deficits of the participatory procedure itself" (ibid: 36).

The question here becomes a basic one for TA as well as for RRI: how to deal with outcomes (of participation or other methods such as vision assessment, scenarios or life cycle assessment) within the context of policy advice and consultation? An approach that can be helpful here is the idealized "Honest Broker of Policy Alternatives" that goes together with a stakeholder model of science and "seeks explicitly to integrate scientific knowledge with stakeholder concerns in the form of alternative possible courses of action" (Pielke 2007:17). In this way the honest broker clarifies and expands the scope of choices and alternatives available for the decision maker to determine according to their values and preferences (ibid: 3).

On this more general level, a rise in demands and pressure for accountability of science results in wide requests for more transparency and participation in what Jasanoff characterizes as a "participatory turn" (Jasanoff 2003: 235). Here, the hope is to gain robust knowledge by embedding it in society and as Stirling describes "opening up a process of technology choice" (Stirling 2008: 279) offering "'plural and conditional' policy advice (ibid: 280). Participatory processes and methods are needed for "technologies of humility" that can bring forward knowledge on "the possibility of unforeseen consequences; […] make explicit the normative that lurks within the technical; and to acknowledge from the start the need for plural viewpoints and collective learning" (Jasanoff 2003:240).

Generally, TA can be understood as a technology governance program with

reflexivity elements by use of for example a "method toolbox" (Decker and Ladikas 2004), including research methods or interactive and participatory methods. Here it becomes clear that RRI takes on many aspects of TA while shifting towards new emphasis. According to Grunwald (2011) RRI focuses more on innovation and how it can be shaped instead of technology because it is on the innovation level that technology and society interact. Further, RRI examines the social contexts of technology and science closer paying more attention to values that shape innovation. Arguably the most important due to its implications for TA is the move towards "a clear indication for intervention into the development and innovation process" (Grunwald 2011) away from a more distant observation role. Here, it becomes about RRI actually actively engaging in the 'real world' in order to be close to social practices and taking over responsibility for interventions.

Therefore, RRI is a concept moving towards becoming an innovation governance program. Yet, even though we find conceptual ideas that are beginning to form a 'practice' of RRI, as mentioned above RRI remains an unclear. As Owen writes: "[there is]an emerging *Zeitgeist* for 'responsible innovation' that may intuitively feel right, but which exhibits a lack of clarity in terms of definition, practice and, at a policy level, motivation" (Owen et al. 2012: 752). Therefore the experiences and reflections of TA in its many different forms are can give valuable for shaping RRI also regarding the many pitfalls of various methods or approaches.

RRI beyond Europe

RRI is a European concept that attempts to accommodate the current practices of ELSI and TA activities under a single term but it clearly refers to issues and challenges that are evident in any society with a vibrant S&T sector. Current developments are less and less bound by country borders. They, more than often, take on global dimensions where a development in one region has a clear ripple effect in the rest of the globe. None of the major new developments in e.g. biotechnology, nanotechnology, and food technology or energy research are restricted to the country they take place in. Consequences are felt immediately everywhere as the research know-how and eventual applications move easily across borders. The aim of shaping these developments according to (ethical) acceptability, sustainability and societal desirability is not only a European desire under the banner of RRI. It

is a global need that is being approached in every country that such developments are underway with or without similar terminology.

Beyond Europe, in emerging economies of the Global South (Brazil, India, China and South Africa) and also in some advanced economies (Japan, Australia), there is little awareness of the concept of RRI although some elements of its constituent pillars have been taken up as thematic priorities by national research organisations. Yet, it is unclear whether the RRI pillar themes are understood in global settings as they are in Europe and whether local understandings and initiatives are understood in culturally and institutionally distinctive manners, reflecting different contexts and circumstances.

If one aims at expanding the scope of RRI beyond Europe, considerable work needs to be done before it is recognised as a concept that offers traction in non-European contexts and research initiatives. It is important to engage major global S&T players in debates over RRI and be also ready to accept alternative conceptual structures. Different countries have different and often differentiated needs that constitute new concepts of "responsibility" in research and innovation that provide different priorities to those that we have agreed upon in Europe.

One thing is clear though: what is entailed within the concept of RRI is far from being a Eurocentric preoccupation. The need to harmonise current science and technology developments with the wider society's aspirations is evident in every advanced economy and one could even argue that there are shared societal objectives in incorporating ethics and societal values into S&T policy across very different global policy contexts. Nevertheless, the fact that RRI is debated mainly in Europe (and to a lesser extent in the USA) is an indication that we need to be attentive to the claim that current understandings of RRI may embody a certain amount of European cultural bias not shared by other parts of the globe.

It is clear that we need to consider, understand and challenge the concept of RRI as a Northern or European political artefact. This would lead to a comprehensive debate that entails RRI's stated goals, motivations, assumptions, and even commitments. How does the concept of RRI in European discussions translate as it travels in and across different national contexts? How does RRI relate to parallel ongoing debates on innovation that are taking place in other parts of world, such as those on social inclusion, access or social justice?

For instance, there are increasing voices that request the incorporation of global principles deriving from those of international justice in the concept and application of RRI (see Schroeder & Ladikas, 2015). Such an approach sees the RRI aspect of societal desirability as a European preoccupation that ought to translate better to the needs of other cultures, particularly those

that relate to the aspect of "access". For this to happen, a principled approach in the application of RRI has to be devised with the incorporation of relevant principles. The Difference Principle, as developed by John Rawls, is a good candidate for an operationalization of RRI at global level. According to this principle, the targets of RRI should prioritise the needs of the least advantaged members of society thus, increasing access and fair distribution of the results of S&T developments (Rawls, 1997). Such principle, which is highly respected amongst politicians and researchers alike around the world, could be adopted as one of the main funding criteria for RRI-based funding decisions.

Overall, there is a need to further reflect on RRI and the processes and applications it entails at global level. Experiences from methods of participation applied by TA as well as the analysis of ethical debates regarding (new and emerging) technologies are extremely valuable in this respect. One ought to build upon those to create a more practicable notion of RRI.

Towards Global RRI: the Case of Ethics

One of the most well-established pillars of RRI is ethics. Ethical acceptability of new S&T developments is the main ingredient in social desirability, in itself a cornerstone of RRI as we have seen above. Ethics represents a challenge in the realization of RRI that is most intimately related to globalization. No other aspect of S&T is more debated or legislated globally than ethics. That fact alone provides enough material to attempt a global analysis but, coupled with the different views on ethics that are based on specific socio-cultural contexts and current dominant value systems, ethics is doubtless a major challenge in the creation of a global RRI.

Focusing on the ethics pillar of RRI it becomes clear that attempting to reshape how research and innovation is done is not an easy path. Debates around technology and its development bring to light values, expectations but also fears making technology an "appropriate subject for reflections on responsibility" (Grunwald 2014, p. 22). Furthermore, how science and technology develop within our societies has naturally to do with the ethical debates around them. Even though there are increased demands for participation, it also becomes clear that the issues, expectations and possible

consequences of S&T developments still remain largely debatable.

Ethics can be highly contested; the weighing of different values and belief-systems can vary substantially across society. The shift towards more participation, especially by including 'lay' people or groups, shows that ethics questions around technology or science are often complex and uncertain while increasingly influencing our everyday lives. Different forms of knowledge and 'expertise' are included in the debates and shape them in a manner unseen before in the history of science. Moreover, responsibility is not about abstract ethical judgments, but is "inevitably interdisciplinary" (Grunwald 2014, p. 24) and therefore RRI requires practical insights gained on a global level.

A unique attempt to investigate ethics at global level was the European Commission-funded project Global Ethics in Science and Technology policy[3] (GEST), which ran from 2011 to 2014 and aimed at analyzing the concepts and issues surrounding ethics in science and technology in Europe and the two main technology-intensive emerging economies of China and India. The project's goal was to create a robust global debate that directly informs science policy. GEST took on an interdisciplinary approach and understood ethics as a non-disciplinary, public area of social interaction, "a common platform for deliberation and discussion of values in society that is based on perceptions of right and wrong, is influenced by cultural norms, aimed at informing policy-making" (Ladikas et al. 2015: 3).

The emphasis on 'perceptions of right and wrong' pertains to the need to acknowledge public perceptions in the debate, regardless of their origin (e.g. religious vs. secular). Public perception research, whether quantitative or qualitative, is nowadays an integral part of the ethics debate around any new science and technology development. What has been termed 'lay morality' is often even more evident in debates than the opinions of expert ethicists, and no decision can easily be taken in direct opposition to public sentiment (see Decker and Ladikas 2004).

For the GEST project the influence of cultural norms in ethics debates is a key subject as it works with a global perspective. Ethical beliefs and attitudes do not exist in a void, which is why the focus is on how value systems in society influence ethical debates in the public and expert domains alike. Ethics debates cannot be dissociated from cultural norms and values. At the same time they aim to influence policy, making them an integral part of the process. This shows the connection to RRI, a policy concept that relies on normative claims. In the following, we point to several relevant findings of the GEST project and what they might mean for RRI and its practical implications.

[3] See http://www.uclan.ac.uk/research/explore/projects/global_ethics_science_technology.php

Scientific and technological developments and innovations have become global while often being applied in local contexts. The ethical debates about these relate to global developments yet at the same time may differ in specific settings. This marks the starting point for the GEST project and its comparison of Europe, China and India: to what extent is there a global ethics in science and technology, and how are ethical debates institutionalized in science, technology and innovation policies? GEST found that each region has a unique structure of ethic debates involving the institutionalization of three related tasks: ethical governance, ethical deliberation and ethical reflection.

Ethical governance in all regions is understood as protecting accepted values (e.g. scientific integrity, human subjects involved in research) through regulatory frameworks. Yet, we also see differences, for example when it comes to animal research, which shows in discussions on the common standards for science, innovation with regard to academic integrity and how to ensure scientific standards and comparable practices.

Regarding ethical deliberation and the institutionalization of ethics in Europe we find a mixture of advisory systems that give early warnings of emerging ethical issues connected to science, technology and innovation. As Europe often uses methods of engagement such as participatory events as a form of institutionalization, the debates are a mix of expert- and lay-based deliberation. Instead, in China and India the advisory committees which are directed at protecting social values and fundamental rights form an essential part of the institutionalization of ethics and setting social agendas. In India, for example, the science and technology policy decisions are an integral part of the agenda-setting discussions.

As indicated above, the constant changing of societies but also technologies and innovations make it necessary to use both ethical governance and ethical deliberation for a systematic ethical reflection. The thriving of emerging technologies, especially in emerging economies such as India and China shows how important the need for a broadening of ethical deliberation as a possibility of an early warning system of arising issues. For this we need reflection in the sphere of academic research, but also as an institutionalized reflective practice. Beyond this it is also necessary to continuously develop societal reflection on core values, rights and ideals.

This is of course also of high relevance for RRI. Ethics poses a main aspect of the RRI concept and therefore experiences gained here can inform the further development and design of RRI. It also reminds us that there are common ideals and values, but that these may differ in local contexts or

when applied to different (technological) developments. Here RRI can offer a new platform for dealing with global approaches that then are locally contextualized.

Towards a comparative framework for ethics at global level

A key focus of GEST and its main outcome was the creation of an analytical tool that can offer meaningful comparisons of the ethics debates at global level (Stemerding et al, 2015). The creation of the tool is based in the assumption that debates on particular fields in S&T vary both in terms of the existing expectations, tensions and conflicts, but also in relation to particular socioeconomic conditions, cultural contexts and values in different countries. In order to better understand the ways in which the expectations, tensions and conflicts in science and technology relate to the current ethics debates, the following analytical framework for a more detailed comparative analysis is developed:

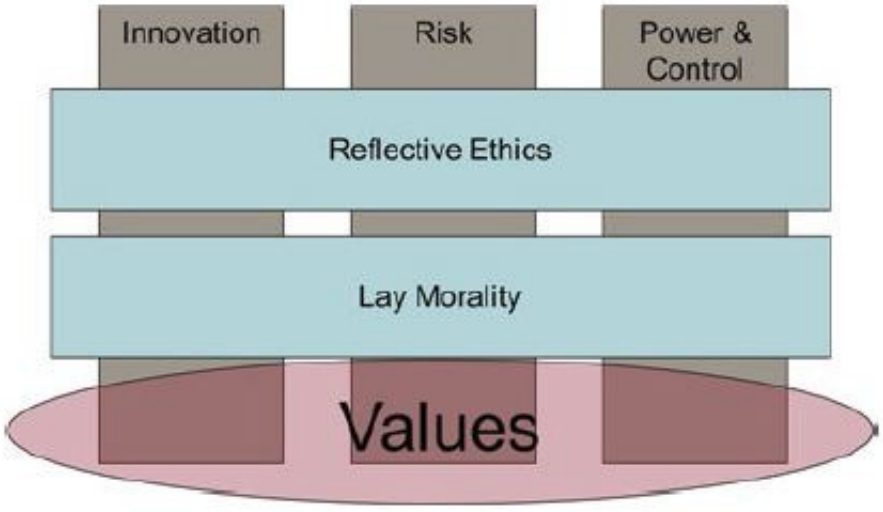

Fig. 1. Three content-related and two reflective and crosscutting science and technology discourses

The framework emphasises societal discourses as the main analytical unit and source of information. These discourses provide narratives that help us map, in a systematic manner, the parameters of the argumentation in terms of expectations, tensions, conflicts and compromises amongst the main actors. Three main common discourses, defined by their specific content and thematic priority, are found in all regions of the world: those relating to issues of *innovation*, *risk* and *power and control*.

The innovation discourse revolves around the topic of investment in S&T. Main themes in this discourse are economic competitiveness, general societal progress, scientific temper and the contribution of S&T in grand societal challenges. The particular values that are debated in the innovation discourse are progress, market freedoms, access, sustainability, self reliance and equality. Main actors in the innovation focused debates are industry, government, civil society and scientists. These are actors that are dominating the content of the innovation system in most countries, albeit sawing different qualities and strengths in different countries.

The risk discourse revolves around the theme of harm that is attached to various topics such as health, environment and rights. The main focus of the risk discourse refers to physical harm as a result of S&T developments, usually also the focus of government regulations around the world. However, non-physical harm is also part of the discourse in terms of economic, social or ethical aspects. A number of standard values are implicated in this discourse such as rights, social justice, sustainability and dignity. The main actors involved in such debates are scientists (particularly in health and safety committees), government, regulatory agencies and civil society organisations.

The power discourse revolves around the themes of control and responsibility. It signifies the power struggles that spring out of other discourses that bring into the equation existing social, economic and geopolitical power relationships. Main topics in this type of discourse include know-how, knowledge ownership and political interests. The values of access, equality, rights and freedoms are implicated in this discourse. The main actors are governments, civil society organisations and lobby groups.

While the three main discourses provide the bulk of knowledge for the analytical framework, it is clear that there is yet another aspect in the discourses that cuts through the specific content: that of the type of ethics that is discussed. Two dimensions of ethics have been found to play a role in this aspect: reflective ethics and lay morality.

Reflective ethics refers to the type of ethics debates that are based on formal theories and approaches. It is the ethics that are articulated within

disciplinary lines and stress implications and consequences of S&T developments in terms of social values and fundamental rights. Reflective ethics has been widely institutionalized in public ethics and bioethics bodies and technology assessment organizations, supporting public debate or playing an advisory role in governmental policy-making. It is viewed as an early warning system to identify tensions in terms of values and developments and it is usually embedded in research programmes with a focus on the ethical, legal and social issues raised by new and emerging S&T.

Lay morality on the other hand refers to ethics deliberations that are instigated and processed by non-experts. This type of ethics discourse does not follow disciplinary concepts or precepts but is rather based on attitudes that are widely shared by society. They signify the increasing participation of groups or individuals that do not claim any particular expertise in the scientific subjects under discussion but are nevertheless persuaded that their voices are as valid as those of the experts. Lay morality often finds expression in spontaneously emerging public debates and controversies surrounding actual applications of S&T developments. On the other hand it might also take shape in organized forms of public dialogue or consultation, such as focus groups or opinion surveys.

The analytical framework can be used to highlight particular commonalities and differences between the debates in the different regions in term of the issues discussed and also to show how these commonalities and differences can be understood in terms of the specific nature of scientific and technological fields, and in terms of particular socioeconomic conditions, cultural contexts and values in each regions. Part of the aim of the analytical process is a better understanding of the history and evolution of the tensions and conflicts in the ethics debates in order to achieve more responsive and robust practices of anticipatory governance of S&T globally.

The GEST project also identified several steps to address this and to better establish global ethics in S&T. These can also be useful in the context of RRI and include: the formation of global deliberation platforms that deal with the social implications of S&T, capacity-building programmes for structure on ethics policy advice, development of common social impact indicators and comparative systematic public perception databases regarding S&T as well as promotion of common templates of public engagement (Chaturvedi et al. 2015).

The Future of Global RRI

With more and more demands for participation and deliberation in S&T decision making, globally, RRI and its implementation is an integral part of moving towards more open and integrated processes in the shaping of science, technology and innovation. Accountability of policy decisions, research agendas or innovations is becoming increasingly important, making the further development of RRI, on a conceptual as well as implementation and evaluation level, essential.

For RRI to take on a truly global perspective, it needs to reflect on experiences and outcomes of debates that deal with such issues. The analytical framework described above, offers the right tools for understanding global ethics debates in terms of stakeholders' values and institutionalization processes. This analysis can be extrapolated and applied onto the other RRI pillars and thus, RRI as a whole.

In any case, it is clear that RRI needs to be adapted and re-contextualized according to local but also global discussions on a specific technology or innovation in order to come to robust governance structures. This can then enable a culturally-sensitive understanding of barriers to the practical implementation of RRI across Europe, advanced economies of the world, and the Global South, in order to devise strategies aimed at overcoming these barriers and to develop targets and indicators aimed at monitoring progress. On a conceptual, normative but also policy level the wider perspective of RRI is a necessary development due to the global character of challenges or impacts of technological developments.

Using the empirical findings from case studies like those in GEST, we arrive at a more practicable understanding of RRI. This is important since what RRI may look like in specific contexts (what is 'responsible', what is 'irresponsible'?) can vary greatly according to local values, customs or rules.

If new technological developments challenge existing responsibilities or ethical understandings and leave us with "normative uncertainty" (Grunwald 2014: 26) an extensive reflection on them becomes necessary. Scaling this up to a global level, while still accounting for local aspects, is the next challenge for RRI. In this sense, RRI should function as a global platform linking established concepts (such as TA), experiences (such as the GEST outcomes) and methods (participatory events) and allowing spaces of

experimentation where case studies and real-life practices can be tested and new formats towards ethical acceptability, sustainability and societal desirability of research and innovation processes can be developed.

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