Governance of Responsible Innovation

GREAT – 321480

Annual Report on the main trends of SiS, in particular the trends related to RRI			
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Glossary

Term	Definition

1 Introduction

As laid down in the Description of Work (DoW), the GREAT project will develop an empirically based and theoretically sound model of the role of responsible research and innovation (RRI) governance. The project will explore the dynamics of participation in research and innovation, and investigate the characteristics of responsible practices. It will investigate the nature of new partnerships among various stakeholders who include but are not limited to researchers, industry, civil society organisations and policymakers that are developing within innovation networks. The investigation will extend to understanding the influence that these developments have on knowledge production and policy. This will be done by:

a. determining the characteristics of research and innovation
b. involving diverse groupings and
c. determining the social processes involved in RRI practices.
d. exploring the knowledge and research potential of multi-stakeholder approaches in research;
e. investigating how responsible innovation is involved in research processes and
f. using this knowledge to inform policy makers on how to integrate responsible innovation in further research activities.

This deliverable is part of work package (WP) 6, which deals with "Guidelines and Recommendations". In order to ensure that the outputs of the project remain relevant, the WP contains a task that will develop three annual reports on current trends and developments in Science in Society and, more specifically on RRI.

This task is related to and will have some overlap with work undertaken in WP2, notably task 2.2 on "Theoretical Review". This overlap will not be significant, as WP2 aims at a critical discussion of possible theoretical underpinnings of RRI, whereas the WP6 reports, of which this is the first one, uses a more explicit focus on the narrower discourse on RRI. The main purpose of this first of the three deliverables is to develop an overview of the RRI discourse and current literature.

1.1 Contribution of the Deliverable

The purpose of this deliverable is to provide an initial overview of the discourse on RRI. The DoW states that this deliverable reports on the main trends in SiS, in particular RRI. As RRI has now become the focus of the recently renamed unit "Science with and for Society", the distinction between SiS (Science in Society) and RRI is no longer relevant and the deliverable focuses on RRI (European Commission, 2013).

In order to avoid misunderstandings, it is important to clarify the knowledge claims and contribution of the deliverable and outline its role in the project. RRI is a term that has only relatively recently been introduced into the debate (Grunwald, 2011; Siune et al., 2009) and there is currently a limited number of accounts of the term itself (see section 1). While many of the contributing activities or topics, such as technology assessment, gender studies, open access, technology foresight or ethics review have long histories in a range of discipline, the discourse on RRI in the narrow sense is much more limited. At present this discourse is growing rapidly. The new Journal of Responsible Innovation[1] promises to be an important source of future contributions. At the same time there are numerous policy-related publications and outputs from a range of European and other research projects that contribute to the body of literature.

This deliverable uses the fortunate timing of the GREAT project to offer a broad overview of the entire discourse, while it is still possible to trace all, or at least most of the salient publications on the topic. The deliverable thus sets out to do just this, namely to trace the overall discourse as it stood during 2013 when the deliverable was developed.

The deliverable claims to cover the most important contributions to this discourse. It is important to underline that this claim is a qualitative one with an important subjective component to it. In the sections below we propose a number of questions to interrogate publications on RRI and to compare these accounts. We believe that our main guiding questions are intuitively plausible and a reader aiming to understand the RRI discourse will benefit from engaging with them: a. What is RRI? b. Why is RRI proposed? c. How is RRI to be implemented? d. Who are the actors in RRI? We concede, however, that these are not the only possible questions and further questions may need to be explored in later stages of the project.

It is furthermore important to reflect on the philosophical stance of the deliverable. We position ourselves squarely in the interpretive tradition of social science research, basing our knowledge claims on hermeneutics and phenomenology (for a detailed discussion of these questions pertaining to the philosophy of social sciences see Stahl (2014)). This means that we do not claim to have unearthed objectively real features of an existing body of literature (a claim that would strike us as strange) but that we have engaged with the different authors with a view to developing our understanding, which allows us to communicate to our audiences, in the first instance the consortium of the GREAT project.

In this spirit, we see it as the main contribution of the deliverable to develop the reader's understanding of RRI. This growing understanding can then be put to use in a number of ways, not least through empirical investigations and testing of different conceptions of RRI against empirical realities.

[1] http://www.tandfonline.com/loi/tjri20

A final preliminary remark is in order to explain the use of technical tools and the way they support and structure our methodology. Given our interpretive stance we do not believe that the use of an appropriate methodology automatically leads to acceptable results. In fact, we are sympathetic to Wastell's (1996) view that an overreliance on methodology can turn it into a fetish, a phenomenon one can sometimes observer in social sciences. In this deliverable the detailed description of the methodology of collecting and analysing sources and the use made of technical tools for this purpose is motivated by the attempt to maximise the transparency of the approach and the resulting narrative. In the spirit of interpretive research we believe that knowledge is most likely to develop during the interaction with a text if the reader finds it easy to access the text. As we are claiming to give an overview of the RRI discourse, an understanding of how the sources were identified and how the reading was undertaken should help readers appreciate the origin and thus the acceptability of the knowledge claims.

1.2 Overview

The deliverable starts by explaining the methodology employed in undertaking the literature review. It then discusses four central questions that influence the current debate:

a. What is RRI?
b. Why is RRI proposed?
c. How is RRI to be implemented?
d. Who are the actors in RRI?

Following the analytic structure set up by these four basic questions, each question is covered in a separate section. By organising the review along the four base questions, a clear distinction is drawn between the different aspects of RRI. In practice, the division of source material over the four basic questions is not always straightforward. First, the structure of the reviewed sources generally does not follow the analytical structure proposed here, as the purpose of the publications tends to follow different logics from the one pursued here. For instance the basic questions are not addressed as such by the authors. Furthermore, answers to one question tend to overlap or draw on answers to one or more of the other questions. As a result some of the information, sources and/or quotes re-appear in multiple sections of this review.

2 Review Methodology

The purpose of this literature review is to broaden and deepen the understanding of RRI by giving an overview of the current discussion of RRI in literature. The review focuses on different aspects of RRI such as concepts involved, motivations to undertake RRI and approaches to implement RRI. Since the goal is to expose and explicate meaning and underlying structures of these aspects, the review uses qualitative methods. This is further corroborated by the qualitative nature of the body of literature, which reinforces the use of qualitative review in RRI(Randolph, 2009). The sources studied therefore are described, interpreted and analysed in a narrative fashion.

2.1 Qualitative method

To ensure systematic rigor, the current literature review is conducted following an eight step method forwarded by Gall, Gall, and Borg (2006). Building on a widely used method by Ogawa and Malen (1991), it consists of the following eight basic steps:

Step 1: Create an audit trail

Step 2: Define the focus of the review

Step 3: Search for relevant literature

Step 4: Classify the documents

Step 5: Create Summary databases

Step 6: Identify constructs and hypothesized causal linkages

Step 7: Search for contrary findings and rival interpretations

Step 8: Use colleagues or informants to corroborate findings

The way these steps were followed is explained in more detail below. Very briefly, steps 1, 3, 4, 5 and 6 are implemented and documented using two referencing / research tools specifically designed to support such tasks called *Zotero*[2] and *Qiqqa*[3]. Zotero is free and open-source reference management software to manage bibliographic data and related research materials (such as PDF files)[4]. Among others it allows users to gather, organise, and analyse sources[5]. Qiqqa is freeware reference management software that allows researchers

[2] http://www.zotero.org/, retrieved 10-4-2013.
[3] http://www.qiqqa.com/, retrieved 10-4-2013.
[4] http://en.wikipedia.org/wiki/Zotero, retrieved 10-4-2013.
[5] http://www.zotero.org/about/, retrieved 10-4-2013.

to annotate, comment and organize documents[6]. By automatically extracting tags and themes, comparing references across documents and generating annotation reports it aims at increasing research efficiency[7].

Although Zotero and Qiqqa offer overlapping functionality, for this literature review the tools were used in a complementary manner. Whereas Zotero is used for reference management and structuring the body of literature, Qiqqa is applied to create, store and analyse annotations and quotes of sources.

Below each of the eight steps is outlined in detail.

2.1.1 Step 1 Audit trail

Audit trails serve as a means of documentation of all the steps taken during the research. It clarifies the evidence that supports each finding, where that evidence can be found, and how that evidence was interpreted (Randolph, 2009). For this literature review an audit trail is automatically generated using Zotero.

First, an online library is created in Zotero. Next, all the sources found during research are stored in that library. Each source receives an entry in the library containing its data (preferably a PDF of the document) and relevant metadata about the source including title, author(s), publication date and abstract.

When a source is added to the library, its date of entry was automatically recorded and added to its library entry by Zotero. Also it registers each time when data or metadata of a source is modified. This way a detailed audit trail of the sources found and used during the literature review is documented automatically.

2.1.2 Step 2 Focus definition

By defining the constructs of the review, it can be determined what to include and what to leave out (Randolph, 2009). As stated in the introduction, the aim of this review is gaining a comprehensive understanding of current knowledge on RRI. Creating such an understanding helps to identify conceptual and methodological ambiguities and gaps thereby guiding further debate and research in the field.

To cover all aspects of RRI in the analysis, four basic evaluative questions are suggested. Together, answering these four questions amounts to a comprehensive overview of how RRI is currently portrayed in literature.

1. **What is RRI?** I.e. What type of phenomenon is RRI according to different accounts presented in literature?

[6] https://en.wikipedia.org/wiki/Qiqqa, retrieved 10-4-2013.
[7] http://www.qiqqa.com/, retrieved 10-4-2013

2. **Why should RRI be conducted?** I.e. what are the motivations brought forward in literature in terms of why RRI should be implemented by the research community as an alternative way of conducting research?

3. **How should RRI be implemented?** I.e. what are the different methods and approaches outlined in literature?

4. **Who should be involved in RRI?** I.e. which actors and stakeholders relevant to RRI are discerned in literature?

RRI is still an emerging concept (Owen, Macnaghten, and Stilgoe, 2012) which has so far predominantly received attention in Western European countries. As a result, the body of literature specifically addressing RRI is fairly limited. Also RRI is classified as an umbrella term (Owen et al., 2013) encompassing a wide range of concepts and approaches that have been studied and documented widely, for example in Science and Technology Studies (STS) in Jasanoff (2012) or Technology Assessment (TA) in Von Schomberg (2012) . Including these would considerably widen the scope of the literature review. For current purposes therefore, these are only touched upon and studied in so far as they contribute to understanding RRI in general.

2.1.3 Step 3 Search for relevant literature

In this step, data is collected and added to the Zotero library. First, a broad search was performed across major, widely used portals for academic research such as Scopus, Web of Knowledge and Google Scholar. As a starting search term 'Responsible Research and Innovation' and closely related terms such as 'Responsible Innovation' and 'Responsible Development' were used. As was to be expected RRI being a novel topic, searching the different portals produced only a limited amount of twenty six sources. To ensure comprehensiveness, the search therefore was broadened to literature from adjacent academic fields and to non-academic sources on RRI such as policy documents.

Moreover, as searching and reviewing advanced, new relevant search terms emerged. These terms often depicted topics closely related to RRI, such as 'midstream modulation', 'Technology Assessment', and 'Anticipatory governance' and were iteratively added to the search process. These terms depict approaches that are discussed in literature as constitutive to RRI (Grunwald, 2011; Owen et al., 2012; Von Schomberg, 2013). They therefore were included into search process. As stated above though, sources of related fields were only incorporated in so far they contributed to the (general) understanding of RRI.

In addition to the search of academic databases, the authors searched for relevant literature starting with the authors Owen, Von Schomberg, Stahl and Grunwald who are known to contribute to the current RRI debate. Other important authors, such as Groves, Guston, Mason and Macnaghten were highlighted whilst iterating through the review steps. Sources by these authors addressing RRI or closely related subjects were consecutively added to the body of literature.

Finally, sources were discovered by consulting the references in the sources that were found. This way of finding relevant literature is also referred to as 'snowball' (Biernacki & Waldorf, 1981) because the amount of references tends to grow rapidly and is considered to be an efficient approach. Qiqqa supports snowballing by highlighting sources that have been referenced to by multiple entries in a body of literature. The idea then is that the more a source is referenced to, the more it can be of relevance to the literature review. It must be noted that for cutting edge research, assessing relevancy this way may be considered less appropriate. For very novel research the total amount of papers may be rather limited. Moreover, as these have been published in a short time frame, they are less likely to explicitly build upon each other. The amount of cross-referencing therefore may be small as compared to more established fields of research. As was to be expected, RRI being an emerging concept, snowballing did not yield many new sources apart from literature on concepts and theories that RRI is built upon.

Deploying the different methods stated above, in total 45 documents were found relevant to the current research. 35 of these are academic papers and book chapters, the other 10 are policy documents.

2.1.4 Step 4 Classification & categorization

In this step the documents are classified according to type and put into broad categories (Randolph, 2009).

A broad variety of types of sources were found, ranging from academic papers and policy documents, to video and written reports of presentations and workshops. Along with other metadata, source type was added to the library in Zotero for each entry. The majority of sources in the library consisted of academic journal papers and book sections. Other academic sources included conference papers, video footage of conferences, scholarly web-pages and deliverables of (European) projects. Non-academic sources included policy documents such as leaflets, brochures, guidelines and legislation, and popular sources such as magazine and newspaper articles, and websites.

Next, sources were classified according to broad categories. Categories were established by drawing on the topical search terms used in step 3. Categories included: RRI in general, Midstream Modulation, Governance, Ethics, Responsibility, Risk, Social Technical Systems (STS) and Technology Assessment (TA). By creating a folder hierarchy depicting the categories in Zotero, all the library entries representing sources were arranged accordingly.

On the basis of source type and categories a first selection was made of the sources that were to be analysed in depth. In line with the review aim, the sources were categorized as 'RRI in general' and added to this selection. Furthermore, for each of the other categories, one or two sources were added that were representative of that category.

2.1.5 Step 5 Create summary databases/ evaluation stage

In this step, a selection of the gathered literature is summarized and evaluated. To this purpose, coding schemes are developed and information in the relevant documents is reduced (Randolph, 2009).

For the implementation of this step, Qiqqa offers a range of functionality that Zotero lacks. At this stage the library constructed in Zotero was transferred to Qiqqa. Besides the metadata that was stored in Zotero, full-text documents for each entry were also stored in Qiqqa. Using the Qiqqa's annotation and analytic tools the selected sources were subjected to a review. In the first reading, important concepts, lines and sections in the texts were highlighted. In the second reading, whole documents, or specifically selected sections of documents were tagged (see figure 1a). Tags can be used in Qiqqa to search, retrieve and aggregate quotes across documents in a library. For more elaborate queries besides tags author-names, years of publication, and other types of meta-data can also be included.

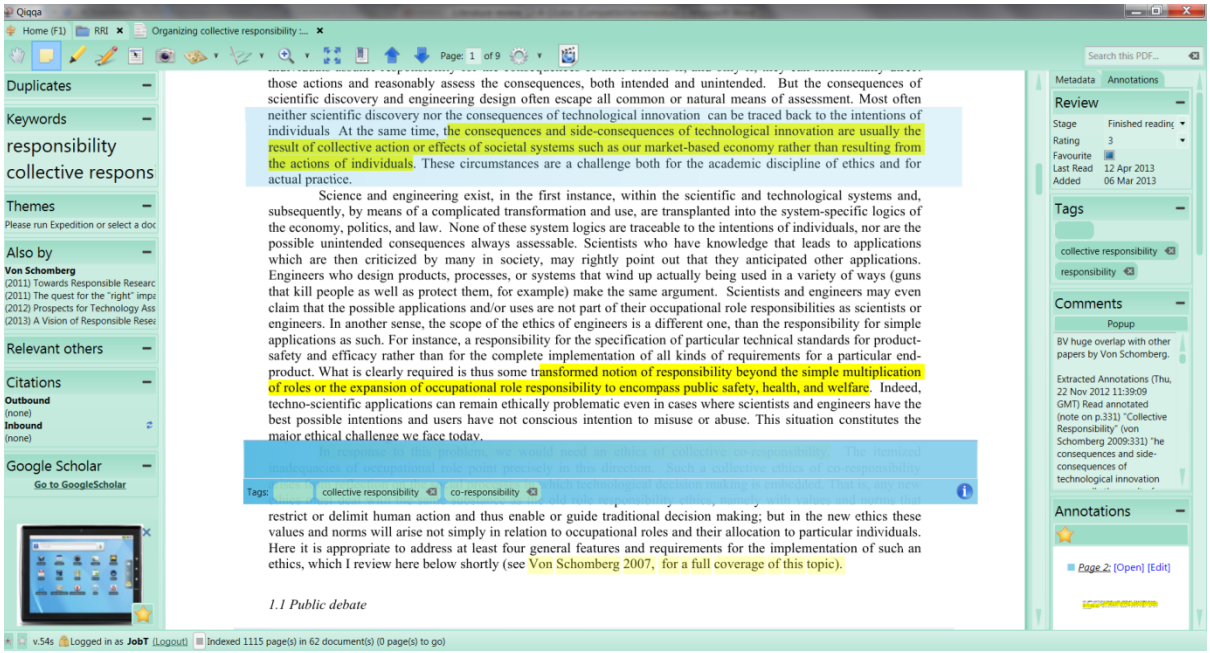

Figure 1: ***Screenshot of annotating in Qiqqa displaying text highlighting, tagging of text selection (blue box), rating (review section top right corner) and commenting (right middle).***

By reviewing the body of literature in this way allowed the generation of different kind of tags that were then assigned to selections including:

- Tags related to the basic questions addressed in the review such as 'what RRI', 'who RRI', 'why RRI', 'background RRI', 'definition of RRI' and 'novelty RRI'.

- Tags depicting specific concepts or aspects relevant to RRI such as 'collective responsibility', 'foresee-ability', 'responsibility', 'autonomy', 'anticipation', 'integration', 'innovation', etc.

- Tags depicting approaches or theories relevant to RRI for instance 'Technological Assessment', 'code of conduct', 'foresight studies', 'ethical assessment', etc.

- And finally, tags stating that cases, issues or examples of RRI were discussed in the literature.

Besides tags, during this step notes were also added in Qiqqa to sources, either referring to a selection of text in a document or to a document as a whole. Comments contained ideas and remarks as well as short summaries of information or arguments. Comments were used as input during the analysis and during the writing up phases of the review.

Finally, Qiqqa supports grading of documents on a scale of 1 to 5. By grading the documents in the library their perceived relevance to the literature research was marked. In follow-up steps of the review, marks figured as indicators as to whether or not to include a document in the further analysis.

2.1.6 Step 6/7 Identify constructs and hypothesized causal linkages / Search for contrary findings and rival interpretations

After documents have been evaluated and summarized, the task is to identify the essential themes of the documents and create hypotheses about the relationships between the themes (step 6) and to actively search for contrary findings and rival interpretations (step 7) (Randolph, 2009). The aim of these steps is to increase the understanding of the phenomena being investigated and to unveil possible gaps in the knowledge, indicating areas that need further research. These two steps, which make up the analytic phase of the review, in practice were undertaken in concert as they are closely interrelated and interdependent and therefore are also discussed together.

Themes were found by reviewing the tags attributed to documents and sections of text in step 5. Those tags re-occurring frequently within and across documents are then considered as a possible theme. As anticipated, and validating the earlier selection of literature, tags relating to the four basic questions posed initially, were among the most used tags and therefore were considered themes. Other tags that appeared frequently in the Qiqqa library were: responsibility, responsibility allocation, definition of RRI, Technology Assessment, RRI, anticipatory governance, policy, reflexivity, public engagement, code of conduct, foresight, ethics, stakeholder involvement, governance, funding and innovation. Many of these tags depict approaches that are encompassed by RRI as an umbrella term, such as Technology Assessment, ethics and anticipatory governance. These tags were discarded as themes because they can be aligned under the theme / basic question 'How RRI'. In a similar vein, tags representing aspects of RRI, such as reflexivity and public engagement, were placed under the broader ´What RRI´-theme. Also the tag ´RRI´ was discarded, because it was considered too broad, encompassing the whole subject area under review.

Other tags, however, appeared to have such importance to the RRI discourse that making them independent themes seemed justified. The tags ´responsibility´ and ´responsibility allocation´ were taken together to form the theme of ´responsibility´, and the tag ´definition

of RRI´ was made a thematic area. Importantly, these two themes also appeared to indicate knowledge gaps in the current field of RRI. As is discussed in detail below (Section 4), the literature review demonstrated that:

- Many questions surrounding the concept and allocation of responsibility in relation to RRI are still open and need addressing.

- Different and in some cases contrary accounts of RRI are forwarded in literature. The question of how RRI should be defined therefore is still an open one.

During these steps the review was put to paper. To that purpose Qiqqa was used to manage, search and quote from annotations, and Zotero to manage and include references into the text.

2.1.7 Step 8: Use colleagues or informants to corroborate findings

In this step, drafts of the literature review report is shared with colleagues and other informants, requesting that they critically analyze the review (Randolph, 2009). Consent among informants then counts as confirmation of the soundness of the review's conclusions.

The following sections of this chapter outline an in depth discussion of these results.

3 A Review of Current Positions on RRI

This review explores the current debate around RRI by looking at some of the more salient accounts and analysing them with regards to guiding questions. The purpose of this section is to attain knowledge about different meanings attributed to the concept of RRI in current discourse. Relevant findings of the literature review are discussed in two successive parts. The first part sketches the historical background of RRI thereby setting the stage on which RRI first emerged. The second part discusses and compares different accounts of RRI which have been forwarded by different authors in current discourse. This section ends with a summary of the findings.

3.1 Background of RRI

Although RRI has come to receive broader attention only recently, it is generally agreed that RRI is not a recent development but stretches back at least a decade (Grunwald, 2011; Owen et al., 2013, 2012; Von Schomberg, 2011b). The phrase RRI itself stems from two earlier terms 'responsible development' and 'responsible innovation' that have been part of the discourses on scientific-technological advance and products, services and systems respectively (Grunwald, 2011; Siune et al., 2009). More specifically language of responsible innovation or development is associated with the rise of nanotechnology (Fisher & Rip, 2013). For instance, as early as 2003 the US Congress adopted a public law promoting 'Responsible Development of Nanotechnology' (US Congress, 2003), and in February 2008 the European Commission adopted the Code of Conduct for Responsible Nanosciences and Nanotechnologies Research (European Commission, 2008a) emphasizing responsible research (Jacob et al., 2013). As R&D on nanotechnology advanced, awareness of possible adverse consequences grew and fuelled the demand for more accountable and governable knowledge and science (Simakova & Coenen, 2013). RRI then can be viewed as an initiative to answer that demand.

Also RRI is regarded as a next evolutionary step in a longer tradition building on developments in related fields and practices that have a longer history such as Technology Assessment (TA), social-technical integration and science and technology studies (STS) (Owen et al., 2013). Grunwald (2011) for instance shows how more advanced strands of TA preceded characteristics currently associated with RRI such as the integration and cooperation between applied ethics, social science and philosophy of science. Although TA is a major contributor to RRI in terms of knowledge, experience and methodology, RRI does have merit as a field on its own. In its 'consideration to ethical issues of responsibility and to broader governance and STS issues' RRI extends its scope of consideration beyond that of TA (Grunwald, 2011, p. 8).

RRI is thus positioned in a longer tradition of reflecting on research and innovation (R&I). It is argued that this tradition even dates back centuries to 17th century Enlightenment (Owen et

al., 2013). At that time an informal contract between scientists and researchers on the one hand and society as a whole on the other arose (Owen et al., 2013). This contract confirmed a reciprocal relation between the contractors that ensured freedom, social licence and funding for research, and innovation in exchange for knowledge, understanding and value (Owen et al., 2013). Also it implied certain standards and responsibilities that researchers and scientists should adhere to. The contract again became the centre of attention in the second half of the 20th century. Major developments in technology and R&D instigating unintended, unforeseen and sometimes transformative consequences for society called for a renegotiation of the contract (Owen et al., 2013).

The appeal for a renegotiation of the contract involved an increase to the usage of the concept of 'responsibility' in connection with scientific and technological progress (Grunwald, 2011). Hans Jonas (1984), for example, argued that the unprecedented impact of the current generation mediated through innovation and technology carries along an enormous responsibility to future generations (Grinbaum & Groves, 2013).

The emergence of RRI in academic discourse is mirrored in developments in policy and governance of R&I. While RRI itself only gained visibility over the last two years, it has evolved from earlier discourses within the EU and European Commission (EC) policy context (Owen et al., 2012). The issue of stakeholder involvement and societal acceptance currently put on the agenda by RRI, were gradually introduced first in the 5th Framework Programme (FP5) in its call for social-technical integration (Owen et al., 2012), in the FP6 Science and Society Programme, and finally in FP7 with the Science In Society framework where RRI earned a place on its own (European Commission, 2011b).

The need for science to consider societal impact has also become a funding condition in many countries (Owen et al., 2012). It was not until 2010 though, that a specific section under the header, 'responsible innovation' was included in a pilot call[8] in the UK (Owen & Goldberg, 2010).

On a EU level, similar considerations are found in the requirement to incorporate impact assessment for the Framework Programmes for Research (Von Schomberg, 2011b). Originally impact assessments focused on negative consequences and adverse effects of technologies, as is the case for risk or environmental impact assessments. This has changed and currently impact assessments can be used to highlight potentially positive impacts of future research policy (Von Schomberg, 2011b). For instance, in the EU there is a long tradition of awarding research grants on the basis of anticipated impacts.

Reviewing its background leads to in a first indication of what RRI conceptually entails and how it can be implemented in practice. More importantly, however, it reveals why RRI

[8] Engineering and Physical Sciences Research Council. Nanotechnologies for Environmental Solutions, 2009.

historically has come into being, and what the fundamental motivations are for pursuing a new discourse.

RRI is viewed as a continuation of, and next step in the historical discourse on reflecting on research and innovation dating back decades or even centuries. In that discourse a novel demand came to the forefront urging for a change in outlook seemingly large enough to justify terming it anew. This central demand states that due to fundamental changes in the nature of research and innovation, current theory and methodology for reflection will no longer suffice. Technology is deeply ingrained in society. At the same time, future consequences of novel technologies are often unpredictable whilst at the same time being of a transformative nature. The choices made today in the use, research and innovation of technology therefore are deeply influential towards future generations. The idea that accounting and taking responsibility for these choices should be an important part of R&I practice has gained support, over time culminating in RRI.

Besides offering a broad general outlook and building on and integrating predecessors like TA and applied ethics, it is still debated what RRI entails or should entail.

3.2 Conceptions of RRI

In this section, different interpretations of RRI that have evolved over the last decade are reviewed. Although accounts mutually inform each other, ultimately extensive literature search revealed eight distinct accounts of RRI:

- René Von Schomberg (Von Schomberg, 2012)
- Richard Owen, Phil Macnaghten and Jack Stilgoe (Owen et al., 2013)
- Jeroen van den Hoven (van den Hoven, 2013)
- Bernd Carsten Stahl, Marina Jirotka and Grace Eden (Stahl, Eden, & Jirotka, 2013)
- Armin Grunwald (Grunwald, 2011)
- European Commission (Geoghegan-Quinn, 2012)
- Hillary Sutcliffe (Sutcliffe, 2011)
- Expert Group on the State of Art in Europe on Responsible Research and Innovation (Jacob et al., 2013)

The analysis of each account is structured according to the four evaluative questions suggested in the introduction: what is RRI, why we should pursue it, how is to be implemented, and who should be involved? Whenever part of an account is referring to an evaluative question this is indicated between parentheses. For example the addition of (WHO) indicates that the section is related to the question: who should be involved in RRI?

Furthermore, for each account the meaning of its key concepts is interpreted using the elaboration offered by the authors of the account itself as well as relevant definitions in online English dictionaries. When making use of English dictionaries online first, the Collins English Dictionary is consulted, when this does not result in a suitable answer, the Merriam-Webster online dictionary is consulted and lastly, the online version of the Oxford English Dictionary.

Finally, the different accounts are compared with each other to highlight differences. The analysis begins with the two most widely used definitions offered by Von Schomberg and Owen et al. A summary of the findings of this review is presented in subsection 3.3

Responsible Research and Innovation (RRI) or Responsible Innovation (RI)?

It should be noted that in their discussion of their account of RRI, authors may use different concepts. Some authors refer in their account to Responsible Innovation (RI) e.g. van den Hoven, some to Responsible Research and Innovation (RRI) e.g. Stahl et al. and some use both concepts alternately, either in the same e.g. Owen et al. or in different publications e.g. Von Schomberg. In the analysis below the difference between RRI and RI will be neglected. In the discussion of the findings (section 4) possible explanations of the usage of different terminology will be looked into.

3.2.1 Von Schomberg

A widely cited definition of RRI is suggested by Von Schomberg in a number of his articles (Von Schomberg, 2011b, 2012, 2013). RRI is defined as ´a **transparent, interactive process** by which **societal actors** and **innovators** become **mutually responsive to each other** with a view to the **(ethical) acceptability, sustainability and societal desirability** of the **innovation process** and its **marketable products**(in order to allow a **proper embedding** of scientific and technological advances in our society).'(Von Schomberg, 2012, p. 9) [emphasis added]

In this definition, RRI is characterized as a process, i.e. a method of doing or producing something ("Collins English Dictionary," n.d.) aimed at aligning the R&I process and its products with societal and ethical goals, and sustainability (WHAT). By distinguishing between the process of R&I and its products Von Schomberg makes clear that producing desirable consequences alone is not enough. Also the way to get to those products should be covered in a responsible manner.

Furthermore, the account makes a distinction between (ethical) acceptability, sustainability and societal desirability. This seems to suggest that each of these three aims has a distinct reach that is complementary to that of the other two. So, ethical acceptability is considered different from societal desirability and these in turn are distinct from sustainability in their reach. That these three aims complement each other is not completely self-evident though. For instance, in order for outcomes of R&I to be acceptable or desirable it may already include a requirement that they are sustainable. And, for outcomes to be considered acceptable, it may necessarily demand that they are also socially desirable. A way of distinguishing these last two notions may be by interpreting ethical acceptability to refer to

a reasoned justification, and desirability as referring to public opinion, which may or may not be backed by reasons. In this reading, desirability is broader, encompassing both acceptability and sustainability. Mentioning (ethical) acceptability and sustainability separately then can be regarded as a means to set further limitations on what can be deemed desirable. In sum, the account is not clear how these three aims relate to each other and must be interpreted to complement each other. In his further clarification of the definition, Von Schomberg substantiates ethical acceptability, sustainability and societal desirability by linking them to fundamental values of the EU. The EU human rights charter provides normative anchor points set in the treaty of the EU and the EU's objective of sustainable development (Von Schomberg, 2012). This way circumvents epistemological and ontological difficulties attached to the notions of (ethical) acceptability and desirability.

Next, the way to attain the aims set is by becoming 'mutually responsive' (HOW). Responsibility here is thus perceived as an activity, namely as 'being responsive' which implies 'being reactive or favourable to suggestions, initiatives, arguments, appeals, etc.'("Collins English Dictionary," n.d.). RRI is thus viewed as a kind of dialogue in which suggestions, arguments, appeals etc. are being discussed.

In addition this should be done by those involved in a 'mutual' way. Reactivity towards what is being discussed is required by and with respect to all those involved in RRI. RRI requires mutual responsiveness of all those involved. Furthermore, the account states that process should be transparent and interactive (HOW). These two requirements seem to be necessary conditions to enable 'responsiveness': when a process is not transparent, those involved are not able to respond to it, and in order to be able to respond to each other interaction is required.

The definition further states that 'societal actors and innovators' should be involved in the process (WHO). A distinction is thus made between those doing the R&I and those affected by R&I products (intended or non-intended). Societal actors then may include a wide range of actors such as governmental organizations, citizens and NGOs.

Finally in parenthesis of the account is added that all this should be done 'in order to allow a proper embedding of scientific and technological advances in our society'(Von Schomberg, 2012, p. 9) (WHY). Embedding can be understood as 'making something integral part of' ("Merriam-Webster Online," n.d.). 'Proper embedding' can thus be interpreted here as integrating the products of R&I in an ethical, sustainable and societal desirable way. This is problematic as Von Schomberg further clarifies, because of the uncertainty of consequences of R&I and the time lag between occurrence of inventions and their eventual introduction into society (Von Schomberg, 2012). Without addressing 'proper embedding' early on the in process, the introduction of the products of R&I runs a risk of failing, as for instance has happened with GMOs in Europe (Von Schomberg, 2012).

3.2.2 Owen et al.

Partly building on Von Schomberg's definition of RRI, a second definition is proposed by Owen et al. It states that 'Responsible [Research and] innovation is **a collective commitment** of **care for the future** through **responsive stewardship** of science and innovation **in the present**'(Owen et al., 2013, p.36) [emphasis added].

The definition is intentionally kept broad as the authors want to prevent it from hampering further debate on and development of the concept of RRI whilst it is still in an early stage of conception (Owen et al., 2013). However, due to its broadness the definition does not provide specific answers to the three evaluative questions how, who and what of RRI.

Central to the definition are the concepts of 'responsiveness' (HOW) and 'care for the future' (WHAT) which the authors term as 'cornerstones' to a (future) framework of RRI (Owen et al., 2013). To a large extent this mirrors Von Schomberg's definition of RRI although Von Schomberg provides a more detailed account of what 'responsiveness' and 'care for the future' should entail, for instance transparency and interaction, and ethical acceptability and societal desirability (Von Schomberg, 2013). Besides, this intentional lack of elaboration of 'care for the future' and 'responsiveness' in the Owen et al. account, potentially makes it more inclusive than Von Schomberg's, exactly because it leaves open what those concepts amount to. This is corroborated in a further elaboration on their account provided by Owen et al. that states that RRI is about 'being responsible, taking responsibility and innovating responsibly […]' (Owen et al., 2013, p.46), thus including multiple outlooks on 'responsibility'.

In the dictionary, 'care' is defined both as 'the provision of what is necessary for the health, welfare, maintenance, and protection of someone or something' and as 'serious attention or consideration applied to doing something correctly or to avoid damage or risk'("Oxford English Dictionary," n.d.). 'Care for the future' then sets the future as the locus of concern and in need of attending to. What is more, care implies an active stance in the provision of what is necessary to protect and provide for the future. Elsewhere the authors corroborate this interpretation by stating that letting the future take care of itself is unsatisfactory (Owen et al., 2013). Again this statement implies an active stance of those involved and affected by R&I with regards to the future.

Furthermore, in their definition, Owen et al. state that the future should be cared for 'in the present'. Responsibility then must be viewed as prospective and forward looking (Owen et al., 2013). Also it makes explicit that the current generations should be engaging in RRI (WHO). In a further elaboration on their account Owen et al. explain that RRI is a collective endeavour calling for a 'holistic approach across the innovation ecosystem, with an important role for universities, institutes and research funders to play.'(Owen et al., 2013, p.46)

The phrase 'responsive stewardship of science and innovation' (HOW) couples responsiveness –already discussed in more detail in the review of Von Schomberg's

definition- to the concept of stewardship. Stewardship can be defined as 'conducting, supervising, or managing something' or more specifically 'the careful and responsible management of something entrusted to one's care' ("Merriam-Webster Online," n.d.). So these definitions found in the dictionary explain that in RRI, care for the future means managing or supervising of R&I in a careful and responsible way. The inclusion of both 'care' in careful and 'responsible way' runs the risk of making the definition circular as 'care for the future' becomes associated with 'careful managing[…] something entrusted in one's care' and responsiveness or responsibility with a 'responsible way'. In that case care would not add additional meaning to responsiveness.

Owen et al. frame RRI as a 'collective commitment' (WHAT). Similar to Von Schomberg's account (Owen et al., 2013) 'commitment' can be defined as 'the state or quality of being dedicated to a cause, activity, etc.:' and 'an engagement or obligation that restricts freedom of action' ("Oxford English Dictionary," n.d.). Here 'a commitment of care' can be understood as 'dedication to give proper care' and also as 'a duty or obligation'. The latter reading seems to be stronger as it entails a restriction of freedom of action to care, as 'dedication' merely counts as a motivation without a necessary restriction (see section 4 for further discussion).

Whilst the definition itself does not provide much detail on the how, who and what of RRI, the questions of why RRI should be undertaken are not addressed at all (WHY). Their overall discussion of RRI Owen et al. however does provide more insight into this matter. The main reasons for pursuing RRI include the existence of a responsibility gap, the nature and impact of consequences of R&I, most notably their disruptiveness and uncertainty, and the failure of and a lack of a coherent implementation of existing approaches, governance and legislation (Owen et al., 2013). RRI should therefore be undertaken for 'substantive and normative, rather than purely instrumental reasons' (Owen et al., 2013, p.46). The pursuit of RRI, the creation of a responsible R&I in which the nature and impact of its consequences are taken into account, thus must be understood as a goal in itself. In section 4.2 motivations to pursue RRI forwarded in current discourse are discussed in detail.

The framework of RRI proposed by Owen et al. can be regarded as a further elaboration on their broad definition. The framework suggests four dimensions of RRI that 'align well with the definition of RRI offered by Von Schomberg' (Owen et al., 2013). Owen et al. suggest that in order to innovate responsibly, a collective and continuous commitment is needed that is anticipatory, reflective, deliberative and responsive (Owen et al., 2013). More specifically RRI needs to (Owen et al., 2013):

- **anticipate** both intended and unintended impacts of R&I;
- **reflect** on 'underlying purposes, motivations and potential impacts, what is known and what is not known, and associated uncertainties, risks, areas of ignorance, assumptions, questions and dilemmas.';

- **deliberate** visions, purposes, questions and **dilemmas collectively** and in an **inclusive** manner;

- be **responsive** to issues related to R&I in an **iterative, inclusive and open** manner.

[emphasis added]

The need to be 'responsive' also found in the definition here is elaborated upon by requiring it be iterative, inclusive and open. 'Open' mirrors the call for transparency in Von Schomberg's account. 'Inclusive' indicates that all relevant stakeholders (WHO) should be allowed to participate and 'iterative' implies responsiveness needs to be repeated over time. This reading is corroborated by Owen et al. when they require RRI to be a 'continuous, iterative process of learning' (Owen et al., 2013)

Anticipation, deliberation and reflection further substantiate the aim to 'take care of the future' stated in the definition. Reflection and deliberation seem to tie in with Von Schomberg's 'being responsive' which was interpreted as a need to engage in a dialogue. Anticipation however may be interpreted as moving beyond mere dialogue, as it also includes taking steps such as intervening in R&I processes. Reading 'anticipation' this way would result in Owen et al.'s account of RRI making a stronger demand than Von Schomberg's.

3.2.3 European Union (EU)

The European Union by word of the European Commissioner for Research, Innovation and Science Geoghegan-Quinn indicates how it understands RRI:

'Responsible Research and Innovation means that **societal actors work together** during the whole research and innovation process in order to better **align** both the **process** and its **outcomes**, with the **values, needs and expectations of European society.**'(Geoghegan-Quinn, 2012, p.3) [emphasis added]

Most of the concepts used in the EU account resemble and in some cases literally match those found in the accounts of Von Schomberg and Owen et al. A reason for this might be that Von Schomberg, being an EU official, was involved in formulating the EU account. In his academic papers on RRI he nevertheless clearly states that his papers present his personal views and an official position of the EU (e.g. Von Schomberg, 2011a). Similar to Von Schomberg's definition, the EU account depicts RRI as setting (additional) requirements to both R&I processes and outcomes (WHAT) and targets 'societal actors' (WHO).

'Work together' also resembles Von Schomberg's 'interacting' and Owen et al.'s 'collective commitment' but can be understood to indicate a closer, more formal collaboration. Moreover, 'values, needs and expectations of European society' (WHY) seems to be more inclusive than Von Schomberg's 'ethical acceptability, sustainability and societal desirability' and much more specific than Owen et al.'s 'care for the future'. When the 'needs and expectations of society' are understood broadly, they do not necessarily have to align with

ethical and (more abstract) societal values. Needs such as personal mobility substantiated by owning and driving a car, for instance, may very well be at odds with the value of sustainability. Also, the EU seems to limit itself to European society, rather than including a global perspective which might diminish its importance and impact to a certain extent. Furthermore, in terms of future orientation the EU account seems to differ from that of Owen et al. Whereas Owen et al. specifically call for a commitment of care for future, 'values, needs and expectations' only implicitly indicate a regard to the future. This regard then does not have to include long term impact or future generations as is implicated in the Owen et al. account.

In a further clarification of the EU definition it is suggested that a RRI framework should consist of six keys. These keys closely resemble and build on pillars put forward by the EU commission in their Science and Society program (FP6) (European Commission, 2001) and Science in Society program (FP7) (European Commission, 2008b). The six keys are:

- joint **participation** and **engagement** in the R&I process of all societal actors – researchers, industry, policymakers and civil society- in accordance with the value of **inclusiveness**, as reflected in the Charter of Fundamental Rights of the European Union;
- **Gender equality** and integration into R&I process;
- Enhancement of the **educational process** geared towards RRI;
- Respect for **fundamental rights** and highest **ethical standards**;
- R&I must be **open and transparent**;
- Governance: **policy makers have a responsibility** to prevent harmful or unethical developments in R&I. (Geoghegan-Quinn, 2012) [emphasis added]

In the suggested six keys of the RRI framework the starting points of the definition are repeated and in some instances elaborated upon. Again many similarities are apparent with Von Schomberg's and Owen et al.'s account in terms of concepts used. For instance, linking RRI to fundamental rights and ethical standards matches Von Schomberg's 'ethical acceptability' and substantiation of acceptability and desirability by referring to the EU charter. Also the call for 'inclusiveness' can be found in Owen et al.'s framework.

Furthermore, 'participation and engagement in the R&I process' (HOW) resemble 'mutual responsiveness' in the account of Von Schomberg and 'collective commitment' in Owen et al.'s. Participation and engagement however are more specific about how involvement of societal actors should be shaped. Especially, participation implies a much stronger involvement of actors than responsiveness or commitment necessarily does. The same holds for the explication in the EU account of the responsibility of policymakers (WHO). Although addressed widely in RRI literature elsewhere, none of the other accounts of RRI specifically

discusses the allocation of responsibility to a specific actor involved. Again the EU account makes a stronger claim than the other two accounts.

Finally, as opposed to accounts of Von Schomberg and Owen et al., the EU account requires RRI to include 'gender equality and integration', and 'enhancement of the educational process'. This focus on gender may be implied but is not explicitly discussed by concepts such as Von Schomberg and Owen et al.'s care for the future. Moreover, nowhere else in current literature on RRI has gender been mentioned in relation to RRI. Education in relation to RRI on the other hand has been discussed widely in the literature (see: Owen, Macnaghten, and Stilgoe 2012; Owen et al. 2013; Mali et al. 2012; Guston 2013; Sutcliffe 2011; Stahl 2012; Lee and Petts 2013). In order for RRI to be successful, education as is needed to raise awareness and teach skills to those involved for instance, to reflect on and discuss societal issues. Educating those involved in R&I therefore must be viewed as an essential component of RRI.

3.2.4 Sutcliffe

Another definition is drawn up by Sutcliffe in her report on RRI (2011). Sutcliffe was asked by the EU commission to explore issues around RRI in her report, building on views expressed by participants of the 2011 DG Research Workshop on Responsible Research and Innovation (European Commission, 2011a). Besides Sutcliffe, four of the main authors of the other accounts discussed here participated: Owen, van den Hoven, Von Schomberg and Stahl. Moreover in her report, Sutcliffe explicitly draws on the definitions offered by Von Schomberg and Owen et al. and the EU. In her account Sutcliffe thus not so much shares her own vision, but summarizes existing accounts of RRI.

This also justifies the relative brevity of the review of her account here. While noting that definitions of RRI are still evolving and therefore preliminary, Sutcliffe summarizes RRI as: '

1. The **deliberate focus** of research and the **products** of innovation to achieve a **social or environmental benefit**.

2. The consistent, ongoing involvement of society, from beginning to end of the innovation process, including the **public & non-governmental groups**, who are themselves mindful of the **public good**.

3. **Assessing** and effectively **prioritising social, ethical and environmental impacts, risks and opportunities**, both now and in the future, alongside the technical and commercial.

4. Where **oversight mechanisms** are better able to **anticipate and manage problems** and **opportunities** and which are also able to **adapt and respond** quickly to changing knowledge and circumstances.

5. Where **openness and transparency** are an integral component of the research and innovation process.' (Sutcliffe, 2011, p.3) [emphasis added]

Not surprisingly, this definition again puts an emphasis on the overall aim of RRI to 'achieve social or environmental benefit' and again as being ´mindful of the public good´ (WHY) which can be regarded as a more formal way of Von Schomberg's 'societal desirability' and EU's 'needs and expectations of society'. Also the suggested 'deliberate focus[…] to achieve social or environmental benefit' (WHAT) hints toward intently and actively pursuing the aims of RRI (HOW) which are also to be found in the definitions of Von Schomberg, EU and Owen et al. In line with Von Schomberg and EU as well, the definition distinguishes between process ('research') and 'products [of innovation]'. Furthermore the involvement in RRI of '(civil) society', more specifically 'public & non-governmental groups' (WHO) resembles the definitions discussed earlier. The inclusion of other actors besides these societal actors is not explicitly mentioned but can be deduced from the five points. Moreover, Sutcliffe discusses other actors in the remainder of her overview of RRI (Sutcliffe, 2011).

The 'involvement of society' stipulated in the definition indicates how RRI should be implemented (HOW). This concept mirrors the 'inclusiveness' of (Owen et al., 2013) and the EU account as well as the societal stakeholder participation implied by Von Schomberg (2013).

Points three, four and five of the account elaborate upon what an implementation of R&I should include (HOW). A distinction is made between 'oversight mechanisms' and 'the R&I process' proper. The requirement that oversight mechanisms should be able to 'anticipate and manage', and 'adapt and respond' is in line with Owen et al.'s notions of 'stewardship' and 'care', to Schomberg's 'responsiveness' and relate to the policymakers responsibility emphasised in the EU account. Lastly, the required 'openness' and 'transparency' match both Owen et al.'s four dimensions of RRI (Owen et al., 2013) and the fifth key of the EU framework (Geoghegan-Quinn, 2012).

3.2.5 Intermezzo: Complement to Sutcliffe's account on her blog

(In the further analysis of accounts in this chapter when the Sutcliffe account is mentioned, the earlier account is referred to. This second account is preliminary, meant as a discussion piece, and has not officially been published by the author.)

Motivated by her disappointment with the definitions by Von Schomberg and Owen et al., two years after publishing her first definition, Sutcliffe proposed another definition to complement her earlier account (Sutcliffe, 2013). Drawing on the Bruntland (United Nations, 1987) definition of Sustainable development RRI is defined as:

'**innovation** that helps **fulfil our needs and hopes** without compromising the **ability of others, now and in the future**, to fulfil their own' (Sutcliffe, 2013) [emphasis added]

In this definition RRI is characterized as a form of innovation (WHAT), aimed at fulfilling our 'needs and hopes' (WHY). This resembles the EU definition which also suggests RRI should target the needs of society, and the definitions of Von Schomberg´s societal desirability with the notable difference that it leaves out society. This is done intently as is shown in a further clarification to the definition in which Sutcliffe conveys that other definitions put too much

emphasis on involvement of society in R&I. Although this involvement is important, RRI is much more than that Sutcliffe argues (Sutcliffe, 2013).

What is more, Sutcliffe's account adds 'hopes' to the aim of RRI. In a clarification, Sutcliffe explains that she wanted the definition to have a more positive outlook, emphasizing the benefits of innovation and its ability to fulfil hopes and dreams. Whilst the other definitions reviewed so far, mention desires, values, needs and desirability, which all embody RRI's progressive outlook of aiming for beneficial outcomes, 'hopes' seems to possess more positive utopian undertones.

The definition also requires innovation never to compromise 'the ability of others' (HOW) to fulfil their needs and hopes, both 'now and in the future'. On the one hand, it can be argued that this account of RRI is liberal and invites people to attain hopes and dreams through innovating. Its structure and argument closely resembles J.S Mill's 'no harm principle', which states that actions of individuals should only be limited to prevent harm to other individuals (Gray, 1991). So Sutcliffe's account can be termed liberal in the sense that it restricts interference with R&I to those cases that others are affected in a harmful way.

On the other hand though, the definition also resembles the 'precautionary principle', which proposes that an action or policy has a suspected risk of causing harm to the public or to the environment[1]. But the precautionary principle is widely criticized for being restrictive as it suggests that in the absence of scientific consensus to whether an action is harmful, that action should not be undertaken until consensus has been reached. The proviso not to compromise the ability of others now and in the future can also be interpreted as being too restrictive. Innovation inherently produces unforeseen consequences that can be both positive and negative. It therefore seems unavoidable to compromise the ability of people in the future. Analogous to criticisms of the precautionary principle, the proviso therefore may put innovation to a halt altogether.

3.2.6 Grunwald

Also building on Von Schomberg's account, Grunwald (2011) suggests RRI is an 'umbrella term' characterized by: '

- involving **ethical and social issues** more directly in the innovation process by **integrative** approaches to development and innovation
- bridging the **gap between innovation practice, engineering ethics, technology assessment, governance research and social sciences** (STS)
- giving new shape to innovation **processes** and to technology **governance** according to **responsibility reflections** in all of its three dimensions [governance, moral and epistemic] […]
- in particular, making the **distribution of responsibility** among the involved actors as **transparent** as possible

- supporting "constructive paths" of **co-evolution of technology** and the **regulatory frameworks** of society' (Grunwald, 2011, p.26) [emphasis added]

Rather than defining RRI, this characterization explains what RRI aims to do and how these aims should be attained. Why that is the case is not covered in the definition. Similar to the other accounts discussed above, the importance of addressing ethical and social issues in the R&I process is central (WHAT).

'Social' seems to be used here as synonymous to 'societal'. In both cases it can be interpreted to mean reflection on influences of society[9]. Still social sometimes is used in referring to individuals not groups i.e. 'social engagement' and 'social life'. Social thus can be used as a synonym but also seems to pertain to a broader range of things than societal.

Whereas Sutcliffe refers to 'ethical impacts' and Von Schomberg to 'ethical acceptability' and the EU to 'ethical standards' Grunwald is the first to use the phrase 'ethical issues'. Moreover, Owen et al. only state that 'dilemmas' need to be addressed thereby only referring to ethics indirectly. These different connotations of 'ethics' may hint towards a different stance towards the involvement of ethics in RRI. The need to integrate ethical practice in RRI then would be most apparent in Grunwald's phrase 'ethical issues' and least so in Owen et al.'s neutral 'dilemmas'. To further corroboration this reading it may be considered that Grunwald's account also is the only account to explicitly make ethics an integral part of RRI.

A further suggestion by Grunwald is that RRI is characterized by bridging the gap between innovation practice and a range of practices that enable reflection on innovation (HOW). The existence of a gap suggests that higher level reflection is currently lacking in the R&I practice and that by integrating existing approaches this gap can be bridged. Although not mentioning approaches in their definitions, most of the other authors discussed here also adhere to the view of RRI as incorporating approaches that support reflection and assessment (e.g. the accounts of Von Schomberg, Owen et al. and Sutcliffe). Also the need for reflexivity in general is suggested in the Owen et al. account.

Grunwald's definition explicitly encompasses the need for reflection on responsibility (HOW) and making the distribution of responsibility 'as transparent as possible' (HOW). Apart from the EU's discussion of policy-makers' responsibility, none of the accounts discussed so far mentions responsibility as such. Where the other definitions describe what doing innovation in a responsible manner would entail, Grunwald's account addresses responsibility itself. The account suggests that the reshaping of the R&I process and of technology governance, which all definitions agree on is the core of RRI, should be done according to responsibility reflections. By making transparent the distributions of responsibilities among actors involved, reflecting on responsibility enables a more effective allocation of responsibilities. However, to what purpose this more effective allocation contributes is largely left

[9] http://www.dailywritingtips.com/social-vs-societal/, retrieved 16-4-13

unaddressed by Grunwald. Apart from the suggestion that ethical and social issues need to be involved in the innovation process, the account does not suggest reasons why RRI should be undertaken. In addition it suggests (normative) reflection is needed without substantiating in what way, or to what norms or values (See also WHY-RRI section).

The Grunwald account can therefore be characterized as procedural as opposed to the substantive accounts discussed before. The choice for a more procedural approach to RRI may very well be intentional when the emphasis on the integration of reflective approaches is taken into account. Reflective approaches such as those proposed by science and technology studies and (in most cases) ethics tend to distance themselves from decision-making or political debate on eventual R&I choices. Instead they prefer a more neutral stance, providing arguments and observations that inform the decision making process without taking an actual position.

The last point of the account calls for 'co-evolution of technology and the regulatory frameworks of society'. This requirement has not been elaborated upon by the author. It seems to suggest a joining of forces of regulators and those involved in R&I to develop regulation when new technologies emerge instead of when they hit the market. This requires a dialogue and maybe other types of interaction between the different stakeholders as is suggested in the accounts of Von Schomberg, Owen, the EU and Sutcliffe.

Although not in his account of RRI proper, but in his accompanying clarification, Grunwald does present arguments as to why RRI needs to be pursued. Notably, these arguments are all quotations from other authors and presented in a descriptive manner to depict how the concept of RRI emerged. These reasons therefore should not be considered part of Grunwald's definition of RRI.

The arguments quoted by Grunwald why RRI has come into being is a need to shape technology according to needs, expectations and values of society with a view to achieving a "better technology in a better society", and evading problems of rejection (Grunwald, 2011) (WHY). Furthermore RRI should make a difference 'not only in terms of research but also as interventions into the "real world" (Grunwald, 2011). Although sometimes different terminology is used, Grunwald's account closely mirrors the accounts of Von Schomberg and the EU. For instance, the distinction made between 'research' and 'the real world' by Grunwald is similar in intention to the distinction Von Schomberg makes in his account between process and products.

Although not stated in his definition, in his further clarification Grunwald outlines that RRI is an inter- and trans-disciplinary effort (Grunwald, 2011). Teams should include ethicists, philosophers of science, political and social scientists, governance researchers and the affected scientists (Grunwald, 2011).

3.2.7 Stahl et al.

Analogous to Grunwald, Stahl, et al. (2013) put forward a procedural approach of RRI. Also in line with Grunwald is the positioning of responsibility at the core of their account, although

the concept is not mentioned in the definition itself. Before reviewing their definition therefore, Stahl et al.´s account of responsibility is discussed first.

Stahl et al. start by arguing that the concept of RRI refers to some interlinked questions about responsibility in R&I, most importantly: 'who is responsible, what are they responsible for, why are they responsible or what are the consequences of these responsibilities' (Stahl et al., 2013, p.199). By answering these questions for R&I processes, a complex picture arises in which everyone involved is entangled in an evolving 'web of inextricably interlinking responsibilities'(Stahl et al., 2013). Responsibilities in this web differ in their degree of visibility and external validity, and even might be 'contradictory' (Stahl et al., 2013). Instead of 'adding one more responsibility ascription or relationship in an already well-populated field' it is subsequently argued that RRI should be conceptualized as 'a higher level responsibility or a metaresponsibility' or 'responsibility for responsibilities' (Stahl et al., 2013). RRI hovers above the existing web of responsibilities with an aim to establish fruitful responsibility ascriptions with a view to societal goals and preventing socially undesirable impacts. Stahl et al. then contrast their account to Von Schomberg's definition to show the additional insight it offers. Von Schomberg's definition, it is argued, fails to address all aspects of responsibility. While it touches upon possible subjects (societal actors) and aims of responsibilities in R&I (desirability of products), Von Schomberg´s account leaves open other aspects such as 'conditions and mechanisms of ascription' (Stahl et al., 2013). By framing RRI as a meta-responsibility, Stahl et al. suggest, in the process of defining and realizing responsibilities, RRI will need to address all aspects of responsibilities.

RRI as a meta-responsibility then is defined as 'a **social construct of ascription** that defines **entities and relationships between them** in such a way that the outcome[s] of research and innovation processes lead to **socially desirable consequences** and importantly **socially desirable for whom and why**.' (Stahl et al., 2013, p.200) [emphasis added]

This is further elaborated upon by suggesting that RRI should encompass (Stahl et al., 2013):

- description of subjects' responsibility
- attribution of objects to subjects e.g. privacy or sustainability
- design of sanction and incentive structures
- reflection on precondition of successful responsibility relationships.

In their account Stahl et al. typify RRI as a 'social construct' (WHAT). Thereby it draws on social constructionism, a set of theories and concepts that seek to explore and explain social phenomena and occurrences on the basis of their historical context and social framing (Turner, 2006). In this theory a social construct is understood as an intentional product of human social interaction instead of by virtue of objective, human-independent existence. In the case of RRI the construction is brought about through ascription.

In ascribing responsibilities, RRI then is 'defining' or producing both 'entities´ i.e. actors and stakeholders in R&I and the 'relationships' between these entities (HOW). Similar to aims of RRI suggested in other definitions, this should be done in such a way that R&I produces 'socially desirable consequences' (WHY). Moreover, in the process of responsibility, ascription needs to become clear for whom these consequences are desirable and why that is the case. This mirrors the call for (ethical) reflection found in the account of RRI by Grunwald and Owen et al. Especially Grunwald's suggestion that innovation processes and technology governance 'should be shaped according to responsibility reflections' (Grunwald, 2011) and closely resembles the general idea behind Stahl et al.'s account. Again this amounts to a procedural account of RRI. Instead of making any substantiated claims with regards to what, how and why of RRI, Stahl et al.'s account offers a higher level procedural imperative to produce desirable outcomes without claiming what these outcomes should be.

3.2.8 Van den Hoven

A more recent account of RRI is argued for by van den Hoven (2013). Responsible Innovation(RI) as: 'an **activity or process** which may give rise to previously unknown **designs** either pertaining to the **physical world** (e.g. designs of buildings and infrastructure), the **conceptual world** (e.g. conceptual frameworks, mathematics, logic, theory, software), the **institutional world** (social and legal institutions, procedures and organization) or combinations of these, which when implemented **expand the set of relevant feasible options** regarding **solving a set of moral problems.**''(van den Hoven, 2013, p.82) [emphasis added]

What sets this account apart from the accounts discussed before is that it puts an emphasis on design. Like some of the other accounts discussed here, it defines 'Responsible Innovation' instead of 'Responsible Research and Innovation'. But to a larger extent than with the other accounts discussed, leaving out 'research' seems to be an intrinsic part of the account of van den Hoven.

A possible reason for not including 'research' can be found in the further clarification that is offered to the definition. In this clarification 'transition to a new situation' is proposed as belonging to the core of Responsible Innovation (van den Hoven, 2013). Transition seems to apply more to innovation than it does to research, as innovation has more of a connotation to practical appliance than research. The same inference can be made for 'designs' (WHAT). Design can be defined as purpose or planning that exists behind an action, fact, or object ("Oxford English Dictionary," n.d.) which also suggests an intent focus on a specific practical application of what has been designed. ´Designs´ in all their possible forms, ranging from physical to conceptual and institutional, by the Van den Hoven account, are taken to be the outcome of innovation processes and activities (HOW). This again corroborates the inference that this account of RI is geared toward practical appliance rather than producing more generic or fundamental results associated with research. Innovation then becomes 'responsible' when implementation of a design leads to an expansion of the 'set of relevant feasible options regarding solving a set of moral problems' (WHY). RI thus is distinguished

from 'ordinary' innovation by its adding of new and 'morally relevant functionality' to designs (van den Hoven, 2013). Functionality is deemed morally relevant if when implemented it expands 'the set of relevant feasible options regarding solving of moral dilemmas'. For instance, when designing a surveillance system a trade-off has to be made between the privacy of individuals under surveillance and the amount of personal information needed to detect dangerous individuals. This stages a two-horned dilemma consisting of two seemingly irreconcilable values: privacy and security. The suggestion of van den Hoven's account of RI then is that through innovation a third 'horn' can be designed that reconciles privacy and security (van den Hoven, Lokhorst, & van de Poel, 2011).

Its overall aim to solve moral dilemmas sets the van den Hoven account apart from the other accounts discussed thus far. Solving moral problems is not mentioned in any of the other definitions. Addressing societal issues such as sustainability, which do figure widely among other definitions, however can be framed in terms of moral dilemmas. Also in many accounts 'ethics' is mentioned as crucial feature of RRI (see discussion of Grunwald's account above). Nevertheless by placing 'solving moral dilemmas' at its locus the van den Hoven account seems to limit the range of issues RRI seeks to address thus making it less inclusive. For instance, attaining societal desires or addressing needs does not necessarily have to constitute a moral dilemma. The EU for example states that it is desirable to equip future researchers with tools to fully participate and take responsibility in the R&I process (Geoghegan-Quinn, 2012) does not need to conflict with other moral values.

3.2.9 EU expert group on RRI

In 2013 the Expert Group on RRI commissioned by the European Commission published a report containing a policy recommendation on RRI for the European Union (Jacob et al., 2013). In this report an alternate definition of RRI is suggested that builds on and overlaps existing accounts discussed above. This comes as no surprise as two members of the expert group, van den Hoven and Stilgoe, are co-authors author of the definition.

The Expert Group defines RRI as referring to ´the comprehensive approach of proceeding in research and innovation in ways that allow **all stakeholders** that are involved in the processes of research and innovation at an early stage (A) to **obtain relevant knowledge** on the **consequences of the outcomes of their actions** and on the **range of options** open to them and (B) to effectively **evaluate** both outcomes and options in terms of **societal needs and moral values** and (C) to use these considerations (under A and B) as **functional requirements for design and development** of new research, products and services. The RRI approach has to be a key part of the research and innovation **process** and should be established as a **collective, inclusive and system-wide approach**.´ (Jacob et al., 2013, p.3) [emphasis added]

Similar to the other definitions discussed so far, this account frames RRI as an essential 'part of the R&I process' (WHAT) geared towards obtaining knowledge of and evaluating consequences of R&I (HOW). In this account however the aims of RRI are further delimited. 'All stakeholders' involved in processes of R&I (WHO) are implied, the focus is not on the

actors themselves, but on the outcomes of 'their actions'. This seems to limit the efforts of stakeholders in a way not found in definitions discussed so far, namely to outcomes and options of *their own* R&I related actions. What is more, knowledge should be obtained about 'options open to them [i.e. the stakeholder]' which also suggests that stakeholders only have to engage with feasible options related to their specific task or role within the R&I process.

Furthermore, evaluation should then be commenced in 'terms of societal needs and moral values' (HOW). So 'societal needs', which figure in most definitions discussed so far, are combined with 'moral values', which are only present in the van den Hoven account of RRI. In the discussion of the van den Hoven account above, it was remarked on that by using moral values instead of 'societal goals' could be regarded as limiting the scope of RRI. Although in this account both are implicated it remains unclear what the status of moral values is as opposed to societal goals. It could for instance be argued that societal goals encompass moral values, as Von Schomberg (2013) for instance seems to imply. If that is the case it becomes unclear why moral values should be mentioned next to societal values.

Considerations resulting from obtaining and evaluating knowledge are subsequently proposed as input for setting 'functional requirements for design and development of new research, products and services' (WHAT). Once more this closely resembles the van den Hoven (2013) account discussed above that also sets design as the locus of RRI.

Lastly, the definition suggests that in order to be responsible, the R&I process is required to be 'collective, inclusive and system-wide' (HOW). Of these three requirements only 'system-wide' is not implied by one of the other definitions discussed here. System-wide can be understood as RRI being integrated throughout the R&I processes. This seems to differentiate this definition from the other accounts of RRI discussed so far. Although most of the other definitions suggest *when* RRI should be part of the R&I process, namely from an early stage until the end of the process, they do not state *where* in the process RRI should be implemented.

Although not in their definition proper, the Expert group does forward reasons why RRI needs to be pursued in their publication. Referring to the overall strategy of the European Union, the Expert group states that R&I are key pillars in creating 'sustainable, inclusive growth and prosperity and [to] address societal challenges […]'(Jacob et al., 2013) (WHY). These reasons are very similar to those presented in the accounts by Von Schomberg, EU and Sutcliffe. Furthermore, also in line with Von Schomberg, according to the Expert group, RRI aims at achieving 'better alignment of R&I with societal needs' (Jacob et al., 2013). As to the purpose of RRI, the Expert group account thus closely mimics the accounts of the EU and Von Schomberg.

3.3 Summary

Above an analysis is presented for each of the different accounts of RRI. Although differences and similarities are highlighted in these evaluations, a more systematic

comparison is still lacking. This section therefore summarizes and compares the different accounts structured to the four evaluative questions (what, why, how, who).

Table 1. summarizes the accounts analysed andwhich are structured along the four evaluative questions. Texts in the table that are stated within brackets do not stem from the definition statements proper, but from accompanying further elaboration of the accounts provided by the authors.

ACCOUNT AUTHOR	WHAT	WHY	HOW	WHO
Von Schomberg	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	proper embedding of scientific and technological advances in our society	mutually responsive to each other; transparent and interactive	societal actors and innovators
Owen et al.	collective commitment of care for the future	[responsibility gap, the nature and impact of consequences of R&I]; care for the future	responsive stewardship of science and innovation in the present	collective; [current generations]
EU/Quinn	align [R&I] process and its outcomes [values, needs and expectations	alignment to 'values, needs and expectations of European society	work together; inclusive' and 'participatory'; gender equality and integration;	all societal actors – researchers, industry, policymakers and

	of European society]		enhancement of educational process; open, transparent, engagement	civil society
Sutcliffe	deliberate focus of research and the products of innovation to achieve a social or environmental benefit	achieve social or environmental benefit'; being ´mindful of the public good	deliberate focus; openness and transparency ; adapt and respond ; oversight mechanisms; Assessing and effectively prioritising social, ethical and environmental impacts, risks and opportunities; involvement of society; anticipation & management problems; adapt and respond	society; public & non-governmental groups; civil society stakeholders
Grunwald	involving/ addressing ethical and social issues in the R&I process		responsibility reflections; making distribution of responsibility transparent; bridge the gap between innovation practice and a range of other practices;	Ethicists, political and social scientists, philosophers of science, governance researchers, affected natural scientists

			integrative approaches	
Stahl et al.	social construct of ascription that defines entities and relationships between them; meta-responsibility	socially desirable consequences	defining' or producing both 'entities i.e. actors and stakeholders in R&I and the 'relationships' between these entities	-
van den Hoven	activity or process which may give rise to previously unknown designs	expand the set of relevant feasible options regarding solving a set of moral problems	outcome of innovation processes and activities	-
RRI Expert Group	part of the R&I process; comprehensive approach of proceeding in research and innovation		obtaining knowledge of and evaluating consequences of R&I; in 'terms of societal needs and moral values; setting 'functional requirements for design and development of new research, products and services'	all stakeholders' involved in processes of R&I

Table 1: *Summary of RRI accounts*

This table summarises the four aspects of our discussion of RRI for the salient accounts that we have outlined individually in the preceding sections. It provides an important starting point that can help us understand the current RRI discourse. At the same time we realise that the RRI discourse is highly dynamic and that there are large numbers of actors who are involved in RRI related activities and who are publishing their ideas and findings.

The following section therefore returns to the four guiding questions and discusses them more broadly. They take their point of departure from the insights provided above and go into a deeper discussion of what constitutes RRI, which reasons are given for engaging in the discussion, who potential actors are and which activities are suggested as a means of discharging responsibilities in RRI.

4 Discussion of Current Accounts

The previous section of this review was ordered by accounts and salient authors. This approach is justified by the fact that the discourse currently remains relatively limited. The further development of this discourse is likely to be influenced by the different accounts and it is therefore important to be able to understand how the different positions relate to one another.

It is, however equally important to synthesise the different positions, which is why we now return to the main questions used to analyse the literature.

4.1 What is RRI?

The first column in Table 1: *Summary of RRI accounts*" represents an overview of the way the different accounts answer the question 'what is RRI?'. This question addresses how the phenomenon RRI must be understood, i.e. what kind of thing RRI is. All the accounts reviewed associate RRI with a process or activity. RRI is framed either:

- as a process aimed at R&I (Von Schomberg, Owen et al., Stahl et al.);
- a requirement to the R&I process (Grunwald, EU, Sutcliffe);
- or as part of the R&I process (Expert group, van den Hoven).

Despite these differences all the accounts reviewed thus aim at appending or altering existing R&I processes.

The three accounts that define RRI as a process on its own could be interpreted as defining RRI as a higher order process, for instance governance that targets R&I processes. What RRI as a process aims for in R&I processes however differs among the three accounts. Von Schomberg specifies what RRI as a process should do, namely 'align R&I processes and its products'. Owen et al's aims are compatible to that of Von Schomberg's account although less specific. Their account merely pleads for a collective commitment without specifying how this should be attained. Stahl et al. also frames RRI as a process targeting the R&I process. Their account distinguishes itself from the other two by choosing a different angle namely the responsible allocation of responsibilities within R&I processes.

Instead of depicting RRI as the process that produces and sets (additional) requirements to the R&I process, the accounts of Grunwald, Sutcliffe and the EU frame RRI as the embodiment of the requirements themselves. All three accounts require the R&I process to align to or aim for specific goals that in practice largely overlap: ethical and social issues (Grunwald), societal and ethical goals, and sustainability (Von Schomberg) and values, needs and expectations of European Society (EU).

Lastly, the view of RRI as an integral part of R&I processes regards RRI as a type of innovation; as an alternate way to innovate. Both accounts put emphasis on RRI as a way to generate novel designs that offer new options to societal or moral issues.

Although the accounts have a different perspective on RRI in relation to R&I processes, in practise their impact on R&I might largely overlap. It can for instance be argued that incorporating additional requirements in the R&I process, gives rise to a novel type of innovation process. Also the requirements set by Sutcliffe, Grunwald and the EU to a large extent overlap with the aims the Von Schomberg and Owen et al. account set out to achieve. The only exception is the Stahl et al account that takes an alternate approach to RRI as a meta-responsibility.

Through their framing of RRI each account forwards a specific view on the concept of responsibility. As responsibility lies at the heart of RRI it seems important to assess whether there are differences among the accounts regarding responsibility, and if so what the implications are for RRI.

4.2 Why Should RRI be Pursued?

The second column of Table 1: *Summary of RRI accounts*" represents an overview of the way the accounts answer the question 'why RRI should be pursued?'. Although the accounts of Grunwald and the Expert Group do not give reasons to pursue RRI, in their definitions they do address arguments in their further clarifications given to their accounts. Also the other accounts, which all only touch briefly upon the why-question in their definition proper, further substantiate reasons for pursuing RRI in their further clarifications. The reasons given in their accounts are often instrumental to those more substantiated reasons. For instance 'embedding' (Von Schomberg), 'care for the future' (Owen et al.), 'alignment' (EU), and 'expanding set of [...] options' (van den Hoven) all point towards more fundamental, intrinsic reasons why that needs to be done such as tackling societal challenges such as global warming. Also when 'social benefit' (Sutcliffe) or 'socially desirable consequences' (Stahl et al.) are referred to, it remains open as to what these entail.

Despite different levels of substantiation of reasons forwarded, all accounts concur that pursuing RRI is desirable at a minimum, but is often necessary when taking into consideration the current societal problems mankind is facing or "grand challenges". Moreover, there is evidence of a general consensus about these accounts given the major overlap in the reasons forwarded in both the accounts and clarifications. Analysing reasons for pursuing RRI may further deepen the understanding of RRI as it unveils the (often implicit) assumptions behind RRI.

4.3 How should RRI be Implemented?

Table 2 contains an overview of the way the accounts answer the question 'How should RRI be implemented?'. All accounts provide some explanation as to how RRI can/should be executed. The directions the accounts offer as to how RRI can be made to work range from abstract to concrete and practical. Owen et al. present an abstract view suggesting

'responsive stewardship' as a way to implement 'care for the future'. As stated before it can be argued that the two terms largely overlap so that 'responsive stewardship' offers little further explication of 'care for the future'. Von Schomberg account offers a bit more of a concrete recommendation by adding to 'being responsive' that RRI should be 'transparent and interactive'. Even more concretely aimed at practice are accounts provided by the EU, Sutcliffe, Grunwald and the Expert group. These accounts present requirements that the processes of R&I and/or RRI –depending on their view on RRI (see above) - should adhere to. In table 1.c requirements are listed that different accounts propose.

Type	Requirement	VS	EU	Su	Ow	Gr	Ex	VH	St
R&I process	**Transparent**	X	X	X		X			
R&I process	**Iterative**	X			X				
R&I process	**Responsive**	X			X				
goal	**process & products**	X	X		X				
R&I process	**Anticipatory**			X	X				
R&I process	**Reflexivity**				X				
R&I process	**Deliberative**				X				
R&I process	**Open**		X	X	X				
R&I process	**Inclusive**		X	X	X		X		
goal	**Assessment**			X					
R&I process	**Collective**		X	X	X				
goal	**address risks**			X	X				
goal	**address dilemmas**			X	X				
goal	**moral problems**							X	
goal	**ethical acceptability**	X							
goal	**Sustainability**	X		X					
goal	**societal desirability**	X					X		X
goal	**fundamental rights**	X	X						
goal	**social benefit**			X					

R&I process	**Participation**		X	X					
goal	**Gender**		X						
R&I process	**Education**		X						
goal	**ethical standards**		X						
R&I process	**Integrative**					X			
goal	**moral values**		X				X		
goal	**needs & expectations**		X						
goal	**ethical & social issues**					X			
goal	**co-evolution**					X			

(VS=Von Schomberg, EU=EU, Ex=Expert group, Ow=Owen et al., Su=Sutcliffe, St=Stahl et al., VH=van den Hoven, Gr=Grunwald)

Table 2 ***Requirements forwarded in accounts of RRI***

The difference in the amount of requirements can be traced back partly to the type of account given, either RRI as requirement, process in itself or part of the R&I process (see above) and partly to the inclusion of further clarification to the account. Accounts that are categorized as RRI setting requirements to R&I processes include multiple requirements, the EU twelve, and Sutcliffe eleven as would be expected from this view on RRI. Grunwald who also adheres to this view of RRI nevertheless only provides four requirements. A possible explanation might be that it has a procedural nature, therefore intently precluding substantiation of that account. The same holds true for the account of Stahl et al., which contains one requirement (i.e. a further clarification to what responsibility ascription entails), and which is both procedural in nature and moreover is of the RRI as a process type. The two other accounts categorized as processes do contain many requirements: Owen et al eleven and Von Schomberg eight. This is misleading though as the amount of requirements mentioned in their definitions proper is only one for Owen et al. and three for Von Schomberg. The bulk of their requirements stem from the further clarification they offer to their accounts. Lastly the account of the Expert group forwards three requirements and van den Hoven only one. Both accounts have been categorized as 'RRI as part of the R&I process'. They offer an alternate focus of R&I processes, namely a design perspective geared towards solving moral dilemmas rather than new ways of doing R&I. For this reason the accounts do not have to provide requirements to R&I or RRI processes.

In the list of requirements set in the accounts (table 2) a distinction is made between requirements to the R&I/RRI process and requirements that set a goal to that process. From

this distinction it becomes clear that the accounts differ in the range of issues and topics that RRI includes. Some are more inclusive than others, as has been pointed out in the discussion of individual reviews above. While the other accounts seem to include a wide range of issues as a target for RRI, the accounts of van den Hoven, Grunwald, and the Expert group are more restricted. The account of Owen et al is very general and leaves open what fall under 'care for the future'. Von Schomberg's account can be regarded as a little less inclusive as it restricts RRI to 'ethical and societal acceptability'. In between these two accounts the definition of the EU can be positioned alongside Sutcliffe's which mirrors Von Schomberg and Owen et al. in this respect. Also the accounts of Grunwald and Stahl et al. are similar to Von Schomberg with their aiming for societal, and social and ethical issues respectively. The van den Hoven account with its design focus restricts itself to moral problems, while the Expert group account mixes both the views of Von Schomberg and van den Hoven.

4.4 Who are Actors in RRI?

Not all accounts explicitly state who should be involved in RRI. In those cases however, such as for the accounts of Grunwald and Owen et al., it can be inferred from the account and explanation given by the authors. Only for two accounts (Stahl et al. and van den Hoven) it is completely left open who should be involved. Nevertheless it must be concluded that there is little disagreement among the different accounts. All accounts either explicitly or implicitly hint towards stakeholder involvement, some distinguishing between innovators and societal actors. Furthermore, the accounts that leave this aspect of RRI open, do not exclude any actors or stakeholders beforehand. So there seems to be no limit to who can be involved in RRI. The Grunwald account finally specifically stresses the importance of including scientists and researchers from multiple disciplines including ethics, natural scientists and social science.

5 Conclusion

This deliverable represents the first annual report on the main trends of Science in Society, in particular the trends related to RRI. The purpose of this initial report was to establish a baseline that can be used to assess different contributions and trace future discussions.

5.1 Relevance to the GREAT project

This deliverable is a relatively independent document that attempted a structured review of the current literature on RRI. It is easy to see, however, that it is linked to a number of other deliverables and activities in the project. It is clearly related to the work undertaken in WP2, which aims to map the main definitions and controversies around responsibility and innovation. Unlike the work in WP2, however, this deliverable is broadly descriptive and does not undertake a detailed discussion and analysis of the theoretical foundations of RRI. WP3 investigates the context of RRI and undertakes an empirical investigation of RRI, which is continued in WP4 where RRI-related data is analysed and case studies are developed. All of these activities require an understanding of possible meanings of the term RRI for preparation and execution of research activities. The gap analysis planned in WP5 similarly has to build on a rich understanding of RRI to which the present deliverable contributes.

5.2 Future Plan: Subsequent Annual Reports

This deliverable will find its continuation in two more reports to be delivered in 12 and 24 months respectively. The present deliverable offers a rich starting point for further exploration. Possible foci to be explored in the following deliverables include:

- Disciplinary specifics of RRI discourses
  There may be different definitions and discursive practices around RRI in different disciplines such as geoengineering, nanotechnology or ICT that need to be explored in more depth, so that relevant outputs for different stakeholders can be produced.
- RRI practices
  This report has only touched on practices related to RRI in a superficial manner. It will arguably be a central achievement of the GREAT project to affect RRI practices, which would require a more detailed understanding of the current state of the art.
- Application areas of RRI.
  The majority of contributions discussed in this document focus on publicly funded research. While understandable as a focus, this raises the risk of missing out on the majority of research and innovation activities which are privately funded.
- Testing of the concepts developed here:
  Following the suggestion by one of the reviewers of an earlier version of this deliverable, it may be worth considering the different aspects of the RRI discourse outlined above with regards to their relevance and implications using the initial empirical findings of the project.

These are some of the options for the next iteration of the report. The consortium will need to discuss which focus would be most conducive for the subsequent instalments of this deliverable. The principle of updating the review of the RRI discourses to inform all aspects of the GREAT project will be safeguarded in any event.

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