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Report on the quality criteria of Good Practice Standards in RRI

Kupper, Frank; Klaassen, Pim; Rijnen, Michelle; Vermeulen, Sara; Broerse, Jacqueline

Athena Institute, VU University Amsterdam

Document description

Document Name	Report on the quality criteria of Good Practice Standards in RRI
Document ID	D1.3
Revision	2
Revision Date	30-03-2015
Author(s)	Kupper, Frank; Klaassen, Pim; Rijnen, Michelle; Vermeulen, Sara; Broerse, Jacqueline
Contributors	<p>Malagrida, Rosina; Santamaría, Guillermo; Heesterbeek, Sara; Smallman, Melanie; Amorese, Valentina; Spaapen, Jack; Walhout, Bart</p> <p>López Verdeguer, Ignasi; Garcia, Daniel; Stilgoe, Jack; Alix, Jean-Pierre; van Dyck, Luc; Harambure, Alexia; Marschalek, Ilse</p> <p>RRI Tools Hub coordinators and members (list in appendix)</p>

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Executive summary

This report presents quality criteria of Good *Responsible Research and Innovation (RRI)* Practice Standards. It constitutes a further step in concretizing what it means to put RRI into practice. It is first and foremost meant for internal use to all partners in the RRI Tools project, as it provides a number of basic building blocks that can be used in developing or selecting (self-)evaluating, monitoring and implementation tools of which the RRI Tools toolkit will consist. Furthermore, the quality criteria may be used for thinking about how research and innovation practice should be designed to make them (more) responsible. In itself, this report on the quality criteria for good practice standards does not so much constitute a tool for implementing, monitoring or (self-)evaluating research and innovation practices on their level of responsibility. The criteria would need to be tailored to the specific context of the practice and accompanied with guidelines on how to use them. Tools could vary between areas of research and innovation, user perspectives, and purposes of the tool within research and innovation trajectories.

At the basis of this report are (a) several articles on quality criteria of RRI and standardizing responsibility in research and innovation, (b) the Consultation Workshops that have been held in the context of the RRI Tools project in the period September-November 2014, (c) the promising practices that have been collected by all partners in the RRI Tools project, and (d) feedback from project partners and RRI experts in the Netherlands.

The first two products this report should inform are (1) the catalogue of good practice standards (D1.4) by selecting (very) promising RRI practices across Europe and (2) a self-assessment tool for RRI that is to be developed later in the project (D5.4). Furthermore, the quality criteria can provide the base of an (self-)evaluative framework for others outside of the RRI Tools project who also want to engage with responsible research and innovation.

The quality criteria of good standard practice are based on the working definition of RRI as formulated in the RRI Tools project (D1.1), and more specifically on the four clusters of process requirements (*inclusion and diversity, openness and transparency, anticipation and reflection, responsiveness and adaptive change*). In Tables 3 – 6 a set of quality criteria and sub criteria, further specified in the form of questions (and sometimes examples), are formulated per process requirement. The criteria and questions formulated here should not be used as a tick-box exercise – as that would not be consistent with what RRI stands for – but as a thinking exercise on whether and how a practice aims to be more responsible.

For a variety of reasons no independent criteria are formulated for outcomes of R&I practices. The integrated nature of outcomes and processes has been made visible in the tables containing the quality criteria. The same also holds for the so-called key dimensions of RRI — which we have re-conceptualized as policy agendas. In addition to displaying in Tables 3 – 6 how the criteria for process requirements relate to outcomes and policy agendas, the integral nature of the concept of RRI is also elaborated on in sections 3.1 – 3.4.

One of the lessons the RRI Tools project has learned so far, is that changes in mentality and behaviour are required for RRI to become successful. Such shifts in mentality and behaviour require an overarching *vision for change* that people can relate to and that can help stakeholders form a coalition for change. However, such a vision for change is not identical with following the criteria formulated here. We deem it important that the process requirements in combination with the outcomes are present to some degree in a research and innovation practice, but for people to truly relate to a vision values underlying the idea of RRI should be clear. We believe the core values of RRI are: (1) *democratic* values regarding participation and power, (2) *social and moral* values regarding the care for the future of our planet and its people, (3) *individual and institutional* values of open-mindedness or receptiveness to change. Arguably, these values together constitute the vision for change RRI Tools should promote. The criteria formulated here can help consolidate these values.

1. Introduction

This report on the *quality criteria of Good Practice Standards in RRI* constitutes the next step in the iterative process of developing our understanding of what RRI means—i.e., of conceptualizing and concretizing RRI. This next step is a further specification of the working definition of RRI that the RRI Tools project has delivered in [D1.1](#) into criteria and indicators. As such, this report is a *thinking aid* towards the operationalization of RRI. We emphasize here that the criteria and indicators should not be considered as a fixed set of evaluation principles carved out in stone. Changing circumstances or newly developed knowledge might challenge them or require that additional criteria are formulated, and they must be re-thought in the application to a practice in order to become meaningful for that specific practice. The list of criteria and indicators presented below purports to be something like a “first aid kit” for those who develop or select specific tools meant for the (self-)evaluation, monitoring, promotion or dissemination of RRI. Next to this use, the criteria might be used for thinking about how research and innovation practices should be designed to make them (more) responsible.

The criteria listed here have a bridge function between the working definition of RRI on the one hand and the context-specific operationalization of RRI that must eventually be provided by the different tools that end up in the RRI Toolkit on the other. Thus, this compilation of quality criteria may serve as a ground for the development or selection of tools, but is not a ready-to-use tool in itself. In order to prove their value in some specific context they would have to be tailored to the application of a specific tool and require accompaniment of a guideline on how to use them. Ideally, a large set of tools tailor-made to fit different contexts is developed and/or selected, where it is vital to recognize the full range of axes along which contexts can vary. For instance, what a tool will look like should vary:

- with the area of research and innovation (e.g., healthcare, sustainable agriculture, secure societies, etc.);
- in accordance with the perspective of those who use the tools (i.e., which type of stakeholder);
- in relation to when and with which purpose in a research and innovation trajectory the tool is to be employed (i.e., at the beginning to steer the trajectory in a responsible direction, throughout the trajectory to monitor it, or at the end, to (self-) evaluate).

That said, the first two products this report should inform are the catalogue of good practice standards (D1.4 of the RRI Tools project) and a self-assessment tool for RRI that is being developed throughout the remainder of the project (D5.4 of the RRI Tools project).

1.1 Background

This deliverable is a follow-up of the working definition that can be found in D1.1. Although this deliverable was originally scheduled for month six of the RRI Tools project (close after submission of D1.1), we decided to re-conceptualize its role and meaning to some extent, postponing it to after the Stakeholder Consultation Workshops that were held throughout Europe in months nine to eleven (i.e., September to November 2014). We considered it crucial that the reflections of the participants of the stakeholder consultation workshops informed the criteria displayed here, so as to give the criteria a firmer ground in RRI practices throughout Europe. Postponing the publication of the quality criteria of good practice standards provided us with a window of opportunity to change, if necessary, the direction of our conceptualization of RRI and gave us a way to include the variety of stakeholder perspectives in our understanding of what RRI is.

What stood out most clearly from our analysis of the reports on the Consultation Workshops, as far as the RRI working definition is concerned, is the need for an integrated, concrete and appealing view on what RRI entails. The working definition failed to persuade people of the necessity of RRI and to clarify what it means in practice. Our explanation hereof is that what was lacking was a view of RRI not as a motley collection of process requirements and outcome characteristics of research and innovation, but as an *organizing concept* that helps establish, communicate and propagate the unity in what distinguishes responsible research and innovation.

In sections 3 and 4 of this report, the integral character of RRI will be elaborated on. Here it will become clear that when looking at R&I practices with a focus on process characteristics, simultaneously outcomes are in view. What is more, also the policy agendas, or the RRI key dimensions as the EC has labelled them, are reflected in the conceptual framework constituted by these criteria.

1.2 From working definition to quality criteria

The framework we use for conceptualizing RRI is provided by the working definition of RRI that the *RRI Tools* project has embraced:

Responsible Research and Innovation is a dynamic, iterative process by which all stakeholders involved in the R&I practice become mutually responsive and share responsibility regarding both the outcomes and process requirements.

The outcomes and process requirements referred to in this definition are captured in Figure 1 RRI Process requirements (p. 9) and Table 1. RRI Outcomes (p. 18).

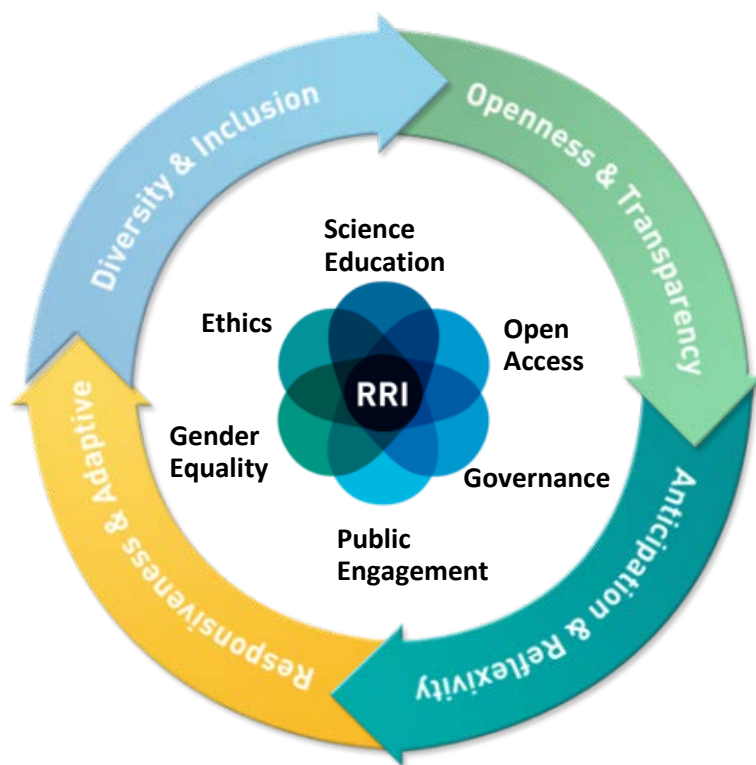


Figure 1. RRI process requirements (policy agendas inside the circle)

Process requirements

Based on literature about responsible research and innovation, we have developed four clusters of process requirements that exist of two requirements strongly linked to each other. They are briefly described below.

Diversity and inclusion

Diverse and inclusive RRI processes should call for the involvement of a wide range of stakeholders in the early development of science and technology, both for normative democratic reasons and to broaden and diversify the sources of expertise, disciplines and perspectives. In this respect, inclusive practices should lead to diverse practices. In reverse, diverse practices are more likely to be inclusive.

Openness and transparency

Openness and transparency are conditions for accountability, liability and thus responsibility. This is an important aspect for publics to establish trust in science and politics. However, more openness does not automatically lead to more trust: information has to be tailored to the needs of stakeholders in order to make sense to them.

Anticipation and reflexivity

Anticipation both concerns understanding how the present dynamics of research and innovation practices shape the future, and envisioning the future. Thus, one enables oneself to act on future challenges. In order to act adequately and be open to changes in direction, also reflexivity is required. This reflexivity implies learning about both the definitions of the problem(s) at issue, commitments, practices, and individual and institutional values, assumptions and routines.

Responsiveness and adaptive change

Responsiveness means responding to emerging knowledge, perspectives, views and norms. Responsiveness is a condition for adaptive change. RRI requires a capacity to change or shape existing routines of thought and behaviour but also the overarching organizational structures and systems in response to changing circumstances, new insights and stakeholder and public values.

Outcomes

Based on literature about responsible research and innovation, we have developed a thematic categorization of RRI outcomes. The outcomes of RRI are divided in three categories (see also Table 1, p. 18).

Learning outcomes

RRI should lead to empowered, responsible actors across the whole range of our socio-technical systems (citizens, scientists, policymakers, NGOs, CSOs, educators, businesses and innovators). Structures and organisations where these actors function should create opportunity for and provide support to actors to be responsible, ensuring that RRI becomes (and remains) a solid and continuous reality.

R&I outcomes

RRI practices should strive for ethically acceptable, sustainable and socially desirable outcomes. Solutions are found in opening up science through continuous meaningful deliberation with societal actors. In the end, the incorporation of societal voices in R&I will lead to relevant applications of science.

Solutions to societal challenges

Today's societies face several challenges. The European Commission has formulated seven 'Grand Challenges' as one of the three main pillars of the Horizon 2020 programme. In order to support European policy, R&I endeavours should contribute to finding solutions for these societal challenges, which are:

- Health, demographic change and wellbeing;
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bio-economy;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Climate action, environment, resource efficiency and raw materials;
- Europe in a changing world - inclusive, innovative and reflective societies;
- Secure societies - protecting freedom and security of Europe and its citizens.

1.3 Integrating RRI processes and outcomes

RRI is about anticipating future outcomes of research and innovation processes. In the same spirit however, it is hard, if not impossible, to specify these outcomes in advance of the development of actual R&I practices as a list of normative prescriptions that research and innovation processes have to fulfil. One reason for this is the wide range of research areas involved, coupled with the fact that for each of them responsible R&I may have a plethora of different outcomes. Indeed, as we see it, it would even be problematic to attempt to formulate criteria for all types of RRI outcomes in advance.

Although criteria for learning outcomes can to some extent be given in advance, this is much less the case for R&I outcomes and for solutions to societal challenges. The reason for this is, of course, that views on such matters should be the outcome of RRI processes rather than an external demand formulated from outside of such processes. In the tables with criteria in sections 3.1 through 3.4 it is specified in which aspect of the process of doing R&I particular outcomes come into view and/or play a role in decision-making. In doing so, the integrated nature of our conception of RRI is visualized and the problem is sidestepped of telling others in advance what is, for instance, ethically right, sustainable or socially desirable.

The central significance of the outcomes of R&I, in other words, is that they constitute the very subjects that should be deliberated in the inclusive processes of anticipation, reflection and action that RRI aims to promote. In the quality criteria for RRI practices presented here, outcomes are therefore not specified individually, but rather emerge from and/or are present in the description of the process requirements. In this way we draw attention to the integrated nature of processes and outcomes in practicing RRI. To give an example, explicit in the formulation of both learning outcomes and R&I outcomes is the variety of types of actors involved in RRI, and the process requirement of diversity and inclusion directs attention to this variety and helps steer R&I practices towards the right type of outcomes.

1.4 Integrating RRI processes and policy agendas

The European Commission has identified six key dimensions for RRI: ethics, gender, governance, public engagement, open access, and science education. For a number of reasons, we have reframed these six RRI keys as ‘policy agendas’. Through this we attempt at a reconceptualization of the meaning of these dimensions to RRI. That is to say, we simultaneously acknowledge their potential contribution to RRI in a specific policy area, but also do justice to their differential conceptual natures.

The term ‘key dimension’ suggests that everything from ethics through gender relates to each other and to R&I more or less in the same way and on the same level, and that each of the six keys should be addressed to in a similar way. When taking a closer look, however, the six keys turn out to be very different from each other. For example, the policy agenda for *Ethics* is a far more generic one than that for *Open access* or *Gender*. Also, the term ‘key dimension’ might suggest that if one directs attention to these keys when doing R&I this will automatically lead to RRI practices, as if they are literally the key to RRI. There is, however, insufficient ground to follow up on this assumption. Looking for instance at the key *Science education*, it is clear that communicating about and teaching science can very well be done in such a way that it does not reflect the standards of RRI. At the same time, it is for instance also clear that many issues belonging to the key of *Gender* are not immediately or necessarily related to R&I specifically.

For these reasons we think it is more appropriate to speak about policy agendas. Approaching the so-called keys as policy agendas, thus separating them from the central conceptual dimensions of RRI, enables us to deal with the differences between them in a constructive way. The six policy agendas each have their own RRI potential, as they can all potentially contribute to realizing responsible research and innovation.

In Tables 3 – 6 below it is visualized how the different process requirements and policy agendas relate to each other. The ‘direction of fit’ here is from process requirements to policy agendas (i.e., we start with the process requirements, and look at how fulfilling them reflects or helps realize the goals of each of the policy agendas).

2. Methodology and results

This report on quality criteria for good practice standards is built on a review of the literature on RRI and standardization and evaluation as well as on the reports of the Stakeholder Consultation Workshops held between September and December 2014 and an analysis of the examples of promising RRI practices that were identified during and after these workshops.

2.1 Literature review

For the formulation of the criteria, we have reviewed literature on the variety of aspects of RRI (i.e., policy agendas as well as process requirements; see the RRI Tools Background note for an elaborate report on this), on the implementation and development of frameworks for RRI (European Commission, 2013; Forsberg, 2014; Stilgoe et al., 2013) and on efforts to draw up specific criteria for RRI (Nordmann, 2014; ScienceWise, 2013; Wickson and Carew, 2014). We have studied comparable conceptualizations of quality criteria for responsibility, for instance sets of recognized evaluating, monitoring and implementation tools for ‘Corporate Social Responsibility’ (CSR) (Labuschagne et al., 2005; Székely and Knirsch, 2005) and Global Reporting Initiative or international standards such as ISO 14000 and 26000 (Castka and Balzarova, 2008; Lombardo et al., 2009). The lessons we have drawn from this literature are manifested in Tables 3 – 6 below.

2.2 Stakeholder Consultation Workshops and reports

In addition, all hub members in the RRI Tools project have held Stakeholder Consultation Workshops, which have yielded rich data about the emerging landscape of responsible research and innovation in Europe. We refer to the Appendix for a complete list of workshops. During these workshops representatives were present from five different stakeholder groups (i.e., representatives of the sectors of Policy, Research, Education, Civil Society Organizations and Business and Industry). The participants engaged in two main activities: first, they reviewed the working definition of RRI that was produced in the first half year of the RRI Tools project (see D1.1), and second they discussed the needs and constraints experienced by the various stakeholder groups in practicing RRI (see [D2.2](#) for the analysis).



Figure 3. Clusters of findings in RRI Stakeholder Consultation Workshop reports; interesting remarks outside the range of process requirements.

Similarly, in Germany the working definition triggered a series of questions:

“The working definition is very general. What claims does it rise? Is it a universal definition for general purpose or a specific guideline how research has to be performed?” (Workshop report Germany, p. 3)

In a different way, also for instance in Austria, similar issues were raised. Here the suggestion was done that two “umbrella terms” were added to the process requirements (viz. establishing framework conditions and taking into consideration context (Workshop report Austria, p. 5)). As we interpret this, this call manifests the same discontent with the working definition from D1.1 as is present in many other reports, insofar as it apparently failed to portray unambiguously and convincingly the broad outlines of what distinguishes *responsible* research and innovation. Focusing on the process requirements and outcomes of RRI helps in this respect, but perhaps other routes should be explored. In the UK too the discussion of the working definition concerned the latter’s vagueness, but it was acknowledged that in order for the definition to remain sufficiently open this should not be amended by making it too restrictive. The suggestion was done that the definition of RRI would describe values rather than actions, and in section 4 below we make a first attempt at following up on this suggestion.

2.3 Promising practices

In preparation for and during the first part of the Stakeholder Consultation Workshops, all participants were invited to fill out a form with an example of what they thought was a promising RRI practice (see D1.2 for the exact methodology). These filled in forms, complemented with practices found by hub members, constituted the base for selecting 3-5 promising RRI practices per hub to be included in the Catalogue of Good Practice Standards (D1.4). Both the filled in forms and the discussions with the hub leaders about which promising practices to work with for D1.4, provided us with an additional check on whether the process requirements fit with responsible R&I practices.

2.4 Feedback

The formulation of the criteria was an extensive, iterative process in which many contributed. We organized this process as follows. By the end of December 2014 a draft version of D1.3 became available for feedback from all Consortium partners and hub members. Feedback was received from a number of partners and incorporated at the end of January and during February. A second draft was sent to a few important members of the RRI community in the Netherlands for additional feedback. The second draft was also commented on during a meeting held early March in Amsterdam, during which 15 partners of the RRI Tools project were present. Comments from both the participants of the meeting and the individual members of the Dutch RRI community resulted in a third draft of the list of criteria. It was agreed upon during the Amsterdam meeting to test the third draft in Spain with a class of PhD students in practice a week later and use their feedback in the last version of D1.3. The main points of feedback we received were that 1) (research) integrity should be more explicitly mentioned, 2) education should be better visualized in the criteria, 3) the language used to describe every sub criterion should be understandable for all stakeholders, and 4) preferably explained with examples. Apart from the fourth point – which was too extensive and possibly too distractive for the generic nature of this deliverable – the feedback has been incorporated in this last version of D1.3.

3. Quality criteria of Good Practice Standards in RRI

3.1 Reading guide

In this chapter we present and explain the quality criteria of good practice standards in RRI. This set of criteria and indicators, further specified in the form of questions, can help to get a grasp on the types of characteristics of research and innovation practices that should be targeted in assessment, monitoring or (self-)evaluation tools. It is only with such tools, subsequently, that it can be investigated whether research and innovation practices are *responsible* and, if so, to what extent. The list is meant to be used as a thinking aid. We urge all who will use this list that the questions posed are meant to give the criteria of good practice standards in RRI their proverbial hand and feet. **Using these questions for executing tick-box exercises contradicts the reflective spirit of RRI and comes with the risk of missing the mark entirely.**

Criteria and sub criteria

The working definition developed in RRI Tools was leading in the development of the set of criteria and indicators. As such, the criteria were set up per process requirement, which in turn have been classified in a way that four clusters of two are formed. Do note that there is some overlap between the themes that emerge from the criteria. As we see it, this apparent redundancy is actually an indication of the integrated nature of the variety of process requirements of RRI we have identified, and is well worth preserving insofar as it might even be instrumental to making R&I processes more responsible.

For each cluster of process requirements a set of criteria has been developed, which are further specified in the form of sub criteria. For each sub criterion a question (and sometimes a clarifying example) has been formulated to facilitate thinking about how to interpret the (sub) criteria in light of assessment, monitoring or (self-)evaluation tools. The criteria are visualized in a table per cluster of process requirements, as well as explained in an introductory text. This text discusses the ideas behind the clusters of process requirements, describes the individual criteria, and explains their relation with the outcomes (as formulated in the working definition) and policy agendas.

Outcomes

As it has been discussed before, we feel that the outcomes and the process requirements are strongly interwoven. In the tables with criteria we have now specified in which aspect of the process of doing R&I particular outcomes come into view and/or play a role in decision-making. Doing so, the integrated nature of our conception of RRI is visualized. Concretely, in the rightmost columns of Tables 3 - 6 you will find outcomes ordered according to the logic of Table 1.







Table 1. RRI Outcomes

1. Learning outcomes	2. R&I outcomes	3. Solutions to societal challenges
1a Engaged publics 1b Responsible actors 1c Responsible institutions	2a Ethically acceptable 2b Sustainable 2c Socially desirable	3a Health, demographic change, and wellbeing; 3b Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy; 3c Secure, clean, and efficient energy; 3d Smart, green, and integrated transport; 3e Climate action, environment, resource efficiency, and raw materials; 3f Europe in a changing world - inclusive, innovative, and reflective societies; 3g Secure societies - protecting freedom and security of Europe and its citizens.

Policy agendas

In the same way, to make the link between policy agendas and our working definition more explicit, we have added an extra column to the list of criteria showing which of the policy agendas are associated with which particular criterion. By using a distinct icon for each policy agenda it becomes visible which criterion of RRI fits with which particular policy agendas. Table 2 shows the icons corresponding to each of the policy agendas.

Table 2. Policy agenda icons

Policy Agenda	Icon
Ethics	
Gender	
Governance	
Public Engagement	
Open Access	
Science Education	

3.2 Diversity and Inclusion

One of the cornerstones of RRI is the idea that science is not only done in or for society, but that it is also done *with* society. We have captured this idea by formulating the process requirement of diversity and inclusion. The public engagement literature gives us at least three arguments for making inclusion one of RRI's process requirements (e.g., Abelson et al., 2003; Burgess and Chilvers, 2006). Firstly, it can be argued that publics have a right to participate in discussions and developments that affect them. Secondly, and more instrumentally, it can be argued that involving the public in research and in R&I decision-making processes increases legitimacy of the process and leads to a higher degree of acceptance of R&I products. Finally, and more substantially, it can be argued that the public holds valuable knowledge, often referred to as experiential knowledge, which would help the development of needs-oriented innovations (Wynne, 1993; Broerse et al., 2009).

For identifying relevant stakeholders to involve in inclusive development one must look at the notion of 'interest' in relation to the topic at hand, instead of focusing only on standard -but equally important- demographics such as age, gender, education and ethnicity (Broerse et al., 2009). This brings us to the issue of diversity that is so closely related to that of inclusion. Diversity is an important feature of a responsive and adaptive innovation system (Stirling, 2007). Policy debates in many areas of science and technology yield numerous reasons for an interest in diversity, and interactions among a diversity of disciplinary perspectives are held to be important means to enhancing rigor and creativity (Stirling, 2007). Therefore, diversity should be reflected in a variety of researchers and policy-makers, in a wide range of scientific disciplines, and in broad and varied research portfolios (Callon et al., 2009). Diversity sensitizes stakeholders to vulnerable groups and to actively search for and listen to 'silent voices', such as ethnic minorities and the ones not employed, educated or in training (NEETs). These groups are especially hard to reach and include in public deliberation but highly valued in finding answers to the Grand Challenges. Although attention for achieving diversity is growing, it is often not rigorously assessed in research and innovation processes.

Inclusion and diversity share the challenge of timing with anticipation and reflection (process requirement three below). The questions of who, when and how to involve are crucial to successful (public) inclusion in R&I processes. Inclusive R&I processes involve a wide range of stakeholders (such as users and CSOs) in the early stages of development to broaden and diversify the sources of expertise and perspectives (Irwin, 2006; Felt et al., 2007).

To assess the "degree of dialogism of procedures", Callon et al. (2009: 160) have suggested using the criteria of intensity (earliness and degree of involvement), openness (degree of diversity and of control of representativeness of spokespersons) and quality (degree of seriousness and continuity of voice). These criteria, with different names, are also included in our list of criteria. We have, however, broken down diversity and inclusion into five different main criteria, which are briefly discussed below.

(a) Engaging a variety of stakeholder groups

For the engagement of stakeholder groups to have the effect wished for, it is crucial that the diversity of values, types of knowledge, types of voices and demographics is appropriate. What 'appropriate' means, of course, varies from context to context. In any case, however, for outcomes of inclusive, dialogical processes in R&I to be robust, it is essential that sufficiently many perspectives and participants are included. Again, what sufficient means is context dependent and should emerge from discourse within the practice. Lastly, it has to be asked throughout the R&I process whether the relevant actors are at the table.

(b) Means of stakeholder engagement

As mentioned before, timing is crucial in the inclusion of different stakeholder groups in R&I practices. From the early stages onwards, R&I practices are to be inclusive, such that, for instance, potentially contrasting values and problem definitions can have their impact on the entire trajectory. Different methods for engaging different types of stakeholder groups might have to be used, such that all stakeholders feel committed and empowered to contribute.

(c) Engagement of public(s)

Of course not only stakeholder groups are engaged in responsible R&I practices, but also members of the wider public. Involving them requires the use of appropriate deliberative forums at the right phases of the R&I trajectory. Engaging different publics, moreover, might well require activities to be undertaken to facilitate capacity building among the publics at issue.

(d) Institutional diversity

Within organizations and systems involved in R&I practices, there should be respect for both group and social differences along all imaginable (demographic) axes. This with the idea that organizations or systems can only carry out real RRI when they are diverse themselves; it will make them more open, responsive, and sensitive to different needs and values. Moreover, recruitment strategies that help increase internal diversity in R&I practices along these same axes are welcome.

(e) Attention for appropriate R&I models and methods

As complex issues might call for new methods or a synthesis of methods used in different disciplines, methodologies should be topic of deliberation within the practice. Something very similar holds for the objects of research. Here too diversity and inclusion are issues that are obviously pertinent to doing R&I responsibly and in such a way that meeting societal challenges not simply means benefiting the majority, but also includes caring about minorities and those with 'silent voices'. As such, a wide range of models and methods should be considered to ensure diverse outcomes.













Diversity and inclusion in relation to the policy agendas







There is a natural affinity between the process requirement of diversity and inclusion and the policy agenda *Gender*. However, it should also be clear from the above that there is no complete overlap here. Diversity and inclusion deals with more than gender alone, while at the same time there is much the policy agenda *Gender* covers that goes beyond the perimeter of R&I and, hence, of RRI. Also the policy agenda *Public engagement* relates closely to this process requirement, as engaging stakeholders and citizens in R&I is at the core of this process requirement. To the extent that taking diversity and inclusion seriously entails one invests in building capacities, also the policy agenda of *Science education* is served by R&I practices that live up to the standards set by this process requirement for R&I.

Diversity and inclusion and RRI outcomes

Making R&I practices as internally diverse and including as large a variety of stakeholders and publics as is pertinent, entails that R&I is steered towards reaching both learning outcomes on all three levels, and ethically acceptable and socially desirable outcomes.

Table 3. Diversity and Inclusion quality criteria

1. Diversity and Inclusion				
Criteria	Specification		PA	Outc.
	Indicators/sub-criteria	Questions that invite thinking about indicators and criteria		1ab 2ac
Engaging a variety of stakeholder groups	Wide range	Is there a wide range of stakeholders involved, such that there is a diversity of values and a diversity of types of knowledge/expertise (i.e., experiential knowledge, scientific knowledge) represented and/or generated? (Rowe and Frewer, 2000)	  	2ac
	Relevant voices	Is there diversity in the stakeholders engaged such that all relevant voices are heard – silent as well as loud (i.e., stakeholder groups that might not feel immediately empowered to let their view know and stakeholder groups that do)?	 	2ac
	Demographic diversity	Is there diversity within the stakeholder groups involved in terms of gender, ethnicity, class, age and other demographics?		2ac
	Sufficient amount	Are sufficiently many perspectives and participants included, such that eventual outcomes are robust? (ScienceWise, 2013)	 	2ac
Variety of means of stakeholder engagement	Early involvement	Are relevant stakeholders involved from early stages of the R&I trajectory onwards?	 	2c
	Engagement methods	Are different methods and techniques for engaging specific stakeholder groups in dialogue taken into consideration? (e.g., is terminology adjusted to interlocutors; is the method for deliberation - interviews, focus groups etc. - tailored to the target stakeholder?)		1b
	Commitment	Are all stakeholders committed to the practice throughout all stages of the R&I trajectory and do they feel empowered to challenge directions of research and innovation?		1b

Engagement of public(s)	Facilitating deliberation	Are there (new) deliberative forums on issues involving science and innovation, moving beyond engagement with stakeholders to include members of the wider public? (Stilgoe et al., 2013)		1a
	Pertinent engagement	Are the right publics involved in the right phases of the R&I trajectory?		1a
	Development of capabilities	Are different possibilities explored or activities undertaken to facilitate the development of capabilities of publics to contribute to a science-literate society (<i>i.e., become scientific citizens</i>)?		1a
Institutional diversity	Internal social differences	Is there attention and respect for group/social differences within the R&I practice (<i>e.g., gender, race/ethnicity, class, sexual orientation, country of origin, and ability as well as cultural, political, religious, or other affiliations</i>)?		2c
	Minority recruitment strategies	Are there minority recruitment strategies in place to increase, within the practice itself, a balance in race/ethnicity, class, gender, sexual orientation, country of origin, and ability, as well as cultural, political, religious, or other affiliations?		2c
Attention for appropriate R&I models and methods	Diversity of methods	Are methods for research and innovation being developed or discussed with different stakeholders such that they respond to the needs and expectations of the different stakeholders? (<i>i.e., considering a wide range of methods and employing an inter- or transdisciplinary process</i>) (Wickson and Carew, 2014)		
	Research objects	Is there diversity within the objects of research, in terms of gender and other demographics? (<i>e.g., are not only male animal models used?</i>)		

3.3 Openness and Transparency

Openness and transparency are included in the RRI process requirements because they are at the basis of creating mutual understanding and trust between all stakeholders involved in the R&I practices. Although it is a misunderstanding that openness and transparency automatically lead to more trust (Chilvers, 2012), they are requirements for the type of meaningful dialogue between stakeholders through which mutual understanding and trust can be built that is vital for establishing responsible R&I. Open and transparent processes help create clarity about ownership and liability, important aspects of responsibility.

Openness and transparency are intimately related to each other. On the one hand, practices need to be transparent about both their results as well as the processes through which results come about and decision-making processes that are at the basis of all of this (e.g., who is included, what is done with the input, and so on). On the other hand, transparent communication remains idle when it is not open for input by all stakeholders. The willingness to and capability of being open for and taking seriously input of different parties involved in the R&I process is the other side of this coin, then. And this, in turn, is a condition for responsiveness and adaptive change (i.e., the fourth cluster of process requirements).

An important notion of this cluster of process requirements is that being open and transparent does not necessarily mean that all data should be published. For instance, raw research data should often not be published without being edited, interpreted or explained, and sometimes R&I data is better not shared too widely, as it might not be responsible to circulate sensitive data such that they end up in the wrong hands —think for instance of synthetic biology and the information on building viruses that might spring from that. Openness of data, processes and results, then, should be ‘meaningful’. This entails, first of all, that the communication of data needs to be both understandable and that data communicated should be usable for potential users (i.e., the variety of stakeholders and publics involved) (Chilvers, 2012), and secondly it entails that in being open one is sensitive to practices that, for instance, deal with intellectual property rights or concern hazardous issues. In practice, the amount and level of openness depends thus on the context and topic of the specific R&I practice.

Based on the conception of openness and transparency described above, this cluster of process requirements has been broken down into five main criteria indicative of good practices.

(a) Honest and clear (re)presentation of the practice details

A first step in transparency in research and innovation practices is to be open about standard project details, such as objectives, finances, and methods. Furthermore, a declaration of interests and affiliations of all actors should be available, as they can be crucial for the interpretation of aims and results. Not only the content of communication is important in RRI, but also *how* communication is arranged. This criterion indicates that policies on open access and information sharing should be accessible to all actors involved, such that clarity about how to find relevant information is brought about.

(b) Open and clear communication about the process of deliberation and decision-making

Not only relatively established facts, as mentioned above, should be openly communicated. As processes of deliberation and decision-making are often problematic because of unclear roles, influences and responsibilities of actors, open communication about these processes and the roles of actors within them should continue throughout the process. Besides, it should be made clear if and how the input of the involved actors is used in the practice.

(c) Open and clear communication about the results of the practice

Apart from project details and processes within the practice, the results of the practice need to be shared with actors. Most practices aim to share end results only. However, sharing preliminary and intermediate results with (some of the) actors can be highly valuable for the practice. A sense of ownership of –both positive and negative– results can be stimulated in actively involved stakeholders. Also, affected stakeholders will feel more valued and listened to. Furthermore, for meaningful interpretation of the results the sharing of uncertainties and limitations of the practice is significant.

(d) Appropriate means and content of communication and education per actor

As said, both the content of communication and the way this content is delivered to its audience is important in RRI. Content and means should be tailored to the actors receiving the information, such that it is for example sensitive to intellectual property rights or that it is understandable for actors less familiar with used jargon. Furthermore, possibilities to share knowledge or competencies gained in the practice in ways of education should be explored as well.

(e) Openness to critical scrutiny from all stakeholders

Lastly, the process requirement does not refer to one-way open communication. It also asks of practices to be open to feedback and criticism of actors and open-minded for new ideas and suggestions. Furthermore, the practice should facilitate and openly communicate about feedback structures and arrangements; for example, how and when they would like to receive feedback and how it will be used.



























Openness and transparency in relation to the policy agendas









Openness and transparency and the criteria set up for these process requirements are strongly associated with the policy agenda *Open Access*. Open access represents an opportunity for free and earlier access to scientific work and governance processes. It is not just about the ability to read publications, but also about what users can do with the content of those publications (Finch et al., 2013). Generally speaking, fuller and wider access to research results will in all likelihood improve the quality of (scientific) research, facilitate fast innovation, constructive collaborations among stakeholders and productive dialogue with civil society. In this sense, it also holds strong links with the policy agenda *Governance*. Furthermore, through open communication, all actors involved in R&I –including the public– will better understand processes within R&I practices, which at least opens up the possibility of increased involvement and sense of involvement, though without all by itself constituting a guarantee that this will actually happen of course. Therefore, practices that meet the criteria for openness and transparency will also likely benefit the policy agenda *Public Engagement*. Lastly, as what meaningful openness entails is determined by the knowledge and competences of the audience of the message, openness and transparency is strongly linked with *Science Education*.

Openness and transparency and RRI outcomes

This cluster of process requirements mainly adds to two of the learning outcomes formulated in the working definition, namely responsible actors and responsible institutions (1b and 1c, respectively). Both actors and institutions are thought to become more responsible by stimulating meaningful dialogue between stakeholders, increasing openness of practice activities and decisions, and openly referring to matters of accountability and liability.

Table 4. Openness and Transparency quality criteria

2. Openness and Transparency				
Criteria	Specification		PAs	Outc.
	Indicators/sub-criteria	Questions that invite thinking about indicators and criteria		1abc 2a
Honest and clear (re)presentation of the practice details	Objectives	Are all objectives, aims and goals honestly and clearly represented?	 	1bc
	Finances	Is there a transparent overview of financial means/expenditure?	 	1bc
	Interests	Is there a declaration of interests and affiliations of all actors?	  	1bc 2a
	Methods	Are all methods honestly and clearly represented?	 	1bc
	Communication policies	Are there policies on open access and information sharing and are they accessible to stakeholders? (Wickson and Carew, 2014)	 	1bc
Open and clear communication about the processes of deliberation and decision-making	Actor roles	Is there an explanation of the exact role of actors in both the deliberative and decision-making process? (i.e., is there a description and explanation of all the actors involved and at which phase of the trajectory they are involved? Is there clarity about the extent to which actors will be able to influence decisions?) (ScienceWise, 2013)	  	1abc 2a
	Use of input	Is there feedback on how the input of different actors is used or what the impact of their input was in the practice?	  	1abc
Open and clear communication about the results of the practice	Results	Are preliminary, intermediate and final results shared with all actors involved and/or affected? (RRI Tools)	  	1abc
	Limitations	Are uncertainties in and limitations of the practice identified and shared? (Wickson and Carew, 2014)	  	1bc 2a
	Ownership and accountability	Is there clarity about ownership and accountability, not only of positive, but also of negative outcomes and impacts? (Wickson and Carew, 2014)	  	1bc 2a

Appropriate means and content of communication and education per actor	Means of communication and education	Are alternative ways of communicating or educating appropriate to the diversity of actors involved and affected, being taken into consideration? <i>(for instance, sharing raw data without interpretation is often inappropriate when communicating to non-scientists, as is the use of jargon; or exploring possibilities and means to contribute to education programs not only to disseminate results of research, but also to spread RRI competencies)</i>	   	1abc
	Content	Has it been considered what information can and should be shared with whom? <i>(for instance, sometimes not all data can be shared with all actors due to intellectual property rights. In such contexts openness is only meaningful within so-called safe havens -i.e., communication is open and transparent only within a restricted community-)</i>	 	1bc
Openness to critical scrutiny from all stakeholders (Wickson and Carew, 2014)	Scepticism	Is the value of organized and disorganized scepticism acknowledged and are conditions created to put it into practice? <i>(e.g., does the practice facilitate provision of feedback by stakeholders on the practice, and is there transparency about what happens with feedback?)</i>	 	1abc

3.4 Anticipation and Reflection

Looking forward in time and reflecting on the variety of possible impacts of R&I practices is arguably one of the essential cores of taking responsibility for research and innovation (von Schomberg, 2011; Owen et al., 2012; Stilgoe et al., 2013). For instance, it is in this spirit that Stilgoe et al. (2013) state that “[r]esponsible innovation means taking care of the future through collective stewardship of science and innovation in the present” (p. 1570). To be able to take care of the future, it is vital that one anticipates which futures are plausible and that one assesses the possible impacts of research and innovation. At the same time, to determine what choices will lead to ethical, socially desirable and sustainable futures, one should reflect on where we are now, what we find important, what potential futures one should strive for, and what one should try to avoid. Therefore, we have conceived of anticipation and reflection, together, as one of the cluster of process requirements for RRI¹.

The need for anticipation is motivated amongst other things by the difficulties in reconciling beliefs about new developments in science and technology among different stakeholder groups, such as scientists, policy makers, businesses and industries, CSOs and the wider public. Anticipation does not simply boil down to envisioning the future, but rather entails developing an understanding of how today's dynamics of R&I, as well as of hoping and promising, shape the future to come (Borup et al., 2006; Rose, 2006). Thusly understood, it is clear that one important task of anticipation is examining the plausibility and desirability also of expectations of the future (e.g., Lucivero et al., 2011; Selin, 2011), which helps to understand why we have grouped anticipation together with reflection or reflexivity, and which also brings to the fore the relationship of these process requirements with the policy agendas of *Public engagement* and *Ethics*.

As already stands out, in order to be able to be responsible R&I processes need to be reflexive at both individual and institutional levels (Wynne, 1993). Room for these reflective processes should be built in in responsible R&I practices in three different ways. They should aim at reflection on definitions of the problem at hand, commitments, and practices, so-called first-order learning (criteria (a) and (d) below). These processes should also encompass reflection on values and assumptions of individuals involved, thereby stimulating second-order learning (criterion (d)). Lastly, as individuals often work in an organization bound to protocols or to principles developed by organizational culture, reflection on the institutional level –or so-called third-order learning– should take place (Schön and Rein, 1994; Keulartz et al., 2004; criteria (b) and (e)).

Taking our cue from the above considerations, we have broken down the process requirements of anticipation and reflection into five separate criteria, which will be shortly explained below. As a general caveat, though, we wish to emphasize one issue

¹ The centrality to RRI of anticipation and its counterpart reflection can not only be seen in the framework for RRI developed by Stilgoe et al. (2013), it also becomes clear if one sees that, outside of the EC research policy context, much of what is conceptualized in Europe as RRI is labeled “anticipatory governance” (Sutcliffe, 2011; Guston, 2013).

which all who design, monitor or evaluate R&I practices in light of this cluster of process requirements should be aware of. Anticipatory processes should happen early enough to have an impact, but simultaneously late enough to be meaningful (Collingridge, 1980; Rogers-Hayden and Pidgeon, 2007). Arguably, an improved understanding of innovation processes and the characteristics of the different phases of the R&I journey will allow for better timed interventions (Rip and Schot, 2002; see also Rip, 1995).

(a) Analysis of the background, current situation, and context of the (planned) R&I

Thinking about the futures one wishes to contribute to or attempts to avoid should start with a thorough examination of where we are now. This not only means one has to inform oneself about the current state-of-the-art in research, but also has to consider the context in which one sets out to work, the relevant actors in that field, potentially diverging problem definitions circulating and societal values informing such definitions.

(b) Envisioning of plausible futures

When anticipating the future, all sorts of considerations come in. When assessing impacts one should distinguish between short-term, mid-term, and long-term effects. As there is a variety of proven methods for such anticipation, one should think which one to use in the specific context. Furthermore, one should also take the possibility of alternative R&I trajectories into consideration as they might fit better.

(c) Variety of impacts

All different types of aspects of the future should be anticipated. So not only environmental or technical impacts and impacts that are perhaps most obviously related to the R&I practice at hand, but also ethical, legal and social aspects.

(d) Facilitating deliberation on values, perceptions, needs, interests, choices and definition of the problem at issue in the practice

Unlike the private, professional self-critique scientists are used to, responsibility makes reflexivity a public matter (Wynne, 1993). Therefore, processes of inclusive deliberation should be seen as component parts of anticipation and reflection. Moreover, we wish to emphasize the intricate relationship between the criteria of anticipation and reflection, on the one hand, with that of inclusion and diversity on the other².

(e) Addressing roles in RI trajectories

Stimulating scientists and engineers to anticipate the outcomes of their work has been argued to provide a means to increase their awareness of the non-linearity of R&I practices and of the societal embedding of innovation trajectories (te Kulve, 2011). An anticipatory attitude makes researchers and innovators imagine possible and desirable socio-scientific futures, think through various options and unforeseen and unintended (societal) impacts. This also entails people involved in R&I become aware of the differences in terms of values, assumptions and purposes of different actors involved, as well as of their role responsibilities and accountability.

² In accordance with this, it should not come as a surprise that there is some overlap between indicators for criteria falling in these two categories.

Anticipation and reflection in relation to the policy agendas

Anticipation and reflection, and the criteria in terms of which we have conceptualized them, have a strong affiliation with the policy agendas *Public Engagement* and *Ethics*, while certainly also contributing to *Governance* and possibly to *Science Education*.


The connection with *Ethics* is probably the easiest to explain, as much of the anticipatory work in responsible R&I practices concerns values of all stakeholders at issue. Deliberating such values and the ways in which they feed into those futures one decides to strive for, is exactly the type of pragmatist ethics that fits well with the spirit of RRI (Keulartz et al., 2004; Meisch et al., 2011).












The policy agenda of *Public Engagement* is served, for instance, by R&I practices that meet criterion (a) of this cluster of process requirements. That is to say, in order to make a proper analysis of the current situation and context of the planned research or innovation, it is for example crucial that a wide variety of voices has been given a role in defining the problem to be dealt with. This, in turn, requires an engaged public.

Anticipation and reflection and RRI outcomes

This cluster of process requirements, focused as it is on possible futures, is intricately linked to all of the outcomes formulated in the working definition. It is conjectured that if R&I practices meet these process requirements, this will increase the chance that the future one cares for will be reached. And that, of course, is a future in which R&I outcomes are ethically acceptable (2a), sustainable (2b) and socially desirable (2c), and in which we have come a long way dealing with societal challenges (3). Along the road, such practices will have helped bring about engaged publics (1a), responsible actors (1b), and responsible institutions (1c).

Table 5. Anticipation and Reflection quality criteria

3. Anticipation and Reflection				
Criteria	Specification		PAs	Outc.
	Indicators/sub-criteria	Questions that invite thinking about indicators and criteria		
Analysis of the background, current situation and context of the (planned) research or innovation. (Nordmann, 2014)	Up-to-date information	Has content research been done on relevant background knowledge and up-to-date information?		1abc 2abc
	Influence other R&I	Has the influence of other innovations/research on the course of this practice been taken into consideration (e.g., alternative and complementary R&I)?		1bc 2b
	Actor analysis	Did an actor analysis take place, identifying all whom the practice might impact on, might have an interest in, and might have relevant expertise for the practice, and identifying how these actors relate to each other?		2ac
	Diverging problem definitions	Have efforts been put in the practice into addressing potentially diverging definitions of the problem at stake?		2ac
	Societal role in problem definition and course of practice	Have efforts been put into giving a role to societal values, perceptions and interests in defining the problem addressed in the practice and the further course of the practice?	 	2ac
Envisioning of plausible futures (Nordmann, 2014)	Variety of future parameters and impacts	Is there active identification and consideration of immediate, mid-term and long-term social, environmental and economic impacts and consequences of the practice –intended and unintended– identified?	 	2ab 3
	Variety of established methods	Did a well-considered selection and implementation of the methods for anticipation take place (based on previous experience)? (e.g., scenario development, real-time technology assessment, etc.)		3
	Variety of R&I trajectories	Have alternative research and innovation trajectories been considered? (process of R&I)		3
Variety of impacts	Ethics	Are ethical aspects and impacts of the practice sufficiently addressed? (e.g., are research ethics honoured, by protecting objects of research, approval from an ethical committee, and documented compliance with research ethics and voluntary codes of conduct –in which, for example, fraud and plagiarism are prohibited? (Wickson and Carew, 2014))		1bc 2a
	Legislation	Are legal aspects and impacts of the practice sufficiently addressed? (e.g., is there documented compliance with highest-level governance requirements (Wickson and Carew, 2014))		1bc 2a

Variety of impacts	Society	Are societal aspects and impacts of the practice sufficiently addressed?		2c
	Environment	Are environmental aspects and impacts of the practice sufficiently addressed?		2b
	Grand Challenges	Are one or more of the Grand Challenges set by the European Commission addressed in the practice?		3
Facilitating deliberation on values, perceptions, needs, interests, choices and definition of the problem at issue in the practice	Integrated reflection and deliberation	Has room for reflection and deliberation on, e.g., impacts, alternatives, possibly changing societal values, perceptions, needs, interests and choices made during the practice, been built-in? (Stilgoe et al., 2013)	   	1abc 2abc
	Deliberating values	Do the actors involved regularly engage in a critical analysis of the values, perceptions, needs, interests, choices and definition of the problem at issue underlying their practice?	  	1abc 2abc
Addressing roles in RI trajectories	Awareness of differences	Do the actors involved develop an awareness of their own assumptions, values and purposes in relation to the perspectives of others?	 	1b
	Awareness of responsibilities	Are actors involved aware of and open for reflection on their role responsibilities and accountability? (Stilgoe et al., 2013)		1bc

3.5 Responsiveness and adaptive change

R&I is often concerned with unforeseen and complex challenges for which there are no clear-cut solutions (Wynne, 1992; Funtowicz and Ravetz, 1993). Solutions need to evolve from collaborations, and decisions need to be taken in reaction to changing circumstances and based on gradually emerging knowledge. To make R&I more responsible in this respect, a dynamic attitude of both individual researchers and institutions or project groups is required, as actions of individuals are often steered by the rigidity of the systems of which they are part (Cavallo, 2000). Only on condition of the presence of such a responsive attitude can R&I adapt to changing circumstances and newly emerging knowledge. Because of this, we have identified responsiveness – being open for possible changing circumstances– and adaptive change –actually act according to changing circumstances– as the fourth and final cluster of process requirements of RRI.

This fourth cluster of process requirements is vital to RRI insofar as this is a major stage on which the effects of the previously described process requirements can manifest themselves. RRI requires that the direction people, organizations and practices take changes in response to (possibly changing) circumstances, values, ideas and needs of both stakeholders and the public to give true meaning to the requirements of inclusion and diversity. Second, openness and transparency are valuable from a democratic point of view, but become more significant through this fourth cluster of process requirements. It requires practices to respond to emerging knowledge, even if it is generated elsewhere, so a collective learning process can be build and R&I can be brought to a higher level. Something similar applies to anticipation and reflection. One can anticipate possible futures and reflect on one's role and actions in R&I, but without responding to changing understandings or newly emerging insights, R&I outcomes in the form of learning or desirable futures will most probably not arise.

For responsiveness of R&I processes to extend beyond responsiveness of individual researchers, policies and political environments and institutions supporting a responsive attitude must be developed (Stilgoe et al., 2013). Such an attitude is important to steer science and innovation in the direction of our desired future (and taking notice of the fact that this might imply one should *not* proceed with a certain R&I practice). Several approaches have already been developed for increasing responsiveness in R&I processes. These include constructive technology assessment (Rip et al., 1995), real time technology assessment (Guston and Sarewitz, 2002), midstream modulation (Fisher et al., 2006), and anticipatory governance (Barben et al., 2008).

To capture the process requirements of responsiveness and adaptive change, we identified six separate criteria shortly explained below.

(a) Structure for seeking and incorporating feedback

The inclusion of input in R&I practices by different people is not very valuable when opinions and feedback are not actively sought and, especially, used. Therefore, and acknowledging that it can be difficult to truly hear, appreciate and give a role to critical input, RRI practices should think of ways or methods to structure the reception and incorporation thereof.

(b) Flexible process management

To react to input, be it from within the project (e.g., to ideas of engaged stakeholders) or from outside the project (e.g., to changing (societal) values and needs), the R&I process should be flexible. R&I practices should be able to alter their course, including the methods used, in response to generated (interim) results and conflicting data or in response to changing circumstances, such as results by competing R&I groups, judicial changes, and so on.

(c) Development and implementation of evaluation strategies

One has to be aware of the impact of generated results or progress to consider the next steps to take within a practice, and the most common way to do that is via evaluations. These evaluations should not merely take place at the end of the practice, but during the whole R&I trajectory. Therefore, it is commendable that R&I practices actively develop and implement evaluation strategies from the start onward. These strategies too should be open for change and responsive to changing circumstances or perspectives. Evaluation frameworks, in other words, need to be established, updated and executed in constant interaction with all stakeholders involved.

(d) Flexible attitudes to revise views and actions

At the basis of responsiveness and adaptive change lies the willingness to listen to others and adapt one's own perspective accordingly. In some rigid organizations, and even in non-rigid ones, this can be a difficult attitude or skill to learn and apply. RRI practices need to be aware of this and should facilitate these processes.

(e) Changing responsibilities

Through deliberation, responsibilities of actors within R&I processes should become clear and actors should accept accountability. This encompasses both negative and positive outcomes of the practice. However, responsibilities can change over time and thus deliberation about this should take place throughout the various phases of R&I trajectories.

(f) Application of results

Although so far we have mainly discussed the role of the people involved in the practice to respond to changing circumstances, we feel it equally important to practically apply new knowledge and learned competencies responsibly. Again, organizations and systems in which people operate should be able to adapt to and facilitate these changes.










Responsiveness and adaptive change in relation to the policy agendas




In a sense encompassing all other process requirements towards responsible action, the process requirement responsiveness and adaptive change has strong affiliation with the policy agenda *Governance*. This fourth cluster of process requirements mainly concerns actively taking care of the future, steering research and innovation practices to results we need and want—it is, in other words, about governing R&I processes. Secondly, it fosters the *engagement* in R&I practices of a variety of stakeholders, including the wider public, as it requires responding to their needs and ideas.

Responsiveness and adaptive change and the RRI outcomes

As this process requirement fosters public engagement, it also helps creating engaged publics (1a). We assume that if people are truly heard and receive response to their given input, it enhances a sense of engagement. Furthermore, through this process requirement a collective learning strategy is set out, through which both actors and institutions will act more responsibly (1b and 1c). Because all input in the practice and the context in which the practice takes place is really taken into account through actions, the R&I outcomes will be steered towards ethically responsible, sustainable and socially desirable outcomes (2a, 2b, and 2c).

Table 6. Responsiveness and Adaptive Change quality criteria

4. Responsiveness and Adaptive Change				
Criteria	Specification		PAs	Outc.
	Indicators/sub-criteria	Questions that invite thinking about indicators and criteria		
Structure for seeking and incorporating feedback	Appreciation	Is critical input, feedback and feed-forward from a range of stakeholders actively being sought?		1abc 2c
	Methods	Are methods for incorporating feedback being explored and implemented?		1abc 2c
Flexible process management	Stakeholder needs	Is it possible to change the course of the research and innovation practice in response to changing stakeholder's needs / interests / values / perceptions?		1bc 2abc
	Results	Is it possible to change the course of the research and innovation practice in response to interim results or conflicting data?		
	Context	Is it possible to change the course of the research and innovation practice in response to contextual changes? (e.g., results by competing R&I groups; judicial changes, etc.)		2abc
	Methods	Is it possible to change methods in the course of the research and innovation practice in response to needs and expectations of stakeholders?		1bc
Development and implementation of evaluation strategies (Regeer et al., 2009)	Evaluation framework	Are objectives concrete enough to develop an internal evaluation framework?		
	Performance indicators	Are (preliminary) critical performance indicators identified?		
	Strategy	Are evaluation strategies or frameworks actively being developed and implemented?		
	Deliberation	Are the evaluation strategies or frameworks developed through interaction and engagement with all participants?		2c
	Open-endedness	Are indicators used in evaluations sufficiently dynamic and context dependent to deal with all sorts of changing circumstances (ranging from changing stakeholder perspectives, unanticipated (interim) results, or changes in contextual factors)?		2abc

Flexible attitudes to revise views and actions	Individuals	Are the individuals involved willing and able to revise their views and actions?		1b
	Organizations	Do the organizations involved offer adaptive space to respond flexibly to changing circumstances, changing needs and values of other stakeholders and organizations involved? (e.g., are research organizations open to rewarding their staff for non-scientific output, such as popular media appearances?)		1c
Changing responsibilities	Role responsibilities	Are actors involved prepared to take, enlarge and/or redefine their role responsibilities? (Stilgoe et al., 2013)		1bc
	Acceptance of accountability	Are actors prepared to accept, through processes of dialogue, accountability fitting their role for potential positive and negative impacts, choices and processes? (Wickson and Carew, 2014)		1bc
Application of results	Stakeholders	Are (affected) stakeholders willing and equipped to apply new knowledge, values/norms and competencies? (e.g., the use of results of a research practice for educational purposes)		1bc
	Organizations and systems	Do the organizations and systems involved offer adaptive space to respond flexibly to changing knowledge, values/norms and learned competencies?		

4. Discussion: Where we are and where we are going

4.1 How to use the quality criteria of good practice standards?

This document should feed into at least two next steps in the RRI Tools project: firstly, the selection of (very) promising practices that is to be done for D1.4 and, secondly, the development of (self) assessment tool(s) that is to be done for D5.4.

In the first step the quality criteria serve as a framework to evaluate the degree of responsibility present in research and innovation in Europe today. Coupled with the right methodology, the criteria are used to select (very) promising RRI practices across Europe from the promising practices that have been collected through the Stakeholder Consultation Workshops held throughout Europe in the context of the RRI Tools project. With the role the criteria play in identifying RRI best practices, we strive towards the situation in which the quality criteria do not provide a limiting, top-down, bureaucratic structure, but serve as a stimulus and inspiration to (re)shape research and innovation in ways that challenge business as usual.

In the second step the quality criteria serve as indicators for the self-assessment tool that is to be developed by the RRI Tools project. The quality criteria should thus inform a tool in which a number of other parameters are also guiding —think for instance of research field, policy agendas, grand challenges, phases of research and innovation trajectories, and stakeholder perspectives. Different quality criteria might provide specific assistance to different stakeholders in different ways advancing RRI, and tools such as the self-assessment tool should provide more structure than the generic list presented here.

Furthermore, these quality criteria seek to provide an evaluative framework for others outside of the RRI Tools project who also want to engage with responsible research and innovation. For instance, researchers who are designing research projects may take inspiration from these criteria and use them to their benefit. If this use is in alignment with the vision of RRI, the criteria will further creativity rather than constitute an obstacle to it.

4.2 Tying things together: going from values to norms

One of the main lessons we have drawn from the reports of the Consultation Workshops and the collection of promising practices is that, for RRI to be implemented successfully, changes in mentality and in behaviour are required. Clearly, these are changes that numerous actors, across all relevant stakeholder groups, have to make.

If, for instance, we take a look at the stakeholder group of researchers, we see that there have been discussions regarding the reward system in science as it stands today, and on how this counteracts *responsible* research and innovation. In a nutshell we can say that in a setting in which scientific careers depend on numbers of publications in highly ranked journals rather than on contributions made to the solution of societal challenges, the type of inter- or transdisciplinary research often requisite to meeting societal challenges is anything but attractive, since this type of research does not come with the guarantee of results that can be valorised in publications in the usual highly ranked journals. Put differently: “researchers go where the money is”, and the money has not usually been with responsible research and innovation. Something similar holds for the stakeholder group of business and industry. For these, the rewards are primarily with marketable products, and only secondarily with products that help solve a societal problem.

Of course, there is a lot of literature on how to change (organizational) mentalities and behaviour. Beyond the general and rather pessimistic lesson from empirical studies on organizational change that change is incredibly hard to realize and takes a whole lot of concerted efforts, we can also discern several positive lessons to hold on to. One of these is that it requires an overarching *vision for change* that people can relate to and that can help one form a coalition for change. As we see it, it is such *vision for change* that should somehow be in the back of our minds continuously when thinking about the conceptualization, operationalization and dissemination of RRI. Thus, such vision for change should also be recognizable here, in the quality criteria of good practice standards, too.

To direct attention to the fact that for research and innovation to be *responsible* it is requisite that not only one or more of the process requirements or outcomes identified in D1.1 is present in a research and innovation practice, we wish to bring to the fore some of the basic values that inform the very idea of RRI. These values both emerge from the Consultation Workshops that have been held and can be discerned in the literature on RRI. Arguably, these values together constitute the vision for change RRI Tools should promote. In brief, the core values of RRI are

- (1) *democratic* values regarding participation and power,
- (2) *social and moral* values regarding the care for the future of our planet and its people,
- (3) *individual and institutional* values of open-mindedness or receptiveness to change.

The working definition of RRI distinguishes four clusters of process requirements and three types of outcomes. In addition to this, there are the policy agendas that are part of the framework in which we have to think about RRI. One might think that these

elements, taken one by one, provide the basis on which quality criteria for good practice standards in RRI can be formulated. In that case this report would be done entirely when answers are given to questions such as *what are the criteria for openness, what for anticipation?*, and so on. Section 3 of this report indeed presents answers to such questions, but we do not think that, all by themselves, these are sufficient for either evaluation or designing research and innovation with an eye to responsibility. Taking such lists to be satisfying increases the risk that the bigger picture is lost out of sight — in that case the project would suffer, in other words, from a *lack of vision*.

And indeed, what distinguishes thoroughly *responsible* research and innovation practices from other such practices is the way in which the *integration* of process requirements and outcomes transpires in them. That, at least, is what came out of the workshop results, as well as in the promising practices we have collected.

The values identified above not only provide us with a vision for RRI, they also help understand how the variety of elements assembled together in our working definition of RRI hang together. In addition to listing the quality criteria of good practice standards in RRI, let us therefore also briefly reflect on this. Below we briefly elaborate on each of these values, and in Table 7 we display how these values hold together many (if not all) of the central ingredients of RRI.

- (1) *Democratic values* regarding participation and power become manifest in the call for inclusion and diversity, but no less in the requirement that research and innovation should be open and transparent. After all, for research and innovation to be responsible also means it should be possible to hold it accountable, to which openness is requisite. Moreover, stressing democratic values helps keep in sight the necessity of keeping the deliberative process involving stakeholders going throughout research and innovation trajectories.
- (2) *Social and moral values* regarding the care for the future of our planet and its people not only implicate that we aim for sustainable outcomes, it simultaneously requires that anticipation and reflection take place and that the interests of different groups of people are taken into account. This builds on the idea that knowledge, though valuable in and of itself, becomes even more socially valuable if it can be valorised in innovations that help solve societal challenges, and that we as a society learn from such practices in all levels identified above. Again, process requirements, outcomes and policy agendas meet in these RRI values. In other words, these values form a bridge not only between several process requirements, they also integrate outcomes into our conception of research and innovation processes.

(3) *Individual and institutional values* of open-mindedness or receptiveness to change in fact are a crosscutting theme. They inspire making the change *to* responsible research and innovation, and, insofar as responsible research and innovation practices are responsive and adaptive, they inform such practices throughout. Being open-minded, moreover, also implies that one dears to open up to feedback, to become accountable, to be transparent and open about one's research and innovation practices. It helps actors on all levels learn. This flows from the recognition that our knowledge is in a constant flux and that, hence, we should be open to change at all times.

To rephrase, these basic values inform Responsible Research and Innovation practices. The question, now, becomes how these values translate into concrete norms that can be used for the assessment of research and innovation practices. Table 7 provides an attempt at doing so displaying, in addition to the various elements of the working definition of RRI and the policy agendas that also figured in the tables in section 3, also the values that bind all of these together.

Table 7. RRI values and the working definition's ingredients

Value	Aspect of RRI
Democratic values	<ul style="list-style-type: none"> • Diversity and inclusion • Openness and transparency <i>Process requirements</i>
	<ul style="list-style-type: none"> • Engaged publics • Responsible actors • Responsible institutions • Socially desirable outcomes <i>Outcomes</i>
	<ul style="list-style-type: none"> • Gender • Public engagement • Governance • Open access • Science education <i>Policy agendas</i>
Social and moral values	<ul style="list-style-type: none"> • Diversity and inclusion • Openness and transparency • Anticipation and reflection • Responsiveness and adaptive change <i>Process requirements</i>
	<ul style="list-style-type: none"> • Engaged actors • Responsible actors • Responsible institutions • Socially desirable outcomes • Meeting societal challenges <i>Outcomes</i>
	<ul style="list-style-type: none"> • Gender • Ethics • Public engagement • Open access <i>Policy agendas</i>
Individual and institutional values	<ul style="list-style-type: none"> • Diversity and inclusion • Openness and transparency • Responsiveness and adaptive change <i>Process requirements</i>
	<ul style="list-style-type: none"> • Engaged actors • Responsible actors • Socially desirable outcomes • Meeting societal challenges <i>Outcomes</i>
	<ul style="list-style-type: none"> • Open access • Public engagement <i>Policy agendas</i>

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Appendix. List of workshops

Date	Country	Organiser	Moderator(s)	Assistant(s)	Observer(s)
11-09-2014	Italy - Milan	Fondazione Cariplo	Valentina Amorese	Riccardo Porro	Angela Simone (Fondazione Bassetti) Luisa Marino (ECSITE)
02-10-2015	Belgium (Flanders) – Brussels	King Baudouin Foundation	Gerrit Rauws Sara Heesterbeek Bénédicte Gombault	Ann Nicoletti	Louisa Marino (ECSITE)
02-10-2014	Greece – Athens	Ellinogermaniki Agogi	Aliki Giannakopoulou	Dimitris Rossis	Eugenia Kypriotis
15-10-2014	Spain – Barcelona	IrsiCaixa, with the collaboration of “la Caixa” Foundation, Fecyt and Cosce	Rosina Malagrida	Josep Carreras Ignasi López Stella Veciana	Guillermo Santamaría Matilde Gordero
16-10-2015	Switzerland - Lausanne	Fondazione Cariplo	Valentina Amorese	Riccardo Porro	Béatrice Pellegrini (Natural History Museum, Heneva) Nicoletta Iacobacci (Future Media – EBU) Jérôme Grosse (EPFL) Sacha Sidjanski (EPFL) Michele Bonnard (EPFL) Papageorgiou Nikolaos (EPFL) Alain Kaufmann

					(Lausanne University)
					Marc Audétat (Lausanne University)
16-10-2014	Luxemburg - Luxembourg	King Baudouin Foundation	Gerrit Rauws Bénédicte Gombault	Sara Heesterbeek	Jean-Pierre Alix (Euroscience)
20-10-2014	Spain – Madrid	IrsiCaixa, with the collaboration of “la Caixa” Foundation, Fecyt and Cosce	Rosina Malagrida	Josep Carreras Ignasi López Stella Veciana	Gonçalo Praça Daniel García
20-10-2014	Czech Republic	Techmania Science Center	Alena Roková	Andrea Králová	Pavel Petrle
21-10-2014	Ireland - Dublin	Science Gallery Dublin	Joseph Roche	Diane Mc Sweeney	
23-10-2014	Germany – Oberhausen	Wissenschaftsladen Bonn (CIPAST)	Norbert Steinhaus	Michaela Shields	Luc van Dyk (Euroscience)
23-10-2014	Greece – Thessaloniki	Ellinogermaniki Agogi	Aliki Giannakopoulou	Dimitris Rossis	
29-10-2014	Denmark - Copenhagen	Experimentarium	Sheena Laursen Morten Fabricius	Christoffer Muusmann	Mai Murmann Caroline Thon Anette Nielsen
29-10-2014	South-Eastern Europe Hub (Serbia, Croatia, Albania, Montenegro, Bosnia-Herzegovina) – Belgrade	Centre for the Promotion of Science (CPS) Faculty of Economics, Finance and Administration - FEFA	Divna Vuckovic Marina Djenic Branka Draskovic Dobriboje Lale Eric	Dusan Vulovic Dragana Djurdjevic Dubravka Vejnovic Ana Brajovic	Ljiljana Ilic Olivera Cacic Milutinovic
30-10-2014	Portugal – Lisbon	Ciência Viva	Carlos Catalão	Gonçalo Praça Marta Santos	

31-10-2014	Greece – Cyprus	Ellinogermaniki Agogi	Aliki Giannakopoulou	Dimitris Rossis	
31-10-2014	Bulgaria – Nisovo village, Ruse	RCCI	Lora Sarkisyan	Petya Gancheva Jordan Petrov Radimira Kireva	Petya Gancheva
03-11-2014	United Kingdom - London	University College London (UCL)	Steve Miller Melanie Smallman Jack Stilgoe	Olivia Hamlyn Natacha Faullimmel Kaatje Lomme	Alexia de Harambure (Euroscience)
03-11-2014	Austria – Vienna	Centre for Social Innovation (ZSI)	Ilse Marschalek Handler Katharina	Maria Schrammel	Gorazd Weiss
04-11-2014	France – Bordeaux	Science Animation Midi-Pyrénées	Malvina Artheau		Cécile Marsan Jean-Pierre Alix
06-11-2014	Sweden – Stockholm	Vetenskap & Allmänhet (VA)	Karin Larsdotter Anders Sahlman	Maria Lindholm Mika Nitz	
07-11-2014	Belgium (Wallonia) – Brussels	King Baudouin Foundation	Gerrit Rauws Bénédicte Gombault	Ann Nicoletti Sara Heesterbeek	Louisa Marino (ECSITE)
07-11-2014	Netherlands – Amsterdam	Athena Institute	Frank Kupper	Pim Klaassen Michelle Rijnen Sara Vermeulen	
10-11-2014	Estonia, Latvia and Lithuania	Science Centre AHHA Foundation	Arko Olesk (University of Tallinn)	Liina Vaher (Science Centre AHHA Foundation)	Inese Zake (Rigas Secondary School no 2)
11-11-2014	Hungary - Győr	Mobilis	Tamás Péter Szilasi	Tamás Németh	Márta Regner

			Zoltán Kalcsu	Szabolcs Rákosi	Erna Vágusz
11-11-2014	Romania - Bucharest	RCCI	Corneliu-Trisca Rusu	Roxana Vasilco Petya Gancheva	Petya Gancheva
14-11-2014	Slovenia - Ljubljana	Centre for Social Innovation (ZSI) Slovenian Research Agency (ARRS)	Gorazd Weiss (ZSI) Tina Vuga (ARRS)		
28-11-2014	Poland – Warsaw	Foundation for Polish Science (FNP)	Adam Zielinski	Monika Biłas- Henne	Hanna Kubicka Julia Zimmermann