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Implementing Responsible Research and Innovation

Organisational and National Conditions

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Executive Summary

This book examines conditions for the uptake of responsible research and innovation (RRI): in Part I, we examine how organisational dynamics act as barriers and drivers, while in Part II, we explore the formative role of national discourses and practices. RRI is analysed both in the form of five policy keys—research ethics, gender equality, science education, public engagement in science, and open access in scientific publications—and as a set of process dimensions, that research and innovation needs to be diverse and inclusive, anticipative and reflective, open and transparent, and responsive and adaptive to change. The book focuses chiefly on the 'research' component of the RRI concept.

The book is grounded in research conveyed in 12 national reports undertaken as part of the RRI-Practice project, covering 23 research conducting and funding organisations both in Europe (Bulgaria, France, Germany, Italy, the Netherlands, Norway, and the UK) and beyond (Australia, Brazil, China, India, and the US). Each national report was written to describe the drivers, barriers and good practices identified with each aspect of the RRI concept, as well as relevant legal conditions and characteristics of national cultures that were seen to affect RRI implementation. The reports also contain plans on how to develop RRI implementation in each of the included organisations, often with suggestions for the development of indicators that could monitor implementation efforts.

In this book, we present a comparative analysis of the 12 national reports, with a specific focus on organisational perspectives in Part I, and on how national policy structures and culture affect RRI implementation in Part II. In Chap. 1, we describe the book and the study on which it is based. Part I comprises Chaps. 2–5. Chapter 2 details the methodology not only for the organisational analysis, but also for the RRI-Practice project in general. In Chaps. 3 and 4, we survey drivers and barriers to the implementation of RRI in organisations. Using an analytic framework derived from neo-institutional theory, drivers and barriers are categorised as either structural, cultural or interchange related. In Chap. 5, we discuss salient findings for developing RRI in research conducting and funding organisations.

In Part I, we find that national policies, regulatory frameworks, laws and monitoring systems are the most effective drivers for RRI, alongside dedicated pilot

programmes and organisational units that provide institutional homes for experimentation, together with organisational mandates, organisational goals, guidelines, procedures and routines. These drivers function not only across various aspects of the RRI concept, but also across types of organisations. Other than drivers clearly tied to existing organisational remits and operations, strong drivers seem to have a rather generic character. The dominant barriers identified in the project are principally the lack of resources in the form of time, people and competence. In addition, important barriers include the lack of incentives, strategies, policies, frameworks, systems and formal structures supporting RRI. Organisational fragmentation is seen as a significant barrier, in part due to the formulation of RRI as an umbrella concept, and where the organisation and implementation of RRI tend to embrace multiple institutional homes, such as gender and diversity offices, ethics committees, and outreach offices. In general, our research suggests that appropriately strong structural measures are required to change incumbent practices.

We find that large-scale science organisations experience coordination issues with respect to almost all the RRI keys. For implementing RRI policies and priority areas into practice, we recommend that the scale of adoption needs to be decided early on, including the question of which RRI aspects are addressed and where. In this way, RRI adoption can take place in a manageable fashion. In addition, we recommend a distributed organisational plan for RRI efforts with clear leadership and commitment at top management level, a set of focused activities, a lean centralized coordination, broad communication of RRI initiatives both within the organisation as well as to wider stakeholders, and, importantly, local organisation and anchorage.

We find that existing norms, values and practices that constitute academic culture can be both a barrier to and a driver for RRI. Based on an analysis employing the layered model of organisational culture from Edgar Schein, we suggest that drivers so far have not been sufficiently leveraged. We further suggest that levels of academic cultural resistance to RRI stem in part from artefacts and espoused values that commonly shape academic practice, that have been introduced by increasingly managerialist and regulatory practices of governance and oversight, and that may be in tension with underlying assumptions of norms and values of academic life cultivated over centuries. Current definitions of academic excellence, we suggest, might just as much be the fruit of regulatory efforts modelled on industrial patterns of production as a reflection of underlying assumptions that have prevailed in academia. A further finding is that research funding organisations have the capacity to be change agents, significantly shaping and reshaping the culture and organisation of research performing organisations, including universities. The latter are keenly responsive to policy signals emanating from funding organisations, not least through requirements in funding calls. The European Commission as well as national and transnational funding organisations have significant capability to alter the current landscape in the science, technology and innovation (STI) system. Our findings indicate that the values, logics and requirements stipulated by the way funders organise their calls impact, directly and indirectly, research performing organisations, beyond the people and organisational units directly affected.

Throughout the data, we see tensions between excellence criteria, premised on maximizing grants and publications on the one hand, and making room for adherence to RRI aspects on the other. As funding organisations increasingly adopt elements of RRI in assessment criteria, while still adhering to the ruling definition of research excellence, the signals of normative forces to research performers are at times in tension.

In Part II, we analyse national STI discourses and practices from our 12 countries and how, through comparison, we can understand the potential for the uptake of RRI in different national contexts. In Chap. 6, we present our methodology. We use the method and approach of sociotechnical imaginaries to develop comparable accounts of how the national STI system is envisioned in each country. We focus on policy structures, particularly policy goals and framings of the responsibilities of STI and actors in the STI system, and policy culture, focusing on the administrative style of the STI system and the role afforded for public participation. We compare and contrast RRI as a model for the relationship between science and society, in which science and social order co-constitute each other, necessitating explicit democratic governance of science, with other models of this relationship. We show how these models shape, in complex and interlocking ways, the constitution of national sociotechnical imaginaries. In Chap. 7, we use this methodological approach to construct elements of a national sociotechnical imaginary of the STI system in each of the 12 countries, and reflect on the potential uptake of RRI in each particular national context. In Chap. 8, we compare these imaginaries and discuss their wider implications for policy and conceptual development. We now set out the four key findings of Part II.

First, in national STI policy, there tends to be a clear distinction between pure curiosity-driven science and applied science, and in the latter between economic and societal goals. Both seek to benefit society, but in different ways, which can create tensions in the STI system, as each demands different skillsets and different values. For example, a science for society policy may stimulate researchers to do independent research on particular societal goals, whereas innovation policy often is aimed at stimulating cooperation between researchers, private sector actors and the government, typically on priorities set by the market. Various imaginaries exhibit a tension where a strong, unreflective focus on economic goals threatens to marginalise other societal goals and values, thus reducing the space for RRI uptake.

Second, in the framing of responsibility in national STI policy, the pursuit of excellent science remains an explicit and often primary responsibility and goal for science. The responsibility of science to addressing societal needs is important, and is differentially configured across national STI contexts, but its realisation is much more complex. In addition, policy goals on excellence, on responding to societal needs, and on public engagement in science are often in tension. This tension is exacerbated by factors that are presented in several reports, such as the chronic underfunding of the STI system and the high workload of researchers. This creates particular challenges for policy-makers, where an underspecification of how RRI policies are to be operationalised can lead to a superficial uptake of desired practices, while an overspecification can lead to bureaucratisation, responsibility

overload and 'box-checking'. Creating space for RRI uptake requires clear and consistent policies that can be flexibly operationalised, and those that acknowledge institutional evaluation systems for researchers as well as underlying academic values.

Third, there are significant differences between the administrative styles of national STI systems: some are more oriented towards achieving consensus on political issues, while others are more oriented towards contestation and achieving a majority. As a model of the relationship between science and society, RRI is particularly aligned with the former. In countries with a more contentious administrative style, RRI risks becoming associated with political parties. This can make its implementation unstable if it depends on specific political party loyalties. Nevertheless, even in those countries with a contentious style of policymaking, there can be spaces for discussion on STI governance through public protests and activism.

Fourth, with regards to public participation, many reports signal public distrust in science, despite a formal orientation of science policy towards societal needs. While such distrust can be viewed as a driver for wider public engagement and the further development of science education, it is vital not to straightforwardly assume that such distrust is a result of a simple deficit of public knowledge about science. RRI would rather interpret the issue as one of unease with current science and society relations, including democratic oversight in the processes through which science influences the social order, and vice versa. This issue cannot be addressed simply by education, but by empowering citizens in shaping scientific trajectories and making the STI system reflexive to societal values. Working with public distrust can be an opportunity and a motivation for scientists and policy-makers to experiment with new forms of science governance that are aligned with the principles and practices of RRI.

Finally, in the conclusion of the book (Part III), we reflect on commonalities and differences between the methodologies and conceptual frameworks used in Part I and Part II. We identify outstanding questions and issues with regards to the democratic governance of the international research system that has not been the subject of our investigation, but has nevertheless appeared as a major factor in shaping organisational and national responses to RRI. Last, we investigate the implications of our work for RRI practitioners and change agents within organisations.

Abstract

RRI is the acronym for *Responsible Research and Innovation*, a key cross-cutting issue in the European Commission's Horizon 2020 funding programme for research and innovation. RRI seeks a new relation between society, research and innovation, to better align both the process and its outcomes with the values, needs and expectations of society. RRI has been promoted as offering a response to current challenges in the research and innovation landscape that include public mistrust of science, scandals related to research misconduct, questions of scientific integrity and independence, tensions and dilemmas surrounding current patterns of industrialised scientific production, and the need for democratic input in the development of innovation and emerging technology. For the European Commission, RRI is implemented as a package that connects five so-called policy keys or priority areas, namely the take-up of research ethics and gender equality in research and innovation, the development of formal and informal science education and public engagement in science, and the pursuit of open access in scientific publications. In addition, a conceptual framework has been developed that frames RRI through four integrated dimensions—anticipation (A), inclusion (I), reflexivity (R), and responsiveness (R), the AIRR framework—that provides a scaffold for raising, discussing and responding to questions of societal concern, deemed to be characteristics of a more responsible vision of innovation. This framework has been operationalised by national funding bodies, integrated in research practice, and is referred to in this book as the RRI process dimensions. Drawing on research from the European Horizon 2020 RRI-Practice project, we examine barriers and drivers for the implementation of Responsible Research and Innovation across the RRI policy keys and process dimensions in 23 research conducting and funding organisations world-wide. In Part I, drawing on neo-institutional theory, we explore the structural, cultural and interchange dimensions of RRI implementation in organisations. In Part II, drawing on the sociotechnical imaginary concept, we analyse and compare national discourses and practices on science, technology and

innovation (STI). In Part III, we tie Parts I and II together and reflect on commonalities and differences between the methodologies, the wider implications for international science governance and for practitioners who intend to use RRI to foster organisational change. The book uses twelve national reports from the project as its main data source.

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Part III Conclusion

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List of Tables

Chapter 1
About This Book and the RRI-Practice Study

Abstract In this Chapter, we give an overview of the book and the RRI-Practice study. The book is an analysis of data collected in the RRI-Practice study. It comprises an organizational analysis and an analysis of national discourses, thus analysing conditions for the uptake of RRI in research funding and research performing organisations in the science system.

Keywords Responsible research and innovation · RRI-Practice study · Organisational analysis · Neo-institutional theory · Discourse and practice · Sociotechnical imaginaries · Organisations as embedded

1.1 The Structure of the Book

The book is composed of two main parts:

- Chapters 2–5: reports on the organisational analysis in the project
- Chapters 6–8: reports on the analysis of national discourses and practices in the project

The two parts are written by two collaborating research teams: Part I by Christian Wittrock (Oslo Metropolitan University, Norway) and Ellen-Marie Forsberg (NORSUS Norwegian Institute for Sustainability Research, Norway); Part II by Auke Pols, Philip Macnaghten and David Ludwig (Wageningen University, the Netherlands). While the two parts are connected, each part employs different theoretical frameworks, Part I *neo-institutional theory* and organisational scholarship (Scott and Davis 2007), while Part II employs Jansanoff's (2015) *sociotechnical imaginaries*. We report on the organisational analysis and the national discourses together, as the wider (national) organisational environment has significant impact on intra-organisational conditions in neo-institutional theory (Strang and Meyer 1993; Lee and Strang 2006). Hence, the view of organisations is that of organisations as embedded in contexts, and organisational practices such as RRI seen as embedded in organisations (Granovetter 1985) (Fig. 1.1).

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Fig. 1.1 Organisations as embedded in national discourses and practices

1.2 The Content of the Book

The book disseminates both the organisational analysis conducted in the project, and the comparison of the national discourses and practices of relevance to RRI. As the overall research design and the theoretical framework employed in the project is of direct import on the coding scheme used in Part I, we treat the research design and theoretical backbone of the project in Part I, while the analysis of national discourses and practices are discussed in Part II. The national discourses and further national environment are frequently discussed and shown to be of importance for the organisations surveyed in Part I. The further treatment and comparison of national discourses and practices in Part II allows us to deepen our understanding of the impact of the national environments of the organisations surveyed with respect to conditions for the uptake of RRI. We conclude the book with reflections on the relation between the organisational and national analyses.

1.3 Introduction to the RRI-Practice Study

RRI is the acronym for *Responsible Research and Innovation*, a concept supported by the European Commission, calling for a new relation between society, research, and innovation[1] (von Schomberg 2012). The RRI-Practice project reviewed RRI-related work in 23 research performing and research funding organisations located in 12 different countries. The organisations vary on parameters such as size, teaching obligations, and impact in the national funding landscape. Additionally, some are policy organisations, closely tied to the political system in the countries, while others

[1] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation. Accessed 1 June 2020.

operate at arm's length to political management or are formally independent entities. (See Tables 2.2 and 2.3 in Chap. 2 below for details of organisations researched).

Through interviews, focus group interviews, workshops of various formats, and document reviews, the project traced *organisational practices* that can be related to the five RRI policy keys (also called *thematic elements*)[2] and four RRI process dimensions, central to *current theorised understandings* of what constitutes RRI-Practices (e.g. Owen et al. 2012; Stilgoe et al. 2013).[3] A common denominator for the keys and dimensions is 'RRI aspects.' It is only in a subset of the surveyed organisations that the notion of RRI is widely known; in some organisations only a smaller portion of the employees are familiar with the RRI concept; and in most cases, this project constituted the first contact for the notion of RRI. This does not leave out the possibility of organisational practices that are commonly parallel or what Sally Randles and colleagues have termed 'de facto rri' (e.g. Randles 2016; Randles et al. 2016). In collaboration with each organisation, the national project research teams developed RRI Outlooks outlining RRI objectives, targets and indicators for each organisation. The result of this work was 12 publicly available country reports, comprising an analysis of the national context for the uptake of RRI, the status of RRI-related practices in each organisation, action plans for developing and sustaining RRI practices, and suggestions for indicators for individual organisations.

It is the data from these 12 national reports that inform this book, and which are summarised in Table 2.4 in Chap. 2.[4] In addition, the project developed a report comparing implementations across case studies at the level of specific RRI keys and process dimensions of RRI (Hennen et al. 2018); a booklet with recommendations to national policy makers (Owen et al. 2019); as well as a handbook on how to develop RRI in organisations, showcasing 11 good practices, and the provision of practical advice to managers, change agents, and researchers with an interest in RRI (Wittrock and Forsberg 2019). We draw on the latter material selectively in our analysis.

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[2] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation. Accessed 25 May 2020.

[3] These were adapted in the RRI–Practice project as follows: that research and innovation need to be diverse and inclusive, anticipative and reflective, open and transparent, and responsive and adaptive to change.

[4] All reports are available at https://www.rri-practice.eu/knowledge-repository/publications-and-deliverables/.

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Part I
The Organisational Study of RRI Implementation

Chapter 2
Introduction to RRI and the Organisational Study

Abstract In this Chapter, we detail our understanding of Responsible Research and Innovation as developed through the RRI-practice project. Further, we introduce the theoretical framework for the organisational study and provide details of the methodology of the RRI-Practice study, and organisations surveyed. In the subsequent Chaps. 3 and 4, we discuss drivers and barriers to RRI, how drivers and barriers interact, and how these differ across types of organisations. In Chap. 5, we discuss key findings in the project emanating from the organisational analysis and the neo-institutional theoretical approach.

Keywords Definition of responsible research and innovation · Research methodology · Neo-institutional theory

2.1 Our Understanding of RRI

In this book we have operationalised RRI as embodying five RRI Keys (Ethics; Gender Equality and Diversity; Open Access and Open Science; Science Education; and Societal/Public Engagement) and four process dimensions (Anticipation and Reflexivity; Diversity and Inclusiveness; Openness and Transparency and; Responsiveness and Adaptation).[1] We now set out brief descriptions below.

RRI Key: Ethics

The Ethics key includes notions of research integrity, ethical regulation and assessment, and ethical reflection. Relevant to this RRI dimension are ethical codes and regulations, ethical committees, research integrity training, ethics or integrity offices and officers, as well as the inclusion of ethical considerations in research and innovation projects or processes. There is broad overlap between this key and the dimension Anticipation and Reflexivity, as well as with the dimension Responsiveness and Adaptation, which we discuss in our analysis of drivers and barriers.

[1] The process dimensions are sometimes called the AIRR dimensions. Locally and nationally situated aspects of RRI, also researched in the project, are not part of this broad comparative analysis, as this material is more fragmented. See the national reports for a treatment of those.

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RRI Key: Gender Equality and Diversity

The Gender Equality key is understood as a "*three-dimensional construct whereby gender equality is reached when (1) women and men are equally represented in all disciplines and at all hierarchical levels, (2) gendered barriers are abolished so that women and men can develop their potential equally, and (3) when the gender dimension is considered in all research and innovation activities*" (European Commission 2018, p. 11). Based on RRI-Practice analyses, we reconfigured the key to include a broader notion of diversity, that includes a broader set of social and demographic distinctions, such as age and cultural or ethnical background. The gender and diversity key is not to be confused with the process dimension of inclusion and diversity, which signifies an opening up of the science process to a wide variety of views and approaches.

RRI Key: Open Access and Open Science

The Open Access key refers to "*the practice of providing online access to scientific information that is free of charge to the end-user and reusable.*" (European Commission 2019). Conjoining the open access key is the open science concept that includes open data, the sharing and making available of research data, either to other scientists, or to other interested parties. Open science can include other aspects such as open code, open lab notes, science blogs, etc.: in other words, opening up the science process from conceptions till publication, to fellow researchers, stakeholders and the public. Even though the open science concept among scholars, and even the European Commission, has developed into a broad concept encompassing societal engagement, citizen science, etc., the respondents in our research almost uniformly understood open science as open access and open data.

RRI Key: Science Education

The Science Education key can be defined as "*helping all citizens acquire the necessary knowledge of and about science to participate actively and responsibly in, with and for society, successfully throughout their lives*" (European Commission 2015, p. 7). With respect to this key, we place emphasis on the provision of educational programmes or activities on science and technology to children in primary and secondary education, and to the population at large. This definition of science education excludes science communication, meaning communicating about specific pieces of science to a broad audience. This particular aspect is often treated as a rudimentary form of societal engagement. However, in the country reports analysed, organisational programmes related to outreach activities are often referred to as both Science Education and Societal/Public Engagement. Being aimed at the public mainly through the school system, science education also excludes traditional university education programs.

RRI Key: Societal/Public Engagement

The Societal Engagement key—or sometimes termed Public Engagement—includes various ways of communicating and engaging with societal stakeholders, that include societal organisations and the broader public. Although societal engagement in an RRI context is inherently two-way communication, many respondents refer to more one-way dissemination activities when asked about this key. Thus, in the following, societal engagement includes communication activities such as media activities, public relations, publications as well as websites for a broader public, open days (e.g. at universities) and public lectures. Furthermore, societal engagement includes forms of participation in research and innovation, such as citizen science initiatives, collaborations with citizens or societal organisations (e.g. in the form of collaborative innovation), as well as the more advanced forms of participatory knowledge co-creation and agenda setting in which societal actors are involved.

Process Dimension: Anticipation and Reflexivity

Anticipation includes various ways in which future consequences can be considered, and future developments are given shape to, in processes of research and innovation. Such anticipation includes uncertainty analyses, the exploration of plausible or desirable futures, and processes in which interested actors engage in early stages in agenda setting, in development, and in the execution of research and innovation activities. In the context of this report, we understand reflexivity as the capacity of an individual or a collective (such as an organisation) to call into question assumptions, activities, theories, framings, or value systems (see for instance Forsberg et al. 2015). As such, this dimension exhibits clear overlaps with the ethics key in most of the country reports.

Process Dimension: Diversity and Inclusion

The Diversity and Inclusion dimension concerns the various ways in which broader publics and societal stakeholders, with often diverging concerns and perspectives, can take part in deliberation or dialogue on research and innovation, i.e. ways of including people and viewpoints that may not otherwise take part or that have been excluded for some reason. In our coding scheme, there is a complete overlap between this dimension and the societal engagement key, thus we have effectively included this dimension in the corresponding RRI key.

Process Dimension: Openness and Transparency

The Openness and Transparency dimension is commonly understood by respondents as related to the Open Access and Open Science RRI key. However, in the empirical material, 8 country reports have separate matrices for this dimension (as opposed to including this dimension in the RRI key). These reports typically use the process dimension to discuss wider aspects of openness and transparency, pertaining to organisational culture or structures that further openness and transparency, sometimes related to formal transparency requirements on public organisations. Conversely, open access and open science are often discussed from the viewpoint of established

procedures of publishing using green or gold open access as well as sharing data via repositories or other established systems. We understand the two aspects of RRI (Open Access and Open Science vs. Openness and Transparency) accordingly.

Process Dimension: Responsiveness and Adaptation

The Responsiveness and Adaptation dimension speaks to the capacity to respond to circumstances, foreseen and unforeseen, and to new knowledge, and to adapt research, innovation, and organisational practices accordingly. This dimension is often understood as integrated in the most embedded version of the three other dimensions. However, some country reports discuss this dimension specifically as the capacity to react and make changes, i.e. for the organisation to have a sensitive interface to what we have dubbed 'interchange' in the neo-institutional framework that underpins the RRI-Practice study (Scott and Davis 2007), and to act upon information and needs from wider society.

Our treatment of overlaps and further information

As is evident from the descriptions above, there is some overlap between concepts, and in particular between the RRI Keys on the one side, and the process dimensions on the other. We have coded our data building on our understanding of conceptual centrality for each of the categories, as delineated above. While the majority of country reports have thorough treatments of the RRI Keys, the treatment of the process dimensions is patchier as respondents have often found it difficult to relate to these dimensions. Accordingly, we have used the RRI Keys as our main coding scheme and added codes on the dimensions, where a treatment of these were evident in the texts, either by wording or by heading.

2.2 Methodology

We now discuss the theoretical framework used for Part I before introducing each of the organisations that were researched in the country reports.[2]

Theoretical framework

The RRI-Practice study is based on a theoretical framework derived from the neo-institutionalist William Richard Scott, and his distinctions of organisational analysis into *rational, natural* and *open systems approaches* (Scott 1981; Scott and Davis 2007). Below, we introduce the framework[3] and how it was used to structure the analysis in the country reports. In the research protocol, distinctions are made to

[2]The reader should note that the project refers to *national* case studies, in addition to the organisational, embedded case studies. In this book part, we discuss *organisational* studies as case studies.

[3]We draw on an unpublished working paper (Forsberg et al. 2018) and on the Norwegian country report (Egeland et al. 2018), and paraphrase these extensively. A similar way of using Scott's framework has also been presented in Boyle et al. (2001) and by Forsberg et al. (2012).

'structural issues', 'cultural issues', and 'interchange dynamics', based on Scott's typology of organisations as 'rational', 'natural', or as 'open systems' (Scott and Davis 2007).

First, for Scott and Davis (2007), organisations can be analysed as a *rational system* with a focus on *structural* aspects, on functional rationality, goal specificity and the formalisation of rules and roles. Within this configuration, distinctive characteristics include the following:"*(1) a visible set of hierarchical authority relations in which (2) work activities are governed by formal rules and clearly defined criteria for evaluation, relations that (3) are designed to pursue some set of goals*" (Boyle et al. 2001, p. 31). Herein lies a focus on the regulative and normative aspects that structure organisational behaviour and that make it more predictable, standardised and easier to govern. The regulative aspects are grounded in a view of instrumentality, which assumes a certain rationality in actors' choices to follow rules and behave expediently, and to pursue their own interests. From the rational system perspective, the structural issues of organisation include:

- Conceptions of current and desirable goals and objectives, ethical norms, expectations and social obligations
- Formalized power and authority structures in the form of formalized power hierarchies, roles and positions in the organisation, mandates, responsibilities, monitoring and assessment systems, formal decision-making structures, reward systems, etc.
- Formalisation of organisations in the form of informal strategies, standards, procedures, performance of duty, defined organisational culture, written rules, codes of conduct, ethical guidelines, but also workload, the availability of resources, etc.

Second, for Scott and Davis (2007), organisations can be analysed as a *natural system* with a focus on *cultural* aspects and on organisations as collective accomplishments. This view leads to two insights; that organisations are encumbered with goal complexity, and that informal and tacit structures matter as much as formal ones. This approach sensitises analysis to the disparity between goals as embedded in policy and goals embedded in practice, to the interconnections between the normative and the behavioural structures of organisational life, and to the study of what may appear to be 'irrational' decision processes. From the natural system perspective, the cultural issues of organisations include:

- Conceptions of organisational cultures, values or identities
- Conceptions of professional culture, values or identities
- Perceptions of managers to various RRI aspects, and the factors that encourage or discourage them to act
- The agency of change agents and other actors
- Institutional work performed towards sustaining or curbing aspects of RRI
- Taken for granted assumptions on how things are done

Third, for Scott and Davis (2007), organisations can be analysed as an *open system* with a focus on *interchange* aspects, recognizing that organisations are comprised of multiple and intersecting actors, who receive information, make decisions and direct action. This leads the analyst to explore the ever-changing formation of sub-groups and alliances, and their role in control and coordination. In an open systems perspective, the influence of the organisational environment is considered of paramount importance, as it is in neo-institutional theory (Tolbert and Zucker 1996; Scott 1987). The important insight of open systems scholarship is that organisations are not only influenced by their structure and culture, but with how they engage in interchanges with other organisations, institutions and the broader environment. In other words, organisations are viewed as open systems, recognising that organisational change is commonly sparked by impulses coming from the environment outside but connected to the organisation. The RRI-Practice mapping methodology on how RRI comes to be understood in national discourses, as well as by stakeholders in the organisations researched, enabled us to analyse how elements of context function as a barrier or a driver to how organisations' work on RRI aspects. For example, if open access is a national priority, and implemented in organisations similar to the ones studied in the project, mimetic processes can be a driver for implementation (DiMaggio and Powell 1983). From an open systems perspective, the interchange dynamics of organisations include:

- The impacts of the wider political landscape and policy guidelines on mediating expectations
- The impacts of national and industry culture
- The impacts of external stakeholders of all kinds
- The collaborations of the organisation with other entities
- The impacts of public opinion, the press, etc.
- Concerns related to reputation or preservation of status
- The impact of funding schemes in the widest sense
- The impact of benchmarks or other measures at extra-organisational level

We note that both the national funding organisations explored in the study and the European Commission and its funding of this project, constituted an important part of the interchange environment for the research conducting organisations. Similarly, national governments were an important part of wider environment for the policy organisations, both as funding providers and as research units.

In this book we suggest that these distinctions enable us to describe important aspects of the RRI concept; how ideas on RRI are turned into organisational practice, and constituting vantage points from which to analyse how organisational practices may fit the RRI label and concept. We suggest that seeing organisations and organising from a rational, natural and open systems perspective provides insight on possible uses of RRI across and between types of organisations, with respect to the individual keys and dimensions. In Table 2.1, we set out how Scott's typology was put to use for the Gender and Diversity key.

Table 2.1 Use of theoretical framework; structural, cultural and interchange perspectives on gender

	Structural issues	Cultural issues	Interchange dynamics
Aspects of organisations	Mandates, legislative frameworks, formal hierarchies	Culture, informal routines, informal reward systems, focus on management	Policy learning, pressures from key stakeholders (owners, the public, etc.)
Potential drivers for RRI	Active ownership (e.g. the state), legislation that includes social responsibility as a core element of the mandate, formal evaluation criteria adapted to RRI goals	RRI dimensions become mainstreamed, managers start seeing RRI dimensions as an obvious part of their responsibilities, no social acceptance for neglect of the RRI dimensions	Pressure from the media, success stories from organisations considered to set 'gold standards' in the field
Potential barriers to RRI	No formalised pressures to conform to RRI dimensions	Informal incentive systems reward economic output/excellence/etc., effectively marginalising the RRI dimensions	Important stakeholders reward, for instance, excellence and economic performance to a greater extent than RRI related matters
Potential organisational actions	Establishment of a sexual harassment hotline	Explicit reference to candidates' attitudes to gender balance in job interviews of leaders	Invitation of citizens to the university to learn about their perceptions of gender equality in our university system
Indicators for success	Awareness of the hotline among our employees/users/students	Increase of reported awareness of this issue in our annual employee survey	Number of employees actually interacting in dialogues with the public about their activities

Source RRI-Practice research protocol (Forsberg and Ladikas 2017).

For each key and process dimension, the national RRI-Practice research teams sorted the data according to this type of table with the theoretical framework described above in mind. These matrices formed the basis for much of the analytic work in the project. Research outcomes describing drivers and barriers, good practices, as well as legal conditions and national culture with respect to each aspect of the RRI concept are reported in the country reports for the organisations.

Overview of organisations studied

The RRI-Practice study comprises 23 organisations, located in 12 countries. Below we provide an overview the ten funding organisations studied and the thirteen research institutions. In one case, the responsible ministry is included among the studied funding organisations (Bulgaria) as one case. Some studied funding organisations are very tightly coupled to political entities in the state apparatus (e.g. for China and Bulgaria). The Italian case is the only strictly non-governmental funding agency in the sample in terms of financial arrangements.

In the 'Policy Organisation' column, we report if the organisation is formally responsible for implementing policy goals to the scientific community. Hence, if funding organisations are state-owned, but autonomous (at a practice level), we would answer with a 'no.' The 'RRI term in use' column delineates the extent to which RRI as a term is used in organisational practice. The descriptor 'little' denotes that few organisational members are familiar with the term, apart from those familiar with EC funding schemes and Horizon 2020 projects. By 'some' we imply that pockets of organisational members, or a disparate but more noticeable community of organisational members use the term, without the term being common parlance amongst the majority of organisational members. We notice that the funding organisations studied differ along several dimensions: the extent to which organisational practices are denoted with the label RRI; the extent of their role as policy providers entangled in the political system of the country; the scope of the funding field (Table 2.2).

Thirteen research-performing organisations are included in the study, the majority of which are large universities, but which also include two organisations that advise governmental bodies (Bulgaria and China); one organisational unit within a large university (USA), and a not-for-profit organisation (Bulgaria). Some of the research institutions have a restricted research mandate, including two that maintain a clear focus on science and technology (France and Germany). In one country, two research performing universities have been researched (the Netherlands). These distinctions are set out in Table 2.3, that includes the prevalence of the RRI term.

To summarise we see variation in research performing organisations alongside the following dimensions: the extent to which organisational practices are denoted with the label RRI; the type of research performing organisation; their mandate in providing advice to governments; and whether they have an applied research focus. We notice that the majority of our funding providers are large-scale national funding providers that constitute a major driving force in shaping national research agendas and that have varying degrees of policy enforcing mandates from the governments in the countries where they operate. Similarly, the majority of our research performing organisations depend on their funding on these kinds of funding providers who also constitute an important part of their institutional environment. The bulk of our research performing organisations are large-scale universities of national and international importance.

Table 2.2 Research funding organisations studied

Country	Name	Type of organisation	Scope	Policy organisation	RRI term in use
Australia	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	National funding provider	Science and technology	Yes	No
Brazil	São Paulo Research Foundation (FAPESP)	Regional funding provider of national importance	Broad, but particularly strong in the natural sciences	No	No
Bulgaria, EU	Ministry of Education and Science (MES)	Ministry	Broad	Yes	Some
Bulgaria, EU	National Science Fund (NSF)	National funding provider	Broad, including humanities	Yes	Some
China	National Science Foundation of China (NSFC)	National funding provider	Natural science	Yes	No
Germany, EU	Helmholtz Association (HFG)	National independent funding provider and largescale applied researcher	Science and technology	Yes	Little
India	Department of Science and Technology (DST)	National funding provider	Science and technology	Yes	No
Italy, EU	Fondazione Telethon	National independent funding provider; and research organisation	Medicine and health care, with a specific focus on rare diseases	No	Some
Netherlands, EU	The Netherlands Organisation for Scientific Research (NWO)	National funding provider	Broad, including humanities	Yes	Yes[a]
Norway, EØS	Research Council of Norway (RCN)	National funding provider	Broad, including humanities	Yes	Yes

(continued)

Table 2.2 (continued)

Country	Name	Type of organisation	Scope	Policy organisation	RRI term in use
United Kingdom, EU	Engineering and Physical Sciences Research Council (EPSRC)	National funding provider	Engineering and physical sciences	Yes	Yes

[a]Corresponding national language term in use

Data in the national case studies

In all countries, researchers conducted documentary organisational analysis, using strategic policy documents, the mapping of national contexts, and the analysis of national discourses with respect to RRI and similar terms (such as 'responsibility'). In addition, expert interviews, national workshops, interviews with organisational members, and focus group feedback sessions were conducted, both in the formulation of reports and outlooks. Table 2.4 present the numbers of each category. In some countries, additional data collection took the form of questionnaire surveys (Bulgaria), and ethnographic research (USA).

2.3 Coding Strategy in the Organisational Analysis

The national reports analyse the barriers and drivers of operationalising and implementing RRI in particular organisational contexts: what the organisations have done—or not done—towards each aspect of RRI, and how the particular aspect may—or may not—fit the focal organisation and its immediate and wider environment. We coded each driver and barrier with respect to the relevant aspect of the RRI concept (keys and process dimensions), as well as to the relevant dimension in Scott's framework. Most mentions of drivers and barriers relate to only one driver or barrier, but some also show clear relevance for more than one key or dimension. The result is a matrix, where each driver or barrier is coded both with respect to relevant aspects of the RRI concept, and with respect to Scott's dimensions. This strategy allows us to gauge if some keys and dimensions have predominantly structural, cultural or interchange related drivers or barriers, and to compare drivers and barriers with respect to Scott's dimensions for each aspect of the RRI concept.

Table 2.3 Research performing organisations studied

Country	Name	Type of organisation	Scope	Policy advisor	RRI term in use
Australia	University of Queensland (UQ)	Large-scale university	Broad	No	No
Brazil	State University of Campinas (UNICAMP)	Large-scale university	Broad	No[a]	No
Bulgaria	Applied Research and Communications Fund (ARC Fund)	Small applied research organisation	Social Science	Yes	Some
China	Chinese Academy of Science and Technology for Development (CASTED)	Smaller applied research organisation	Science and technology	Yes	Some[b]
France	Alternative Energies and Atomic Energy Commission (CEA)	Large-scale specialized applied research organisation	Energy and related sciences	Yes	Little
Germany	Karlsruhe Institute of Technology (KIT)	Large-scale technical university, with applied research unit	Technical and social sciences	No	Some
India	Jawaharlal Nehru University (JNU)	Large-scale university	Broad	No	No
Italy	University of Padova (UP)	Large-scale university	Broad	No	Some
Netherlands	Wageningen University and Research (WUR)	Large-scale technical university with applied research unit	Technical with a focus on agriculture	No	Some[b]
Netherlands	Radboud University (RU)	Large-scale university, with large hospital attached	Broad	No	Yes[b]
Norway	Oslo Metropolitan University (OsloMet)	Large-scale university with applied research unit	Applied sciences	No	Yes
United Kingdom	University of Bristol (UOB)	Large-scale university	Broad	No	Yes

(continued)

Table 2.3 (continued)

Country	Name	Type of organisation	Scope	Policy advisor	RRI term in use
USA	Arizona State University's Biodesign Institute (ASU-BI)	Smaller applied research within large scale university	Biomedicine and health outcomes, sustainability, and security	No	No

[a]UNICAMP is nevertheless often represented in commissions and advise institutions that produce policy in Brazil (Monteiro, personal communication)
[b]Corresponding national language term in use

2.4 Limitations of the Study

This book is based on national reports from 12 countries on 23 organisations and a study of the national conditions for the uptake of RRI in each report. Therefore, the interpretations by the present authors are based on interpretations made by other researchers in the project on the country in question. In the project, we sought to streamline the reporting through the use of common templates for the reporting of findings and key data. These can be found in the national reports. However, an important aspect of the project was an action research component with interventions taking place in each of the organisations, and with the formulation of policy recommendations at organisational and national levels. A simple delineation between description (what we found) and advocacy (what we advocate) is not always clearly separated in the national reports. In addition to these considerations, research teams (and individual researchers) have diverging research interests and varying theoretical commitments. It is fully possible that the reported national and organisational stance towards the RRI concept in national reports is influenced by the national researchers own commitments and preferences. Nevertheless, in this book we have sought to maintain consistency through consistent convergence, through close engagement with each of the research teams, and through a common analytical framework. Last, we cannot claim our selection of cases 'represents' a larger population in a well-defined way, although they are central to the national science systems of interest, and therefore exerts considerable influence on these.

Table 2.4 Data collected for national case studies

Country	Organisations studied	Documents reviewed	Interviews	Focus group participants	Workshop participants
AU	(1) Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2) University of Queensland (UQ)	91	42	21	13
BR	1) São Paulo Research Foundation (FAPESP) (2) State University of Campinas (UNICAMP)	50	20	19	12
BG	(1) Ministry of Education and Science (MES) (2) National Science Fund (NSF) (3) Applied Research and Communications Fund (ARC Fund)	23+	29	24	18
CN	(1) National Science Foundation of China (NSFC) (2) Chinese Academy of Science and Technology for Development (CASTED)	120	25	8	8
DE	(1) Helmholtz Association (HFG) (2) Karlsruhe Institute of Technology (KIT)	721	18	7	7

(continued)

Table 2.4 (continued)

Country	Organisations studied	Documents reviewed	Interviews	Focus group participants	Workshop participants
FR	(1) Alternative Energies and Atomic Energy Commission (CEA)	29	16	26	16
IN	(1) Department of Science and Technology (DST) (2) Jawaharlal Nehru University (JNU)	50	40	22	59
IT	(1) Fondazione Telethon (2) University of Padova (UP)	n/a	17	15	12
NL	(1) The Netherlands Organisation for Scientific Research (NWO) (2) Wageningen University and Research (WUR) (3) Radboud University (RU)	80	71	7+	30+
NO	(1) Research Council of Norway (RCN) (2) Oslo Metropolitan University (OsloMet)	50+	36	n/a	9
UK	(1) Engineering and Physical Sciences Research Council (EPSRC) (2) University of Bristol (UOB)	350	38	n/a	14

(continued)

Table 2.4 (continued)

Country	Organisations studied	Documents reviewed	Interviews	Focus group participants	Workshop participants
US	Arizona State University's Biodesign Institute (ASU-BI)	56+	18	25	54
Inter-national	Workshop with experts on two days in Berlin				22
Totals	All countries	1620+	370	174+	274+

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Chapter 3
Organisational Drivers for RRI

Abstract In this Chapter, we give an overview of drivers furthering the implementation of RRI. We analyse drivers as structural, cultural and interchange related, using a framework derived from neo-institutional theory. We include a discussion based on types of organisation (such as research funding versus performing organisation) and we provide overall reflections the role of on drivers in implementing RRI.

Keywords Drivers for RRI · Responsible research and innovation · Structural drivers, cultural drivers, interchange drivers · Implementation · Neo-institutional theory

Organisational drivers are those that support the uptake of RRI in organisations and that alert organisational members to the merits of RRI. Each country report was set up to discuss drivers for RRI under the five keys and the four process dimensions. In this chapter we discuss the structural, cultural and interchange drivers, focusing on the following questions:

1. What are the drivers across the RRI keys and dimensions?
2. What is the interplay between drivers that are structural, cultural and interchange related?
3. How do drivers relate to research funding and research performing organisations respectively, and what are the differences?
4. How do drivers relate to small and large organisations?
5. How do drivers relate to different fields of research and funding?
6. How do drivers and barriers relate to groupings of countries?
7. From an organisational perspective, does use of RRI as a phrase make a difference, and how?

3.1 Structural Drivers for RRI Keys and Dimensions

Structural drivers are the most prevalent drivers identified in the national reports (alongside interchange drivers). Across the constituent RRI keys and dimensions, these include:

C. Wittrock et al., *Implementing Responsible Research and Innovation*, SpringerBriefs in Ethics, https://doi.org/10.1007/978-3-030-54286-3_3

- Dedicated (pilot) programmes, infrastructure, and organisational units dealing with the key or dimension or integrating several of them into a coherent bundle of practices.
- Organisational mandates, regulations, policies, strategies and organisational goals.
- Guidelines, procedures and organisational routines (including planning processes) in place to support the key or dimension or bundles of them.

A key driver is the existence of programmes aimed at supporting aspects of RRI in the form of specific keys or bundles of keys and dimensions, such as ethics and process dimensions conceptually close to ethics (Anticipation and Reflexivity, Responsiveness and Adaptation). Programmes exists for all types of keys, and to some extent for the process dimensions too, and programmes may combine more than one of these, such as in initiatives that combine societal engagement and science education. The existence of organisational units that deal with specific keys or—less often—coherent bundles of keys are also frequently mentioned, such as offices for outreach, gender equality or ethics. Likewise, infrastructure supporting keys and dimensions appears to be an important driver, such as the existence of a university-wide repository for publications, or an archive for research data, supporting the Openness and Transparency dimension, and the Open Access key. Other structural drivers that feature prominently in the reports include organisational mandates, regulations, policies, strategies and organisational goals. For instance, a funding organisation may have research ethics as parts of its mandate and a set of policies aimed at promoting societal engagement. Similarly, policies may be accompanied by funding, for example, for open access publishing in research performing and research funding organisations. While the exact measures may differ between funding and research organisations due to the nature of their work, the nature of the measures (for example, in the form dedicated programs, mandates, or guidelines) differ less.

When aspects of RRI are in line with official goals pursued by the organisation, this is seen as a strong driver in the reports. Such convergence can drive attention, and in some cases 'policing.' Convergence may also facilitate support through internal funding mechanisms. Gender equality and open access seem to benefit from such convergence in some of our cases, but ethics and outreach activities, the promotion of science education and public engagement, are also present. Soft governance mechanisms in the form of guidelines, established procedures, and organisational routines can have similar effects in supporting the implementation of RRI. These may be guidelines supporting gender equality, for societal engagement, or procedures for publishing open access. We see no clear picture in the drivers discussed above in relation to funding providers versus research organisations; they seem to appear across types of organisations.

Less, but still frequently mentioned structural drivers include:

- RRI included as an integrated part of evaluation criteria or other incentives.
- RRI as incorporated into established research methods and procedures.
- Training courses on aspects of RRI.

These drivers focus on the integration of keys and dimensions into organisational practice. One important driver discussed in the reports is the existence of evaluation criteria that further a particular key or dimension, such as counting only open access publications in evaluation processes. Another driver is the existence of incentives. Some organisations (such as the Indian Department of Science and Technology) use incentives that target women to increase the share of women in science and curb issues related to maternity leave. Evaluation of funding applications against clear criteria for gender equality or ethics are also common among funding organisations. Training courses to raise awareness and competence are also mentioned frequently, such as courses in ethics or science education. While some funders provide training courses, these are more commonly mentioned in connection with research institutions. In short, the more RRI keys and dimensions are included into the everyday practice of researchers, and into activities organised by research funding organisations, the better the chances for RRI to become institutionalised.

3.2 Cultural Drivers for RRI Keys and Dimensions

Cultural drivers receive relatively little attention in the country reports. However, these are manifold, and include:

- An organisational culture, expressed in established organisational values and organisational identity, that fits the key or dimension and that supports it.
- An overlap with traditional scientific values and norms, that include the training of next generation academics.
- Institutional entrepreneurs, managers and other 'translators' that further a particular RRI key or dimension, or several of them, in the organisation.

In some organisations, members see themselves as aligned culturally or by means of values with aspects of RRI. In some reports, such convergence is even described as part of the identity of the organisation, such as the Bulgarian ARC Fund's focus on societal engagement (see (Damianova et al. 2018)), which is both ingrained in the culture and the mandate of the organisation, and a key in which the organisation has built significant expertise over many years. Cultural fit (Ansari et al. 2010) appears the strongest driver for the Ethics key, as well as for the Openness and Transparency dimension with respect to cultural drivers, and is also mentioned for other aspects of RRI, across types of organisations. Several national reports (for example, Brazil (Reyes-Galindo and Monteiro 2018), Netherlands (van der Molen et al. 2018), and France (Grinbaum et al. 2018)) discuss how RRI aspects align with classic scientific norms and values, often deeply ingrained in the classical role of universities, and how this drives (and constrains) the appetite for Openness and Transparency, Responsiveness and Adaptation, Anticipation and Reflection, as well as for the Societal Engagement key. Interestingly, this type of cultural driver is not mentioned in discussions of the Science Education key. Additionally, the perception

that science should be unbiased carries over to the way in which funding organisations allocate funds, and is mentioned several times as a driver for the Ethics key (Netherlands (ibid), India (Srinivas et al. 2018), and Germany (Hahn et al. 2018)). While the impact of long held ideas of what a university is and should be, is connected mostly to research performing organisations, classical scientific values and norms are described as drivers for funding organisations as well (Netherlands (ibid)). The same is true of values found in health care and medicine, which are particularly strong influencers with regards to the Ethics key (see the Telethon foundation in the Italy report (Neresini and Arnaldi 2018)). The importance of the training in RRI aspects (such as in ethics, or in research integrity) is a frequently mentioned driver for research performing organisations (Netherlands (ibid)).

Institutional entrepreneurs, in viewing culture more as a 'toolkit' rather than a solidified and static concept (Swidler 1986), are occasionally mentioned as strong drivers for either the entire RRI concept or parts of it. This is particularly salient in the Gender and Diversity key and among research performing organisations (Norway (Egeland et al. 2018), Australia (Sehic and Ashworth 2018), and the USA (Doezema and Guston 2018)). Institutional entrepreneurs create attention, mobilise organisational members and instigate programmes. Sometimes such entrepreneurs are also managers of the entire organisation or units. Similarly, the role of 'translators' and institutional entrepreneurs is discussed in some reports as an important counterbalance to contexts where RRI—or aspects of RRI—is conceived as being of less immediate relevance to the organisation, of where the concept is not widespread in the country, or where the interchange pressures to adopt RRI are weak (France, Bulgaria). While these agents are important for organisational change processes in a broad sense (e.g. Randles 2016; North 1990), their roles are seldomly explicated in the national reports. We have been surprised by this fact, as a common narrative structure in most societies is to focus on (single) 'heroes' creating change (MacLeod 2007; Hutto 2007). For additional information on the role of change agents of good practices see Wittrock and Forsberg (2019). Other important cultural drivers include:

- That the key or dimension is seen as a good in itself, sometimes as part of existing institutional work.
- That the relevant aspect in RRI matches with existing organisational discourses.

In some cases, a particular key or dimension is seen as a good in itself within an organisational culture (what Suchman (1995) would call *cognitive legitimacy*), or as part of an organisational practice. Ethics, for instance, is seen as inherently good, and may be further supported by a fear that science is losing credibility in society at large. Similar ideas are on occasion tied to other keys and dimensions, for instance in relation to the Openness and Transparency dimension. Some organisations—across funders and research organisations—see their mission as closely tied to the development of ongoing ethics, societal engagement or science education work: in other words, these aspects of RRI *touch upon what the organisation does in this world*. Likewise, the education of the next generation of researchers is mentioned as a driver

for reflection and ethics in research performing organisations that also have doctorate students.

Organisational discourses (or national ones) create a backdrop against which RRI is evaluated; talk fosters organisational change and is an integral part of change (Sturdy and Fleming 2003). In some cases, national report authors point to such ongoing 'organisational talk' as an important driver for RRI. This can be the case for instance in relation to gender equality or diversity, but also in the case of the Ethics key. As we discuss when dealing with the interaction of structural, cultural and interchange dimensions, the existence of organisational units catering to specific keys or dimensions often supports such organisational discourse. Likewise, national discourses sometimes support specific RRI aspects, as discussed in Part II of the report.

For the Ethics key and process dimensions conceptually close to ethics (Anticipation and Reflexivity, Responsiveness and Adaptation, Openness and Transparency) a special group of drivers are mentioned in addition to the ones above. These are:

- Hiring staff from outside the organisation with expertise.
- Avoidance of conflicts.

Specifically, with respect to the medical sector, respondents in the Telethon study mention that employing staff from industry aids ethical considerations in the organisation. The reason is that research ethics is deeply engrained in the medical sector, and enforced by strict guidelines and procedures, which are binding for organisations wishing to put a product on the market. The avoidance of conflicts relates to drivers that we discuss further in the interchange dimension. However, in the cultural dimension, the avoidance of ethical conflicts appears to be tied to perceptions of what science is and should be, namely an activity that does not create ethical challenges.

3.3 Interchange Drivers for RRI Keys and Dimensions

Interchange drivers are mentioned roughly as often as structural ones, but appear more diverse, falling into many groups. Frequently mentioned ones include:

- National policies, regulatory frameworks, laws and monitoring systems, as well as international benchmarks driving policies, such as the PISA assessment.
- Politically initiated programmes.
- Demands from funding agencies, and the EC, particularly through its framework programs and their assessment criteria.
- Expectations from stakeholders and the public, as well as expectations of expectations, creating pressure.

National policies, regulatory frameworks, laws and monitoring systems appear an effective and dominant bundle of drivers, applying across funding organisations and research organisations. In many cases, funders by mandate seek to sway research

organisations to adopt RRI aspects by virtue of their assessment criteria (see below), monitoring systems, and policies. These drivers are relevant for all keys and dimensions, although not well developed for all keys and dimensions in all countries researched. In fact, few countries, if any, appear to have effective measures for all aspects of the RRI concept. International benchmarks are mentioned occasionally, especially the PISA assessment in connection with the science education key. Many of the keys and some of the process dimensions are addressed by politically initiated programmes. While programs relevant to research performing organisations appear more widespread than for funding organisations, such programmes may influence both types of organisations (such as gender equality measures in a Dutch context, or science education efforts in an Indian context). The programmes are quite diverse and most often relate to single keys, although also to process dimensions, and sometimes in combination (such as in the combination of societal engagement and anticipation and reflexivity in the context of emerging science and technology).

The demands of funding agencies and their assessment criteria is a very dominant driver for research performing organisations. The European Commission and its framework programmes are mentioned as important drivers in all the national reports, both as a condition for participation in EC funded projects, and as a factor in how EC programmes shape national funding priorities. Likewise, EC programmes have reach beyond the EU, not least through peer review, as well as in participation in projects involving researchers from within and outside Europe (China (Zhao et al. 2018)). Expectations from stakeholders in the immediate environment of organisations, as well as from political quarters and from the public constitute, a strong driver for all types of organisations studied, as well as across keys and dimensions. The effect includes 'expectations of expectations' or what may be called social expectations; in other words, if the organisation perceives that ethical conduct or gender equality may be an expectation held by important stakeholders (even in the absence of strict evidence), this has the capacity to influence the organisation and consequently may pave the way for RRI activities. The neo-institutional insight that organisations align with their environments (DiMaggio and Powell 1983) is well documented in the national reports. In some reports, the expectations of industry partners are also mentioned as drivers for RRI. This is particularly pronounced in the Ethics key, but also applies to the Anticipation and Reflexivity dimension (see e.g. Italy report). The concerns of industry partners appear most relevant for research performing organisations, although this is determined by the specific operations of the individual organisation. Some funders also come into close contact with industry partners. While the group of drivers discussed above constitutes the most frequently mentioned ones, several others appear important. These are:

- Societal discourses and national norms supporting (aspects of) RRI keys and dimensions.
- Bodies (such as ethics commissions) that monitor organisational practices.
- The mandate of the organisation.

We have seen above in the section on cultural drivers that organisational discourses play a role as a driver for RRI keys and dimensions. Stronger though, seems to be the influence of societal discourses and national norms that are then in some cases reflected in organisational discourses. For instance, national norms supporting gender equality or diversity appear a strong driver for this aspect of RRI, regardless of organisational type. Another strong driver is the existence of bodies (for example, in the form of commissions) monitoring organisational practices. This is particularly pronounced for the Ethics key, and across types of organisations, but does also relate to other keys. We discuss this further under the heading 'Isomorphism and funding organisations as environment for research organisations' in Chap. 5.

The mandate of the organisation can also be a driver. For instance, the dimension Openness and Transparency may benefit from mandates given to policy organisations, as is also commonly the case with the Ethics key. In fact, across all organisations, mandates pertaining to the Ethics key appear to be a frequent driver, as does the nature of the organisation or the research field covered (for example, ethics is particularly pronounced in research on nuclear power, medicine or artificial intelligence). In the case of Oslo Metropolitan University, the recently acquired status as a university (replacing the status of university college), is mentioned as a driver for attention to RRI as it is seen as related to professionalization of research.

Public pressure is a strong driver in relation to the Ethics key and to the dimensions closely related to it, such as Anticipation and Reflection, Responsiveness and Adaptation, and Openness and Transparency. Particular drivers have been associated with fraud cases, catastrophes, and scrutiny by the media. Scandals such as Cambridge Analytica or national cases of research misconduct are a strong driver for a focus on research ethics and integrity, as are catastrophes like the Fukushima nuclear disaster (see e.g. the Netherlands and Norway reports). In general, scrutiny by the media and resulting public attention appears to be a very strong driver for ethics across all types of organisations. We also find descriptions of how such cases have occasioned policies, regulation, and other structural drivers.

Furthermore, a set of drivers relating mainly to the Open Access key, Ethics, and to Public Engagement are concerned with the reputation of the organisation, and what is seen as popular at any given moment. In line with neo-institutional theory, the reputation of the organisation is mentioned in many national reports as an important concern that drives attention to core aspects of the overall RRI concept. RRI also seems to capture some trends in current research and innovation thinking, as national reports mention the topic of some keys and dimensions as fashionable or at least popular today. By engaging with these topics, the organisations will then appear to be on the forefront of progress (Abrahamson 1996). While reputation concerns are mainly connected to policy and research conducting organisations, the theme of popularity appears to cut across types of organisations. For instance, in the Bulgaria report it is noted that RRI is connected to the EC, and thus seen as attractive.

The final group of interchange drivers concern collaboration and cooperation across organisations and countries. Collaboration and cooperation that transcends organisational units, or organisational borders, is frequently mentioned as a driver

for several keys. This appears most pronounced amongst research performing organisations. Cooperation with researchers foreign to the organisation or organisational units has a tendency to promote Anticipation and Reflection (indeed, this was the most frequently mentioned driver for this RRI dimension), Openness and Transparency, Responsiveness and Adaptation, and Science Education, as well as being a very dominant theme in the Ethics key (China (ibid)). Successful programmes demonstrating the merits of societal engagement—i.e. collaboration across organisational boundaries—is also a frequently mentioned driver in the Societal Engagement key. Similarly, a number of country reports mention that international collaboration drives attention to gender and diversity. These findings are hardly surprising, as research consistently shows that personal networks facilitate contagion and diffusion across otherwise unconnected entities (Watts and Strogatz 1998). One may theorize that researchers in international projects function as a 'hub' (or centrally placed node) connection in 'small worlds' across the globe.

3.4 Interaction of Structural, Cultural and Interchange Related Drivers

Structural, cultural and interchange related drivers interact. In many cases, they mutually reinforce each other, thereby gaining strength. In some cases, drivers are both interchange related and structural. For instance, this happens when national legislation demands that organisations implement policies or measures to further some aspect of RRI. The national reports contain reviews of national legislation which illuminate this dynamic. Another prominent example, often alluded to, is the role of national policymaking and funding programmes as structural and cultural drivers for organisations. The pursuit of open access in some countries is an example of this point. In other cases, national cultural drivers (interchange related) and organisational culture overlap. This happens when national culture reinforces organisational culture in some way relevant to the RRI keys or dimensions. This tendency is for instance reported in the case of open access in Brazil and science education in France. Gender provides a good example too. When national culture is in favour of gender equality, this often has an impact on organisational culture, as reported in the Norwegian case study.

3.5 Discussion on Types of Organisation and Embedding Dynamics

In this section, we expand the discussion on drivers to address more directly some of the research questions posed with respect to drivers for RRI across keys and dimensions. Some of the findings are discussed further in Chap. 5, where we collate

results. With respect to groups of organisational types and RRI drivers, the most striking finding is perhaps that most drivers cut across the spectrum of organisational types. Likely, one reason for this is that RRI addresses many societal issues which are prominent in the interchange dimension of our analysis. And most of these issues are of relevance to all types of organisations, whereby they all experience considerable pressure from their environments.

Research performing versus research funding organisations

A striking finding in our research is the encompassing attention to policy signals, shared across research funding and performing organisations. Another is the extent to which research funders constitute an important part of the environment of research performing organisations. This is evident across cases, where the research performing organisation depends on the research funder for financial support. Some differences are obviously connected to different circumstances of their mandate and operation, such as the impact of international collaborations, and requirements in funding applications. However, understanding other differences are less clear. Research funding organisations in general appear to experience:

- Comparatively fewer drivers in the Anticipation and Reflexivity dimension
- Comparatively fewer drivers in the Societal Engagement key
- Comparatively fewer drivers in the Science Education key

These are interesting findings, for which there may be many reasons. However, especially for the Science Education key, it indicates that research funding providers likely could do more to support science education and find ways of integrating such support in new ways in the funding of research. We discuss this further in Chap. 4 on barriers.

Differences between small and large organisations

Elsewhere in this book we suggested that smaller organisations typically are easier to change than larger ones. While there is some evidence of that in our sample, we focus on a counterfactual picture emerging in our data that large universities with top management and leadership supporting gender equality and diversity are capable of making significant progress on the Gender and Diversity key by means of multiple projects and dedicated resources. They also appear to have significant success in changing the culture of their institutions to think differently about gender and diversity issues. In our RRI handbook, we have described the very innovative and research-based Christine Mohrmann programme at Radboud University in the Netherlands (Wittrock and Forsberg 2019). However, we see similar patterns in Australia, Germany, Italy, Norway and the US. From a neo-institutional point of view, the pressure from the environment of the organisations may be strongest on the gender and diversity key, and it appears that skilful change agents in organisations have successfully leveraged pressure to change their organisations. One may speculate if they would have similar success in furthering other RRI keys if they applied themselves to this task. Several reports indicate that this might be the case.

Top management and leadership of organisations have also successfully advanced green open access (with a preference for gold), while other organisations have been successful in developing a societal engagement culture, as well as supporting science education.

Differences with respect to fields of research and funding

Our sample contains several technical universities and funding bodies that focus on science and technology and the natural sciences. Likewise, our sample contains several broad and often classic universities and well as broad national funders. Differences between these groups are not clear in our data material. In our sample, we also have a group of organisations working in the health care sector. The Italian Telethon is the most obvious example, but Radboud University in the Netherlands also has a large university hospital and associated research tied to it. This appears to translate into a high interest in, and attention to, the Ethics key. Research ethics is a key concern in health care, and one that is supported by players in the health care industry too, as the field is tightly regulated, and lack of compliance can be fatal.

Differences in RRI attitudes related to national embedding

National differences receive analytical treatment in Part II of this book using social imaginaries theory as a methodology. Consequently, we wanted to consider possible differences between groups of countries in this section which we may connect to branches of neo-institutional theory. In our original coding scheme, we first hypothesized that we would find differences between European and non-European countries. We also thought we would find differences between occidental and non-occidental countries. However, the hypothesized differences are not clear-cut in the data. It appears that a more telling distinction is that of centre versus periphery. By this we mean who is being emulated (centre) and who are seeking to emulate (periphery) in our case countries. This distinction has support in diffusion studies, and in the study of organizational innovations; it is known that apparent success (or popularity) drives efforts to emulate (Macy and Strang 2001; Sahlin-Andersson and Engwall 2002). In our study, such a distinction should transfer into stronger interchange related pressures related to the perceived attractiveness of particular models of organisation, and of the national STI system, for others to emulate.

This approach has some support in the data: Mentions of interchange related pressures stemming from European policymaking and Horizon 2020 programmes, international collaborations, and global trends on issues addressed by RRI all appear less frequent in reports from Germany, France and the UK, than from the Netherlands, Norway and Bulgaria. Hence, the old and large 'science countries' in Europe may be less interested in RRI, than the periphery. Similarly, reports from countries outside Europe appear generally more positive towards RRI than the actual European countries, and seem more frequently to see RRI as being in line with current (popular) trends, which they perceive as important or future-oriented. They also frequently point to international collaborations as being a driver for RRI-related

activities and organisational change processes. Several factors other than a centre-periphery dynamic may explain these observations, for instance author bias or preferences, and a generally positive attitude to new ideas. However, we find it interesting that European policy-making (here in the form of the concept of RRI) seems to be on the radar of countries far removed from Europe, and less so in the large dominant players in the European Union. The project may also have been a factor as ambassador for RRI in countries where the idea is new to most organisations in the science field.

What difference does formal recognition of RRI as a term make?

In the RRI-Practice project, we surveyed both the concept of RRI and what Sally Randles and colleagues have called 'de-facto rri', in other words, practices that may not be labelled RRI in their host organisations, but that may from a 'content' point of view—that what people actually do—be subsumed under the RRI label (Randles et al. 2016; Randles 2016). It is not clear from our data that drivers to RRI differ significantly in the few organisations where the RRI label is in current use, and reasonably widespread. However, there are indications of some differences when RRI is formally recognised: descriptions of drivers are more specific, and often take the form of concrete actions or provisions; more drivers are mentioned; and policy pressures and public pressures appear at times taken for granted.

3.6 Conclusion and Reflections on Drivers for RRI

In this Chapter we have seen that structural and interchange drivers seem to be the most important drivers for RRI. They are discussed more than twice as often as cultural drivers. National policies, regulatory frameworks, laws and monitoring systems appear to be the most effective drivers, alongside dedicated pilot programmes and organisational units providing institutional homes for practices, as well as organisational mandates, organisational goals, guidelines, procedures, routines, and like measures. Likely, they are most powerful in unison, where outside pressures are aligned with intra-organisational measures supporting RRI or aspects of the concept (Reay et al. 2013). Similarly, some of the most cited cultural drivers are values and perceptions of organisational identity that match one or more RRI aspects; providing a cultural fit (Ansari et al. 2010). However, organisational cultures seem often to need to change in order to accommodate RRI and obtain the sought-after institutional change.

In the RRI-Practice project there has been a hypothesis (in part based on Randles (2016), in part based on the experience of consortium members) that change agents, or RRI champions, are of great importance for the implementation of RRI practices in organisations. However, this is not clear from the data, other than with respect to separate aspects of RRI, especially the Gender and Diversity key. It may be that we call RRI champions, in toto, are typically champions of specific RRI keys, such as

gender equality, open access, research ethics, public engagement or science education. Alternatively, they may be champions of concrete major projects that have supported one of the RRI keys, such as the Indian 'Science Express' project, which is a milestone in science education globally. As we obtained further information from consortium partners and from the field, more change agents did appear to emerge in case studies developed from the research. It appears that the most effective change agents have been able to capitalize on external pressures in order to promote aspects of RRI. This is not surprising as change agents work with the concrete situation at hand in order to obtain some objective, either by combining policy frameworks (structural/interchange drivers), or from some pressing situation that needs to be resolved. Certainly, our data suggest that change agents are more successful when they have institutional support. Similarly, external and internal drivers help change agents make their case.

In general, it appears that practices are likely to change only with sufficiently strong structural measures, and that interchange or structural forces need to be in place for RRI champions to be effective. For the European Commission, these considerations indicate that the EC needs to work with policy-makers in member states, and on occasion with those in non-member states to successfully implement RRI. Similarly, we have seen how the demands of funding organisations are commonly an important part of the environment influencing choices and priorities set in universities, at both the policy level and the level of individual researchers. Working with national funding organisations therefore constitutes a viable way of influencing the STI system in Europe for the EC. In general, the pattern that emerges affiliates with the neo-institutional insight that organisations align with their environments, and seek to obtain legitimacy by complying with widespread norms of perceived good conduct and organisation (Tolbert and Zucker 1983), albeit sometimes only at a surface level (Meyer and Rowan 1977). International collaboration appears to be an effective way of transmitting norms from perceived centres of excellence and through processes of emulation to other organisations, including those at the periphery (Sahlin-Andersson and Engwall 2002).

A final reflection on the concept of RRI is in order. When comparing drivers for individual RRI aspects with the general drivers for RRI, it appears that drivers for ethics are close to drivers for RRI in general. However, ethics is not always promoted as a key part of the RRI concept; it is, for instance, not mentioned among the process dimensions or in most co-creation policies. RRI might appear as a more coherent and forceful concept if ethics is more explicitly profiled as a driving force for RRI. A further finding is that research funding organisations exhibit comparatively fewer drivers on some aspects of RRI, particularly on the Science Education key. Likewise, there are indications that policy organisations are more concerned about reputation management as a possible driver for RRI, and that organisations working with the healthcare sector experience comparatively stronger drivers for research ethics. Our data imply that the EC label, international collaborations, and global trends may be less important drivers for countries at the centre of European decision-making (Germany, France, and the UK). More clearly, the EC has a lot to learn with respect to diversity from countries where this issue has been longstanding and deeply

embedded in national identities (Australia, Brazil, India, and the USA). We do not see clear differences with respect to drivers when comparing organisations where the RRI term is in current use and those where it is (largely) unknown. However, there are indications that descriptions of drivers are more plentiful and more detailed in organisations where the term is in current use.

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Chapter 4
Organisational Barriers for RRI

Abstract In this Chapter, we give an overview of structural, cultural and interchange related barriers to implementing RRI in organisations, using a framework derived from neo-institutional theory. We discuss barriers related to different types of organisations, such as research funding and research performing organisations. Finally, we provide overall reflections on the role of barriers, and discuss how barriers to RRI intersect.

Keywords Responsible research and innovation · Structural barriers · Cultural barriers, interchange related barriers · Implementation · Neo-institutional theory

Organisational barriers are those that hinder or work against the uptake of RRI in organisations, and make organisational members reject or de-prioritise the relevance of RRI. The country reports each discuss barriers to RRI for both the keys and process dimensions. Although we have coded barriers for each aspect of the RRI concept, our concern here is the barriers across keys and dimensions, grouped as structural, cultural and interchange in accordance with the theoretical underpinning of our study.

In this section, we address the research questions:

1. What are the barriers across the RRI keys and dimensions?
2. What is the interplay between barriers that are structural, cultural or interchange related?
3. How do barriers relate to research funding and research performing organisations respectively, and what are the differences?
4. How do barriers relate to small and large organisations?
5. How do barriers relate to fields of research and funding?
6. How do barriers relate to groupings of countries?
7. From an organisational perspective, does use of RRI as a phrase make a difference, and how?

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4.1 Structural Barriers to RRI Keys and Dimensions

Structural barriers to the adoption and successful use of RRI in organisations are plentiful in the country reports. Whether more prominent or just easier to identify, structural barriers are the dominant reason for hindering the uptake of RRI in organisations, both for funding and research performing organisations. These include:

- Lack of resources (money, time, people, training, expertise).
- Lack of incentives.
- Lack of strategies, policies, frameworks, systems, and formal structures supporting practices pertaining to the aspect of RRI.

While all of these are important, the lack of resources, combined with the lack of incentives seems particularly potent as a barrier. For instance, for large universities, perceived pressures for high profile publications, lack of resources, and lack of (other) incentives (than publishing) seem to severely cripple attempts to engage staff in ethical reflection, public engagement, science education, as well as all the process dimensions. An additional theme is that of fragmentation: fragmentation within organisations and fragmentation of the RRI concept. We discuss the former first, although there are overlaps between the two categories. Fragmentation of organisations has dimensions that include: the lack of dedicated organisational units dealing with RRI or aspects of RRI; the use of non-standardised guidelines and procedures for aspects of RRI within the organisation (most prominent in the case of ethics); disparate programmes with lack of coordination (also within one key); and unclear mandates. RRI aspects that require formal procedures of compliance—such as the Openness and Transparency dimension, and the Open Access and Open Science, as well as the Ethics keys—are often troubled by bureaucracy, a barrier prominent for research funders and research performing organisations alike. Such findings are hardly surprising in professional bureaucracies with many operationally independent departments (and institutes) and a large and fragmented operational apex (Mintzberg 1979). Paradoxically, this barrier can also be a driver, because it allows for dedicated change agents in various units of the organisation to pursue an RRI agenda without the bureaucratic rigidities and strict policing imposed by central administrations.

Structural fragmentation is also a feature of RRI implementations because RRI is an umbrella concept with many institutional homes; there are few centralized RRI offices in organisations, even if there are organisational units for gender issues, outreach, ethics, etc. This fact can render RRI relatively invisible in organisations and do result in little coordination between separate initiatives. A final structural barrier is that the RRI concept, cutting across keys and dimensions, has a long-term perspective, with short-term results that are difficult to trace and document. This is particularly noteworthy, as research on diffusion maintain that lack of clear results—or the ability to track these—are connected to poor diffusion of innovations (Rogers 2003).

4.2 Cultural Barriers to RRI Keys and Dimensions

Cultural barriers represent the second largest group of barriers, often seeming to work in unison with structural ones. However, aspects of academic culture, prominent in both research performing organisations and organisations funding research, *also exhibit drivers* for RRI that are often *closely related to the barriers*. The most prominent cultural barriers across the keys and dimensions are:

- Lack of knowledge and awareness.
- RRI seen as an add-on, rather than as a central activity of the organisation.
- Classic academic values of autonomy and merit that operates in tension with RRI.
- Ingrained ideas of innovation that operates in tension with RRI.
- Perceived lack of clarity in the RRI concept.

The first group of barriers (lack of knowledge and awareness) requires little discussion but is likely to affect the perceived relevance of RRI. In short, the message of what RRI is, and what could be facilitated through the concept, is unclear for most of research funding and performing organisations, outside a limited group of dedicated stakeholders close to EC science policy. Adding to this barrier is the problem of lack of concept clarity that may hamper diffusion, particularly to the academic community, alongside a perception that there exist a number of other concepts that may be doing the same work, such as sustainability. This is particularly pronounced in the case of the ethics key, where other competing concepts include integrity, honesty and responsibility.

With respect to lack of concept clarity, conceptual ambiguity or interpretative variability is generally an important driver for the diffusion of management innovations, as such characteristics enables disparate actors to interpret the concept in line with their own interests (Giroux 2006; Benders and Van Veen 2001). Competing concepts though, can operate as a barrier for the spread of a particular concept, if these other concepts (come to) dominate the public discourse (Thawesaengskulthai and Tannock 2008; Abrahamson and Fairchild 1999). However, plural concepts that draw attention to closely related practices (e.g. sustainability, accountability, integrity, RRI, etc.) also help guide attention to those practices or family of phenomena and should aid the development of organizational practices that support 'de facto rri.' In sum, many concepts pointing to the same types of practices suggest institutional pressures to adopt models of management that accommodates ideas and techniques theorised as core to these concepts (cf. Guillén 1994), whereas competing concepts pointing to disparate organisational practices divert attention. We suggest therefore, that the underlying cause for the barrier discussed (lack of concept clarity), may be perceived lack of relevance, coupled to (misguided) perceptions of RRI as a 'science concept' rather than a mapping of elements which constitutes responsible research and innovation as a practice. The five keys and four process dimensions suggest that RRI practiced has multiple aspects, which are only adequately captured as an umbrella concept (cf. Bort 2015; Hirsch and Levin 1999). Speaking in the language of statistical analysis, RRI is an index for good research and innovation behaviour, not one factor from

a factor analysis uncovering how researchers on average think about good research and innovation behaviour, or rather one particular aspect of it. Notwithstanding these considerations, it is clear that the disparate character of the RRI concept has consequences for its application in practice, as has the differing ways of operationalising RRI across organisations. We discuss this further below.

Two cultural barriers that reinforce the perception of RRI as an add-on to core activities, lies in dominant ideas on academic excellence, and dominant ideas on innovation. On the former, traditional ideas of academic excellence centre on pure curiosity-driven research, the discovering of new knowledge, and the pursuit of truth. According to this model of science policy, examined in more depth in Chap. 6 under the 'linear model' label, lies the idea that the research process governed internally by an autonomous scientific community, unhindered by external agencies or stakeholders (such as ethics boards or governments), which are seen to curb scientific freedom to pursue truth and progress. This reasoning means that science is an activity judged predominantly from the viewpoint of scientific merit, where merit is the discovery or generation of new knowledge. In some countries, particularly those where academic freedom is taken as a given, there is fear that RRI may give governmental bodies a pathway to unduly influence science and possibly science outcomes.

Similarly, dominant ideas on innovation as the driver of progress (Rogers 2003) question if innovation needs to be directed or curbed, with assumptions that economic progress can be related to societal progress and that the marketplace can be trusted to respond adequately and appropriately to societal needs. Curbing the creativity and engagement of the individual, according to these narratives, are likely to hinder progress and economic development (Schumpeter 1983). These two narratives imply that RRI activities should be divorced from research activities, and from the innovation process, and left to other actors, if pursued at all. According to these narratives, RRI is an add-on, a bureaucratic burden. Likewise, some reports mention RRI as a 'luxury' in the face of resource constraints experienced.

These broad streams of cultural barriers to RRI have consequences for multiple keys and dimensions. First, seeing science as driven solely by narrow criteria of excellence (for example, prioritising high impact factor peer reviewed journals) can be in tension with initiatives aimed at aiding women to succeed in fields where they may be at a structural disadvantage. Second, the Anticipation and Reflection and the Ethics key are at times turned into 'check-box' activities, or are outsourced to ethics boards, thus reinforcing their perception as administrative burdens. Many of the keys and dimensions are seen as potential threats to the autonomy of science. Their representation as add-ons helps ensure that RRI aspects do not become integrated into science practice. Other cultural barriers viewed as important across keys and dimensions are:

- De-coupling effects.
- Low buy-in from the 'older generation.'
- Lack of managerial support.

The barriers discussed above seem to lead to de-coupling effects under some circumstances. This is prominent in the Ethics key, and its intersection with the Anticipation and Reflection and the Responsiveness and Adaptation dimensions. For instance, de-coupling occurs when compliance with ethics frameworks becomes a matter of box ticking or when ethical reflection is outsourced to external bodies, rather than undertaken by the researchers involved. Some reports explicitly mention a concern with organisational image as both a driver and a barrier. Such concerns may lead to superficial treatment of RRI aspects internally (to the extent that constitutes non-adoption), while broadcasting the use of the very same aspect externally. This is a dynamic well established in institutional theory (Brunsson 1989; Meyer and Rowan 1977). Finally, a number of reports mention a lack of managerial support, with little buy-in from older generations of researchers, and a heavy focus on other concepts (such as scientific excellence) deemed more important.

4.3 Interchange Barriers to RRI Keys and Dimensions

In the group of interchange related barriers, the role of funding organisations, their requirements, standards and systems as well as national policies and expectations—or lack thereof—figure prominently. We discuss the role of funding organisations (including the EC) as a salient element in the environment of research organisations in the section on key findings in the study. Across RRI keys and dimensions, we find the following interchange barriers pronounced in the national reports:

- Lack of policies and clear mandates.
- Lack of clarity in various ways.
- Lack of perceived interest and pressure from the public and political field (including translation issues).
- Organisations not held accountable.
- Privacy and commercial interests.
- Other concepts dominate the public discourse (e.g. accountability or sustainability).

Lack of policies and clear mandates supporting RRI is widespread according to the reports and pertains to both research funding and research performing organisations. In some cases, disparate frameworks used by funding organisations (or across the same funding organisation) seem to alienate the researchers applying for funds and fuels a lack of clarity on what the key or process dimension is supposed to mean. In other cases, national legislation or other policy documents are at odds with each other, or mandates are unclear. Judging from the reports, it appears that national legislation and policies generally are rather fragmented, and often fail to address broader systemic issues in the science and innovation systems as these are understood according to the RRI concept. Across keys and types of organisations, it seems to be

the case that organisations are often not held accountable by national authorities on RRI aspects (keys and dimensions).

A group of barriers relate to the perceived lack of interest and pressure from wider environments of the organisations studied, including both structural and cultural aspects of the environment. For instance, many reports mention that the wider public is perceived as uninterested in what organisations do on science education, on the process dimensions, and on ethics. In some cases, even the national discourse on gender equality may seem to suggest that the broader public find this topic rather superfluous in today's society. In other cases, there are few external pressures, such as dedicated policies or funding schemes, that prioritise aspects of the RRI concept. This seems to be a broader systemic issue across the keys and dimensions. Likewise, national legislation in some cases changes rapidly, complicating compliance, and leading to confusion, or may not be in place at all. Lack of incentives also figure prominently across keys and types of organisations. In the interchange dimensions too, a lack of integration seems dominant. For instance, collaboration in the science system usually do not include the RRI keys or dimensions.

A further interchange related barrier is the general problem of translation. Either good translators of science to broader audiences are unavailable or not sufficiently skilled, or the translation of science to broader audiences is conceived of as difficult. This is pronounced in science education, but also appears as a barrier in other keys where communication to broader audiences outside the science field is required, such as public engagement and some of the process dimensions. As discussed in the section on cultural barriers, it is mentioned in several country reports that other concepts, such as accountability or sustainability, dominate the discourse (here the public discourse), leading to less emphasis on the RRI label. Finally, privacy and commercial interests curb development of several keys and dimensions. For instance, such interests at times create issues in relation to open access, as well as to the dimension Openness and Transparency. In general, such concerns are raised in connection with other public engagement types of activities, and where process dimensions (Responsiveness and Adaptation and Anticipation and Reflexivity) can support such types of efforts. Below, we discuss in further detail how barriers relate to the aspects of RRI overall in the study.

4.4 Interaction of Structural, Cultural and Interchange Related Barriers

Structural, cultural and interchange related barriers interact. In many cases, they mutually reinforce each other, thereby gaining strength. In some cases, barriers are both structural and interchange related, and in conflict. For instance, this happens when national legislation against differential treatment of groups leads to organisation-wide policies that fail to address structural disadvantage of some groups—such as women—as regulation or initiatives helping those groups would be

against the law. This issue is treated at length in the US report (Doezema and Guston 2018). In other cases, cultural barriers and interchange related barriers overlap. This happens when national culture reinforces organisational culture in some way relevant to the RRI keys or dimensions. Gender again provides a good example. We also find notions of the general public not understanding science as a cultural barrier to science education in both the national contexts and the organisational contexts. Similarly, the new political agenda in the US, Brazil and the UK, and corresponding new laws and policy enforcement, have had implications for several of the keys and dimensions. In the US case, gender and diversity seem to be under attack, but the general discredit of science has importance too for other RRI keys, and support for the RRI dimensions seems significantly downplayed in the current climate. Likewise, science is perceived as under treat in a Brazilian context, but here it leads to a strong focus among scientists on preservation of independence (see Brazil report (Reyes-Galindo and Monteiro 2018)). In the UK context, Brexit appears to reinforce an economic growth-oriented science policy agenda which is detrimental to the RRI dimensions, as well as having potential consequences for individual keys, such as science education and possibly research ethics, as power dynamics between industry and researchers shift, and time is seen as scarce by researchers (see UK report (Pansera and Owen 2018)).

4.5 Discussion on Type of Organisation and Embedding

In this section, we return to the research questions on barriers to RRI across keys and dimensions.

Research performing versus research funding organisations

In the section on RRI drivers, we noticed that most drivers cut across RRI dimensions. This is equally true for the RRI keys, although differences are more pronounced. We notice several differences, most of which relate to the differing functions of research funding and performing organisations. These differences are important to current debates, as they showcase structural issues in the current science system, and in particular issues stemming from current ideas of what excellence in science is. Often cited barriers across RRI keys and dimensions that are significantly more pronounced in research performing organisations are:

- Lack of rewards and incentives promoting RRI.
- Lack of time to prioritize RRI aspects in the work.
- Focus on science production, i.e. output mainly in the form of scientific papers.
- Negative experience of bureaucracy, and of RRI as contributing to bureaucracy.
- Aspects of RRI seen as a 'luxury,' external to science, or to be outsourced to third parties.
- The need to protect the independence of research, and RRI as a potential treat in this regard.

- The risk of questioning the status of science (already under pressure) through RRI.
- RRI is not part of the curriculum/lack of training in RRI.
- Pressure from market forces/industry collaborators counteracting RRI aspects.
- No institutional home for RRI aspects or perceived fragmentation in efforts.
- Culture of academia, organisation or country counteracting RRI.

Most of these barriers are apparent across RRI aspects, but some are more pronounced with specific keys. Most clearly, the issue of fragmentation and the lack of an institutional home is cited often in connection with the Societal Engagement and Science Education keys. Similarly, 'cultural' explanations of barriers stand out (comparatively) in the Gender and Diversity key but are also comparatively prominent in the Open Access and the Societal Engagement key. Some of these differences may be attributed to the organisation of large-scale universities and to the current understanding of (quantifiable evidence of) academic excellence, installed in those organisations. Considering in detail salient differences between research funding and research performing organisations, we notice that funding organisations in our study experience comparatively fewer *drivers* in some aspects of the RRI concept. With regards to barriers, this pattern is even more salient and research funding organisations experience:

- Comparatively fewer barriers in the Anticipation and Reflexivity dimension.
- Comparatively fewer barriers in the Societal Engagement key.
- Comparatively fewer barriers in the Science Education key.

For the Societal Engagement and Science Education keys, this suggests that funding organisations could do more. The lack of drivers suggests that even with few barriers the motivation to implement these RRI aspects is lacking. Our impression is that research performing organisations have activities in these keys, but receive little support from research funders to instigate initiatives. Researchers may be responding to policy signals on these dimensions, but without support from research funders. The lack of incentives, rewards, and time to pursue anticipation and reflection, societal engagement, and science education are cited barriers that appear significant for researchers. Research funding organisations have the capacity to provide drivers to mitigate these barriers, and significantly change the way research is evaluated, but may not act on this opportunity until such expectations are laid on them. In other words, while gender and diversity and open access issues are well established in the science system, similar debates on the capacity to foster anticipation and reflection, as well as sustaining and developing societal engagement and science education are far less pronounced.

The data also suggest barriers that are more salient for research funding organisations than for research performing organisations. These centre on governance aspects such as:

- Lack of mandates in relation to RRI keys and dimensions.
- Lack of opportunities for follow-up and for the monitoring of funded activities.

While the former can be addressed through national and local policies, the latter are less easily resolved, not least due to the complexities associated with effective monitoring, where effects may only be spuriously connected to concrete activities (Pawson 2006). This is a known issue when considering institutional change (Dacin et al. 2002; Beunen and Patterson 2019). The finding is striking, as research funders appear to experience about the same level of barriers in the well-established cases of ethics and gender, where initiatives with impact do exist. Where research performers' mentions of barriers cluster around certain themes, the variation and spread in barriers mentioned is much larger for research funders. With neo-institutional theory in mind, this finding points to research funders being much less restricted in their organizational form than research performers (DiMaggio and Powell 1983). I.e. research performers around the globe may answer to much more restricted and clearly defined norms and expectations about their undertakings and organisation than research funders do. If this is correct, inserting institutional change should be significantly easier to commence with funding organizations, than with research performers, as the latter requires change of well-established norms on a global scale. The fact that science since the Middle Ages has been a transnational and highly institutionalised phenomenon supports this idea.

Differences between small and large organisations

In discussing drivers for RRI, we showed that the large universities in our sample had been active in pursuing gender equality and diversity. We do not see parallel patterns in our analysis of barriers, but with one exception:

- Large scale professional bureaucracies experience coordination issues.

This is a known problem in the management literature (Bach and Wegrich 2019). As we argue, large-scale professional bureaucracies, and archetypically the traditional university (Mintzberg 1979), pose both barriers and opportunities for RRI. In our sample, some of the funding organisations qualify as large-scale professional bureaucracies too due to their organisational form (e.g. the Helmholz Association (HFG), and Fondazione Telethon). In these organisations barriers relate to:

- Scattered initiatives across various RRI keys and dimensions.
- Lack of centralized coordination.

This type of barrier appears pronounced for the Societal Engagement and the Science Education keys, as captured in the German national report (Hahn et al. 2018, p. 42):

> The main obstacle for science education is the lack of a cross-KIT, integrative strategic concept and communication structures. Because many activities arise bottom-up, they are highly detached from each other. […] Respondents critically formulated that existing experiences are not recognised although they exist. Cooperation and synergies only take place within a limited framework on an individual basis […]. Respondents pointed out that this lack of communication also leads to competition between the individual units offering science education for funding and recognition.

The issue is not simply a lack of initiatives or coordination, but also a lack of visibility and recognition, as initiatives are not communicated across the organisation. In such circumstances, the institutional interchange dynamic remains weak; the activity internal to the organisation does not succeed in raising external pressures through the nurturing of expectations. If other organisational members were aware of the activities taking place, they may conceive of the organisation as a place where science education is a norm and feel a pressure to conform in their own practices.

Differences with respect to fields of research and funding

Our sample ranged from universities and funding providers oriented to the natural sciences and technology, to classical universities and broad-spectrum national funders. Differences between these groups are not clear-cut although there are pockets of differences, particularly with regards to the Open Access and Open Science key and the Societal Engagement key. In particular, science and technology-oriented organisations tend to cite the following as barriers to open access, open science and societal engagement activities:

- Complaints about the lack of institutional embedding.
- Issues springing from industry collaborations.
- Issues with intellectual property rights.
- Lack of incentives.
- General doubts about the RRI concept.

Conversely, broad-spectrum research funding and performing organisations express more general barriers, such as:

- Tensions between 'curiosity driven' research and application-oriented research.
- Lack of skills and training.
- General lack of awareness.

While these tendencies are not clear-cut in our data, they do point to RRI as addressing general debates in the science and technology field. Broad research performers such as classical universities focus on broader issues and are generally less concerned about current discussions in the science and technology field than the more technology-oriented ones. This observation raises the question of how RRI may be profiled to better suit concerns of large scale universities.

Differences in RRI attitudes related to national embedding

As in the case of RRI drivers, establishing meaningful clustering of countries in their shared perspectives of barriers to RRI is not easy. One such clustering is that of 'old' industrial Western economies (Western Europe, US, Australia) compared to newer and more emerging economies (Brazil, China, India). Ethics appear to be a topic of less concern for emerging economies than for the core of old industrialised countries, with strong economies and infrastructure. Similarly, among research performers, a male dominated culture as a barrier to gender equality and diversity is mentioned only in reports from old industrialised countries. We suggest this implies higher levels

of attention to *cultural issues* with regards to gender issues in old well-established economies, where gender perspectives have been on the agenda since the early 1900. In the Science Education key, research performing organisations in old industrialized countries expressed greater concerns on:

- Lack of coordination.
- Lack of shared approach.
- Scattered initiatives.
- Lack of management focus.

This pattern, however, does not carry over to the Societal Engagement key, where the same organisations cited the lack of financial resources as a significant barrier. In the Open Access and Open Science key, we find 'engrained habits' of researchers as a commonly cited barrier (amongst others). Taken together these findings may reflect organisations who have more established science systems, and more experience of organising research in society. Overall, we suggest that these findings reflect high expectations with respect to results from change initiatives emanating from RRI, in the group of old industrialised countries, rather than the comparative level of conduct for this group of countries. Hence, these results reflect expectations of proper organization in well-established systems, rather than the current level of affairs. Such experience and expectation may function as a barrier as well as a driver for RRI.

What difference does formal recognition of RRI as a term make?

In the Chapter on drivers, we outlined how organisations that both are familiar with and that use the RRI term, mentioned comparatively a greater diversity of drivers, and that these often were more specific. In the analysis of barriers, our analysis suggests that the kinds of barriers are more technical in organisations where the term is in use. For instance, with regards to societal engagement, the UK national report mentions that maximizing influence is not accomplished most effectively through societal engagement activities, that self-selection in who participates in societal engagement activities is a problem for the democratic ideal expressed through the key, and that preference for gold open access can be a barrier for green open access. Similarly, the Dutch national report discusses difficulties in monitoring open access from the viewpoint of funders, as publications often are written only after projects have ended (van der Molen et al. 2018). The Norwegian report discusses funders' challenges in balancing a rigid implementation ethos with a more flexible and listening approach when communicating the open access and open science key with research performing organisations (Egeland et al. 2018).

4.6 Conclusion and Reflections on Barriers to RRI

Just as structural drivers were the most important in explaining successful RRI practices, structural barriers were also the most important in explaining impediments. Where structural drivers are in place, for example, in relation to ethics, gender

and open access, these practices emerge and flourish. Where there are no structural drivers, for example, for the process dimension and for societal engagement, attempts to develop initiatives become fragmented. Not having a formal policy on an RRI aspect is in itself a barrier, as there will be a lack of incentives for a practice. Moreover, there will be counterincentives, such as strong incentives for scientific production (e.g. for published papers), which remain in tension with RRI policy signals or incentives, such as those aimed at promoting societal engagement. The dominant barriers identified in the project are: the lack of resources in the form of money, time, people, training for expertise; the lack of incentives; and the lack of strategies, policies, frameworks, systems and formal structures to support RRI. Fragmentation is a further barrier, arising on account of organisational complexity, and to the configuration of the RRI as an umbrella concept, with disparate keys having multiple institutional homes, such as gender and diversity offices, ethics committees, and outreach offices. We discuss fragmentation both as a barrier and as an opportunity in Chap. 5.

In Chap. 3 we saw that cultural drivers for RRI are less prominent than structural and interchange drivers. This was not the case for barriers, where respondents commonly cited the prioritisation of excellence in the form of producing e.g. papers over societal impact as a significant cultural barrier. Coupled with structural barriers, there remain significant hurdles for those RRI aspects that are not mandated in law or incentivised by funding policy and programmes. Other prominent cultural barriers are lack of knowledge and awareness, RRI perceived as an 'add-on' activity to scientific practice, the prevalence of classical values of autonomy and merit in the academy, narrow and economistic ideas on innovation and finally a lack of clarity on what RRI is.

The main interchange barriers relate to the lack of policy and mandate, lack of clarity on multiple dimensions, lack of perceived interest from external stakeholders, the absence of pressure from the external environment of the organisation (including policy makers), the lack of accountability for compliance with RRI aspects, tensions between RRI and privacy and commercial interests, and competition with other concepts dominating national discourse. This rather broad spectrum of barriers appears to cut across types of organisations. In many cases we find that there is no policy (interchange related structure) on societal engagement at the national level, because there is no culture at the national level for considering this aspect of RRI. Moreover, cultural barriers at the national level can also be mirrored in the culture of the organisations; culture emanates from country to organisation (Hofstede 1980). So, the lack of a driver cam be manifest in all of Scott's three levels, and this unsurprisingly functions as a significant barrier. Where barriers are manifest across Scott's dimensions, we believe change agents have a difficult or even impossible job. If there, in addition, are no or few drivers, which can be utilised in order to gain legitimacy for RRI aspects, we believe change is unlikely.

To break this cycle and to strengthen relevant RRI aspects, a cultural shift is necessary, facilitated perhaps by public communication campaigns to inform the political and organisational discourse. The European Commission could further support the institutional RRI agenda by working to influence the attitudes of key stakeholder

organisations in the European Research Area and public perceptions in European member states. However, this is in itself a difficult task (as evidenced by Brexit and similar movements in members states) and influencing public perceptions outside Europe is even more challenging. The current EC strategy of trying to influence local RRI cultures by experiments in a few research organisations may be only partially effective, but anecdotal evidence from the RRI-Practice project—as well as institutionalist scholarship—show that learning effects can be significant. Such learning effects can be difficult to measure in the kind of empirical work conducted here but should not be disregarded.

Finally, a word on RRI as "*an approach to research and innovation where 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*".[1] It is relevant to observe that national legislation and policies generally do not appear to address broader systemic challenges in the science and innovation system, and instead tend to focus on individual RRI keys in isolation. If RRI is seen as an integrative approach to the relation between science and society, there is a need to emphasize this overall perspective rather than focusing narrowly on the keys. Moreover, the policy focus should be kept over time, with necessary adjustments and updates, as we have seen that a barrier to RRI is rapid change in policy concepts, potentially leading to confusion. Likewise, trying to measure effects too early is a barrier to RRI, as such organisational changes supporting RRI require time to work in practice and get institutionalised.

In terms of differences between types of organisations, we find that research performing organisations experience some drivers more saliently, most likely due to their organisation and function. While this is true across keys and dimensions, the issue of fragmentation and lack of institutional home is cited often in connection with the Societal Engagement key and Science Education key. Similarly, 'cultural' explanations of barriers stand out (comparatively) in the Gender and Diversity key. The impact of current definitions of scientific excellence also appear to cast long shadows on the ability of researchers to undertake other tasks than the ones already rewarded and measured as part of the current production regime. In Chap. 3, we found fewer drivers for the Anticipation and Reflexivity dimension, the Societal Engagement key and the Science Education key for research funding organisations than for research performing organisations. This pattern is mirrored symmetrically in the analysis of barriers, possibly due to a lower level of activity and knowledge among research funders in our sample. Conversely, the lack of mandates and opportunities for follow-up appear more pronounced as barriers among research funders. Unsurprisingly, we find that the classical coordination issues of professional bureaucracies are more pronounced among large scale universities. Science and technology-oriented research performers and funding providers appear to experience more saliently a handful of barriers, which leads us to suggest that they may overall have more experience with, or just be closer to the discourse of RRI.

[1] https://ec.europa.eu/research/swafs/index.cfm?pg=about Accessed 27 May 2020.

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Chapter 5
Key Findings in the Organisational Study

Abstract In this chapter, we build on and extend the discussion on how we may further the implementation of Responsible Research and Innovation across types of organizations. We consider first the structure of universities as a driver and barrier for RRI, using Mintzberg's study on the structure of organisations with an emphasis on expert bureaucracies; second, we consider academic culture as a barrier and opportunity for RRI, using Schein's layered model of organizational culture; and third, we discuss isomorphism and the role of funding organisations as a salient environment for research performing organisations, using core insights from neo-institutional theory.

Keywords Responsible research and innovation · Organisational structure · Expert bureaucracies · Organisational culture · Organisations as open systems, isomorphism · Neo-institutional theory · Organisational change · Implementation

5.1 The Structure of Universities as Barrier and Driver for RRI

In Chap. 4 we discussed how structural organisational fragmentation operated as a barrier to RRI uptake. We also showed how norms and values of academic freedom and scientific autonomy may operate as a barrier to RRI, though the same professional culture can support aspects of RRI through convergence of ideals about the role of the scientist in society. The organisational structure of universities is in many ways the mirror image of norms and values of academic freedom. While the organisation may be fragmented by design, it also poses openings for the pursuit of RRI, we suggest. In this section, we explore this issue using Mintzberg's (1979) typology of organisations as a prism.

The Canadian management scholar Henry Mintzberg proposed five typologies of organisations organisational forms—or structures (Mintzberg 1979). One of these typologies is the 'professional bureaucracy,' that includes universities, professional consulting firms, government agencies and hospitals. Such organisations generally have a high degree of local discretion in organisation and decision-making, and the workforce a high level of autonomy. Although modern reforms have put

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this autonomy under pressure in the case of universities, the professional bureaucracy typically relies on standardised skills and professional norms for its organisation, rather than on the standardised organisation of work processes (Enders 2015). The professional bureaucracy depends on trained professionals, such as professors, lawyers, accountants, doctors, political scientists, and economists for their operation. Therefore, even though professional bureaucracies are hierarchical in structure, power to a high degree lies with these professionals (Hewitt 2015). These features make wholesale organisational reform and standardisation difficult, but it also creates pockets for RRI initiatives to flourish, precisely because academic professionals work relatively independently, with a high degree of discretion, and in a system where hierarchical control is blurred (Enders 2015). Mintzberg has identified 5 generic parts that all organisations comprise:

- The strategic apex
- The middle line
- The technostructure
- The support staff
- The operating core

The strategic apex comprises the broad of directors, the president, executive committee, and the president's staff. The middle line comprises managers in the traditional silos of organisations, such as operations, marketing, plant managers, regional sales managers, as well as middle managers of various units. In universities, these would be department and institute heads, leaders of laboratories and research centres, and managers of the technostructure and support staff (see below). In Mintzberg's terms, the technostructure is occupied by specialists overseeing the strategic planning, personnel training and HR personnel, finances, library services, and so on, whereas the support staff are conceptualized as the parts of the organisation taking care of indirect services, outside the operating work flow, such as payroll, public relations, reception, building maintenance, cafeterias, and in the case of universities also the university press, bookstores, and student services (Mintzberg 1979, p. 31). Whereas the technostructure in most organisations sets the standards for *how the organisation should operate and how work is organised*, the technostructure traditionally enjoys a low status among members of the operating core of professional bureaucracies (Mintzberg 1979). Additionally, in professional bureaucracies, the operating core is by far the largest and most important part of the organisation, and members of the operating core typically maintain personal relations with the main clients (such as students or client organisations in the case of research performing organisations). At universities, how one conducts research and teaching is governed less by organisational routines than by the training of academics, and other means of inculcating a professional ethos. To qualify as a member of a professional bureaucracy:

> [t]he initial training typically takes place over a period of years in a university or special institution.[…] There typically follows a long period of on-the-job training, such as internship […]. Here the formal knowledge is applied and the practice of the skills perfected, under

> the close supervision of members of the profession. On-the-job training also completes the process of indoctrination, which began during the formal teaching. (Mintzberg 1979, p. 350)

Universities are difficult to change in a top-down manner precisely because the strategic apex has a low span of control, the technostructure does not detail how the work should be carried out, and enjoys low credibility, and the work of the operating core is governed by academic ethos, rather than precise specifications of the work. Where organisational change in most organisations would be instigated through the technostructure, this is inherently difficult to obtain at universities, and in most cases will not be welcomed in the operating core:

> organisational change takes place mainly through continuous local adjustments, while major change is difficult to achieve. Central organisational policies are often responsive rather than proactive, and interventions on this basis may have only minor, local effects. (Enders 2015, p. 845)

Many authors of national reports cite fragmentation as a barrier to RRI in the organisations studied, and lament that activities are uncoordinated. Characteristically, the issue cuts across RRI keys and dimensions, though possibly less pronounced in the case of the Gender and Diversity key. However, professional bureaucracies are known for coordination issues, since coordination is obtained mainly through the professional ethos and the fact that: "*the system works because everyone knows everyone else knows roughly what to go on…*" (Weick 1976, p. 14). We suggest that the salient way to remedy issues experienced as coordination problems and fragmentation is not necessarily through top-down attempts at coordination, but rather through mobilization, broadcasting of ideas, and a distributed organisation. In organisational terms, such strategy entails:

- Clear anchorage with top management, wherever possible.
- Focused activities (which can later be scaled up), rather than broad-scale change.
- Lean centralized coordination with clear anchorage in the technostructure.
- Broadcasting of initiatives taken in the operating core to the organisation, as well as to the environment of the organisation (to create interchange pressure).
- Local organisation and anchorage in the operation core, commencing with initiatives in units favourable to the idea.

While such a recipe circumscribes ideal circumstances, it is equally clear that the organisation of universities can enable change to come from the operating core of the organisation, because institutes, departments, and research centres have significant latitude in their organisation. This is captured well in the US national report:

> For these interviewees, leadership could drive ethical debate, collaboration across centers, and anticipatory work. When asked if there were any turning points in the history of the Institute [Biodesign, a research unit at Arizona State University] in how issues of responsibility had been dealt with, the nearly universal response was to point to changes in leadership that had taken place in the past. Most pointed to an influential and charismatic previous institute director, who had particular vision and personal qualities that allowed him to do what no one since has achieved as far as vision and collaboration. (Doezema and Guston 2018, p. 49)

In the absence of line and command instigated change from the top of the organisation, the key to obtain change is mobilisation, not coordination (Soule 2012; Strang and Jung 2005). In designing successful initiatives, it is possibly advisable to keep in mind that an effective framing is key to the persistence of ideas on 'how to manage' an organisation (Benders et al. 2019). Based on findings in the RRI-Practice study, and our discussion of RRI as an umbrella concept in Chap. 4, we suggest that RRI initiatives in organisations are likely are best served by connecting the integrated RRI concept to the keys or dimensions that already have traction in the organisation.

5.2 Academic Culture as a Barrier and Opportunity for RRI

We have seen above how traditional elements of academic culture can curb the practice of RRI related keys and dimensions. However, we have also seen how academic culture can also support keys and dimensions. The barriers to RRI, found in academic culture, hinges on two main dimensions in our data: the protection of academic freedom to pursue research without outside intervention; and the pursuit of academic excellence, as currently defined by measures adhered to in the field, dominated by successful publications in top tier journals. These barriers inhibit the diffusion of all keys, and appear a potent cocktail in organisations where there is a high pressure against scientific freedom from the organisational environment; and where is a high workload and consequently no time for 'add ons' to current work commitments.

These findings set out three challenges for advancing RRI which, to date, have not been adequately answered in national or European policymaking:

1. How can RRI—or elements of RRI—be positioned credibly as compatible with academic freedom in ways that mitigate against a (mis)perception of the concept as posing a form of political interference and a threat to scientific freedom?
2. How can RRI be incorporated into definitions, framings, and accompanying reward structures of scientific excellence?
3. How can academic work be organised in ways that frees up resources for the pursuit of RRI keys and dimensions?

In ten out of twelve reports, academic culture is discussed as a driver for aspects of RRI (keys or dimensions), and all aspects are covered. For example, the Brazil national report states:

> The idea of public that pervades the institution is a powerful driver to seek institutional innovations towards more inclusion, more intense engagement, and increasing transparency. (Reyes-Galindo and Monteiro 2018, p. 49)

Discussing drivers for the gender equality and diversity key, the Italian national report notes: "*The refusal of any type of discrimination is part of the values of the University, both as described in the University's Bylaws and Codes of Ethics.*"

(Neresini and Arnaldi 2018, p. 38) Later, in discussing open access and open science, the Italian national report continues: "*Finally, respondents emphasize the ethical case for Open data and Open access. From this point of view, sharing data is seen as a constitutive part of the professional identity and deontology.*" (ibid, p. 40) And, as a final example, the Bulgarian national report discusses drivers for the Ethics key: "*Shared perception of ethics as a pillar of research excellence and research quality; internalised moral/professional responsibilities toward dealing with socially sensitive topics among management and research staff.*" (Damianova et al. 2018, p. 35).

We discussed in Chap. 3 that (organisational) culture is likely to be insufficient as a driver for RRI, and that combinations of structural, cultural and/or interchange related drivers are typically necessary to foster institutional change. This is captured in the Indian national report, in discussing the conditions for research ethics:

> The notion that funding for science should be done in a professional manner and should be free of biases is a cultural factor that gives legitimacy to such policies. The adoption of this policy is necessary but not sufficient. Only a comprehensive policy will make a difference and be a game changer. (Srinivas et al. 2018, p. 60)

We do find examples where cultural dimensions driving RRI are integrated into policy, such as in the Chinese national report (Zhao et al. 2018, p. 70).

> The openness and the transparency have been covered in the 13th Five-Year Plan of NSFC. The specific sectors are responsible for the open access. The fund sharing service network and basic research knowledge base have been built. So traditionally, the openness and the transparency are critical parts of the culture in NSFC.

Still we have seen examples where institutionalized reward systems act as barriers to aspects of RRI, as reported in the Dutch national report:

> There is a fundamental tension between WUR's institutional culture and its institutional structure when it comes to societal value. On the one hand, both WUR and its scientists are driven, often quite explicitly and vocally, by the desire to create societal value. On the other hand, formal reward mechanisms at WUR, while not disconnected from societal value, are not sufficiently aligned with it. As one interviewee put it, WU basically rewards its researchers for high-impact publications, and WR rewards them for project acquisition. (van der Molen et al. 2018, p. 53).

We hasten to say that this is by no means a problem only experienced at Wageningen University and Research, but rather a problem related to RRI being at odds with current governance and reward systems in academia at large.

We now dive deeper into Schein's (2010) theory of organisational culture as having three layers:

1. Artefacts.
2. Espoused Values and Beliefs.
3. Basic Underlying Assumptions.

Artefacts are visible and sentient structures and processes and observed behaviour. They are easy to observe but difficult to decipher. Espoused values and beliefs are ideals, goals, values, and aspirations, ideologies and rationalities. However, just as consumer attitude surveys tell us about preferences and not actual behaviour, espoused values in an organisations culture do not provide a coherent picture of what governs choices by organisational members. According to Schein, the choices are largely governed by basic underlying assumptions. These are often unconscious, taken-for-granted beliefs and values that determine behaviour, perception, thought, and feeling. An important point is that the three layers of organisational culture may not necessarily be aligned as a consistent whole. It is for instance possible to impose artefacts, while not changing basic underlying assumptions. Likewise, espoused values are susceptible to interchange pressures; organisational members may well support progressive values in society or new trends, without actually supporting those values as part of their taken-for-granted belief system, and unconscious reactions.

What we have surveyed in the RRI-Practice project with respect to organisational culture is largely at the level of the artefacts and espoused values and beliefs. We do, however, believe that some of the espoused values we have cited from national reports above, do in fact point to basic underlying assumptions in academic culture. In other words, we suggest that academic culture possesses some basic underlying assumptions that are drivers of RRI, while, at the same time, some elements of academic culture at the level of artefacts (including incumbent finance models and publication requirements), and espoused values (including goals on high impact publications as an indicator of excellence) act as barriers to RRI. We further suggest that current artefacts and espoused values in academia have themselves been transformed by external shocks, including new finance models in the wake of New Public Management reforms in the governance of universities and the research sector, and this has created tensions with traditional academic norms and values. Thus, academic culture may offer opportunities for advancing RRI.

Schein (2010) proposes that organisational cultures change in three stages. In Stage 1, the current ways of doing things in the organisation suffer delegitimation leading to anxiety or guilt, possibly from a scandal or a large-scale merger. During this stage, organisations need to create psychological security to overcome learning anxiety, to unfreeze current perspectives by developing strategies that may include the hiring of new staff with new perspectives. Stage 2 is characterized by the imitation of, and identification with, role models, or by scanning the environment for solutions and trial-and-error learning cycles. The important aspect of this stage is that new concepts are learned, and that old concepts—and ways of thinking and doing—acquire new meaning. Finally, Stage 3 entails the incorporation of newly acquired learning and ideas into organisational forms, including members' newly developed concept of self, role and identity. This new learning and standards are then embedded into on-going relationships, based on confirmation from experience that the change has been worthwhile.

Our data from the RRI-Practice project suggest that some organisations experience a disconfirmation of current ways of operating and mentions of scandals external to the surveyed organisations figure as drivers. However, a widespread disconfirmation

of the science system, not to speak of anxiety or guilt, does not currently appear on the horizon. The learning of new concepts by imitation of 'role model organisations', as well as the scanning of the organisational environment and trial-and error learning processes, do occur in some instances. For instance, the efforts to develop and introduce the RRI AREA framework at the British EPSRC funding organisation has served as an example to emulate for the Research Council of Norway. While the development of RRI in the Dutch NWO may have been spurred by several scandals in Dutch academia (see the Dutch national report), the Norwegian case appears driven by visionary internal change agents combined with external assessments pointing to a need for change. Conversely, developing the AREA framework at the EPSRC itself was to a large extent the outcome of a series of realizations connected to funded projects that created serious concerns for the organisation (Owen 2014; Macnaghten and Owen 2011).[1] Similarly, as we have seen, many reports mention international collaborations as pathways of influence, promoting new ideas that are aligned with RRI aspects. Learning through imitation and the wish to join the club of progressive research organisations adhering to RRI appears to have some currency. The EC (and European policies) is a label that has not lost its cachet—at least for countries that are not at the centre of European policymaking.

In contrast, the internalisation of new concepts, meanings, and standards appears embryonic in our data for most organisations studied. Even the EPSRC is still in a process of scanning and trial-and-error learning. Institutional change takes time, and—we suggest—still requires a significant and continuous policy pressure, if RRI is to succeed as an organisational concept in the science, technology and innovation (STI) system (Owen et al. 2019). Changing organisational cultures requires that the bulk of organisational members engages in what is known as 'double loop' learning (Schein 2010). In other words, organisational members must change their mental models, and come to question the way they have previously solved problems—in our case problems of relevance to the RRI concept. This is the fundamental requirement for changing what Argyris and Schön (1978, 1974) called theories-in-use (as opposed to 'espoused theories'), again in relation to actions and choices of relevance to the many aspects of RRI. It appears, there is still a long way before such change is widespread among organizational members in our sample of organisations and institutionalised in the science and innovation system.

5.3 Isomorphism and Funding Organisations as Environment

A core finding in our study is the extent to which organisations across typologies respond to policy signals. The most salient of these responses regards funding, in the sense that large scale universities, and other research organisations, depend on basic state funding (that may partly be indicator based) as well as competitive research

[1] Details of the ESPRC case can be found in the RRI handbook (Wittrock and Forsberg 2019).

funding. The requirements of funding organisations appear to have major import on the organisation and culture of research organisations. Therefore, the EC and national funding organisations have the potential to significantly alter the current landscape in the science system. In short, money talks, and our findings indicate that the values and logics promoted by the way funders organise their grants and calls for proposals, trickle down into research performing organisations beyond the people and organisational units directly affected.

This finding resonates with the central insight of neo-institutional theory, namely that organisations are influenced by their environments in profound ways. However, that the requirements of funding organisations appear to trickle down in research organisations is a potentially important finding. Neo-institutional theory views organisations as comprised of many actors, capable of semiautonomous action and decision-making. In our study, this is evidenced by the presence of many local, but scattered initiatives furthering RRI, even in cases where management may not promote RRI in any particular way. As Scott and Davis claim: "*The open systems view of organisational structure stresses the complexity and variability of the parts – both individual participants and subgroups – as well as the looseness of connections among them.*" (Scott and Davis 2007, p. 106). While organisational parts are interdependent, they are also at the same time loosely coupled. Therefore, the trickling down of funding providers' requirements are akin to organisational coordination, likely achieved through organisational (academic) culture, and peer to peer learning, as discussed above. Academic culture may be a barrier to RRI, but it is also a coordination mechanism, which appears to promote the type of ethos that funders communicate to their applicants.

Neo-institutionalism is traditionally concerned with various types of (perceived) pressures and how they play out in organisations of all kinds (Scott 2014). Such pressures drive organisational change, as the organisation adjusts to its environment. In their seminal paper, DiMaggio and Powell (1983) identifies three such types of pressures or mechanisms of change:

- Coercive mechanisms.
- Mimetic mechanisms.
- Normative mechanisms.

The distinction is an analytic one, in practice there may be overlaps between the three mechanisms. Since pressures stems from the environment of the organisations, being in the same institutional environment drives isomorphism. Hence, we would expect for instance large scale research performing organisations to be organised in more or less the same way, as they all respond to the global science system as their most significant environment, other than the particular nation in which they are situated, and—as shown in this book—to their national funding organisations. In the following we discuss the three forces potentially driving organisational change with respect to our findings. We pay special attention to the role of research funders as a salient influence on research performing organisations.

Coercive institutional forces stem from formal and informal pressures, political influence, cultural expectations and the legal environment (DiMaggio and Powell 1983). These pressures are premised on the organisations' need to obtain and maintain legitimacy. Such pressures either promote or work as barriers to a given concept. In our project, we see that national as well as academic cultural expectations have major import on organisations and sometimes hinder, sometimes further, aspects of RRI. We see that current definitions of, and measurement of, academic excellence institutionalized in the science system is a major barrier to all RRI keys, while political pressure furthers the implementation of keys in other ways. Crucially, absence of political or other pressures to adopt keys appears to be a significant barrier. Coercive mechanisms may be legally sanctioned. This is an important driver for RRI in the case of the Gender and Diversity key and the Ethics key. Legal frameworks and statutory instruments supporting open access and open science are nascent in some countries, whereas societal engagement and science education receive less pressure from legal frameworks. It appears that this trend is mirrored in most funding providers' attention to RRI keys and consequently in their requirements for funding applications. As funding providers in our sample most often are policy organisations, they organise in a way that supports national and/or EC frameworks. Therefore, research performing organisations may be both directly impacted by legislation, as well as indirectly through coercive forces from funding organisations.

> The main driver for preserving gender equality remains the legislation, although there is increasing awareness across the society about the need to actively uphold equal opportunities for women and men, often provoked by comparison with other EU member states. (Bulgaria report, p. 61).

This appears to be the case with respect to the gender equality and ethics in particular and is a strong driver for RRI aspects in general. The mimetic mechanism of diffusion is characterized by pressures of uncertainty. Uncertainty—when it is not clear what to do, or how to approach an apparent issue—lead organisations to copy behaviour, or use models, of other organisations. Typically, the organisations emulated are perceived to be more successful or more legitimate (DiMaggio and Powell 1983). Mimetic forces are also amplified under circumstances where it is clear that other successful organisations use particular strategies, concepts, or the like. This is also the case at country level between funding organisations:

> There is also pressure coming from the cooperation with other foreign institutions. Since the internationalization of the fund's management is one of the critical tasks for NSFC. To cater to the global gender equality movement, the level of gender equality awareness and attention has become a significant indicator for internationalization, which requires improvement on practical policies and measures. (China report, p. 66).

As mentioned above, it appears that the EPSRC in the UK has exerted significant influence on the way the Research Council of Norway has approached RRI. We also find descriptions of mimetic forces at play between research organisations, as discussed above. The perceived leaders in the global research system are being monitored and inspires organisations in other parts or the world. As such, gaining RRI

advocates within prestigious university networks, such as the League of European Research Universities (LERU) may be highly effective for spreading RRI through mimetic mechanisms. However, it is not clear that there is a high level of perceived uncertainty leading organisations to look for other organisations to emulate, as discussed above in the section on cultural change.

Normative institutional forces come from pressures to professionalize in accordance with normative rules of professional and organisational behaviour. Such normative rules and frameworks may be developed by transnational organisations (EU for instance). RRI is an example of such a framework, although it still lacks the cachet of a widespread fashionable concept:

> An external relevant driver is the way FAPESP values international connectedness to global practices. If RRI becomes part of a global discourse and is adopted as a global standard by internationally renowned funders, this would be a strong incentive for RRI to become more explicitly present in internal practices; more explicitly that is, as managers generally perceive that RRI keys as already being present in existing practices, albeit in local specific ways. (Brazil report, p. 66).

We also see that funding organisations influence research organisations in a rather direct manner:

> UNICAMP, for example, is in the process of establishing its own code of good practices and this was in part a response to FAPESP's demands, which shows the great impact of FAPESP's policies as a push towards specific forms of regulating science at the highest levels. (Brazil report, p. 69).

Note that the Brazil example shows the chain of influence: International norms impact funding organisations, which in turn impact national research performers. We have discussed elsewhere how the 'old industrialized' countries at the centre of European decision-making appear less concerned with external pressures from e.g. the EC. However, the normative influence exerted by funding providers over research performers is also present in these leading countries:

> Regarding research integrity, the guidelines of the German Research Association (DFG) to ensuring good research practice were the basis for the guidelines done by the HGF in 1998, which can be seen as a main driver in this area. (Hahn et al. 2018, p. 56).

However, all normative pressures promoting RRI aspects are competing with other frameworks providing normative pressure. These may stem from funding providers, or other stakeholders and actors in the science system. Other stakeholders and actors providing normative rules are ministries providing government basic funding and professional associations and networks (Scott and Davis 2007). Normative rules of e.g. good scientific conduct external to RRI may similarly be adopted by funding organisations. Throughout the data, we see tensions between excellence criteria, premised on maximizing grants and publications on the one hand, and making room for adherence to RRI aspects on the other. As funding organisations increasingly

adopt elements of RRI in the assessment criteria, while still adhering to the ruling definition of research excellence, the signals of normative forces to research performers are at times incoherent.

From the standpoint of promoting RRI, it is encouraging that we can identify coercive, mimetic and normative pressures in the data material. We hold though that RRI still has a week position among the many forces impacting research funding and research performing organisations in the science system, be they coercive, mimetic or normative.

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Part II
Comparison of National Discourses and Practices on RRI

Chapter 6
Introduction, Methodology and Data

Abstract In Part II of the book, we discuss the national discourses and practices researched in the project. In this chapter, we introduce the topic, the methodology and the theoretical framework used to analyse the data. Because the focus of this research is different from that of Part I—national discourses and practices rather than organisations—we use a different method and analytical framework, namely sociotechnical imaginaries. In Chap. 7, we identify imaginaries of science in each of participating country that we use to explain differences in RRI uptake at a national level. Due to the nature of the project and the data gathered, the focus will be largely on the 'science' part of the science, technology and innovation (STI) system, though we also reflect on the broader STI system, especially where the three elements are strongly linked. In Chap. 8, we discuss the lessons that we draw from comparing the imaginaries.

Keywords Sociotechnical imaginaries · Responsible research and innovation · Linear model · Science for society model · Systems of innovation model

6.1 Introduction

The RRI-Practice project has analysed RRI-related discourses and pathways to implementation in 23 organisations in 12 countries. While differences in those discourses and pathways can partly be accounted for by variation between institutions and research teams, another part has been dependent on factors that prevail at the national level that include national science policies and cultures of participation (see Davies and Horst 2015; Lukovics et al. 2017). At the same time, RRI is not a monolithic concept, but a collection of ideas that have been developed and designed to restructure the relation between science and society for particular reasons, and that can mean very different things, depending on context (Doezema et al. 2019). Hence, the main research question for this part of the book is: '*How can we understand the potential for the uptake of RRI in different national contexts?*'.

Answering this research question requires us to specify how we conceptualise 'national contexts' or 'national discourses and practices' for the purposes of our analysis. This conceptualisation should meet a number of requirements:

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- First, it needs to present a consistent and coherent picture of national contexts in which the STI system has evolved, preferably one that spans several decades (for example, for many Western countries, from the Second World War onwards), to show coherence as well as change over time, whether incrementally or suddenly, including the tensions or dilemmas that the system currently finds itself in.
- Second, it needs to be possible to develop the conceptualizations largely derived from the *available data set* (the RRI-Practice national reports). We would like to stress that identifying one 'national context', let alone comparing twelve, requires a degree of generalization and the inevitable blurring of nuance, specificity and local exceptions within each country. It also requires at least two layers of interpretation: those of the report authors and those of the authors of this book.
- Third, the conceptualizations should acknowledge that national contexts—and associated STI policy cultures—typically share elements that are both flexible and contingent as well as enduring. National STI policy contexts and cultures change over time, yet tend to be structured by and through more enduring cultural styles and tropes of governing.
- Finally, the conceptualizations have to offer *guidance to actions*. They should not only describe, but also be usable to derive prescriptions for implementing RRI, or at least, to lay out questions one should ask when intending to introduce RRI in a particular national context.

We now explain why we consider Jasanoff's (2015) *sociotechnical imaginaries* to fit our criteria, and how we use this framework to analyse our case studies, to show what RRI could mean for the national contexts studied.

6.2 Methodology

In this book, we use Jasanoff's *sociotechnical imaginaries* as our analytical framework for researching STI systems in different national contexts. Sociotechnical imaginaries are defined as "*collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology*" (Jasanoff 2015, p. 4). The concept of the sociotechnical imaginary has been developed following the assumption that sociotechnical systems (including national STI systems) are always embedded in a material, moral and social environment. Moreover, Jasanoff argues that the way in which these systems allow us to represent and gather knowledge about the world cannot be seen apart from the way in which we would like to live in our environment and organise it. STI systems, for example, are concerned with developing knowledge about and designing accurate models of the world. At the same time, concerns over issues such as societal responsibility influence research priorities and project designs.

Sociotechnical imaginaries recognise that STI systems across the world can adhere to similar values (e.g. those of validity and accuracy of knowledge claims) while being

subject to different incentives and pressures from the national contexts in which they operate. By highlighting this interplay between STI system and national context, the methodology allows us to *identify* where and how STI systems align with RRI ideas in distinct national contexts, and to *explain* why this is so. For Jasanoff (2015) comparisons are helpful to get a better understanding of both form and content of imaginaries, as they help us to distinguish the universal from the specific. Thus, the availability of the twelve national reports as comparative data sets facilitates the use of this particular methodology.

We offer one methodological caveat. To date, researchers have used the concept of the sociotechnical imaginary to explain why new *technologies/techniques* are received differently in different national contexts. The classic example is the one by Jasanoff and Kim (2009), who examine the effect of national imaginaries in understanding the reception of nuclear technology in South Korea and the US. We are using the concept to perform a slightly different function, namely, to examine why and how *a new model on the relation between science and society, namely, the 'RRI model'* is received differently in different national contexts.

Another point of divergence is that in our usage of sociotechnical imaginaries may not necessarily be *explicitly* held or articulated as such. Sometimes it may be necessary to *reconstruct* some of their aspects, if they are not codified in policy documents, but part of routines or informal arrangements. Finally, imaginaries may be more or less stable, and have more or less competition from other imaginaries. In our analysis, we assume that the imaginaries described in the national case study reports are relatively stable, though we do highlight significant ongoing changes and contestations within theses.

There is no formal method established in the literature to identify an imaginary; no checklist of characteristics to determine its capture. For our method we have considered several characteristics investigated both in earlier work comparing biotechnological innovations across jurisdictions (Jasanoff 2005)[1] as well as in two signature publications (Jasanoff and Kim 2009; Jasanoff 2015) and have chosen two variables, policy structure and policy culture, as the most relevant for our analysis *and* the most manageable, given the number of national contexts to be analysed and the data available.[2]

– *Policy structure*: refers to the values, goals and decision procedures that have been established in public policies and in STI governance systems. This section identifies why STI systems are supported in the national context, and what factors legitimise (particularly public) spending on STI. This has the following aspects:

[1] Although Jasanoff's (2005) *Designs on nature* isn't officially a comparison of imaginaries, we consider there to be sufficient overlap in method and aim to group it under the same header.

[2] We have left out the following possible aspects because they were not relevant to our topic or identifiable in the gathered data: *closure*, the moves by which a polity takes some issues or questions out of the domain of politics as usual; *boundaries*: how new scientific and technological developments create boundary objects that require work; *institutional reasoning and discourse*: this is the domain of different work packages within the RRI-Practice project; *changes in actor identities* due to the creation or destruction of categories.

(a) *STI policy goals*: What are the goals of STI policy? For which reasons do countries support STI?
(b) *STI framing*: How are the goals of STI policy framed? How is the role of particularly science in society framed? How are the responsibilities of scientists conceived? What alternative/critical frames pertain in society on these topics?

– *Policy culture* is defined as the systematic means by which a political community makes binding collective choices.' (Jasanoff 2005, p. 21). This includes both formal institutionalised processes as well as the tacit unwritten norms that govern institutional behaviour. This has the following aspects:

(a) *Administrative style*: What is the style of policy-making in a nation-state? For example, is it consensus-oriented or contentious, egalitarian or top-down, bureaucratic or informal?
(b) *Public participation in STI policy*: Whether, and if so, how, societal actors are involved in scientific processes and in STI policy-making.

In the previous sections we have elaborated our analytical framework for comparing STI policy across nations, using the concept of the sociotechnical imaginary and highlighting in particular distinctions of political structure and political culture. Before analysing the dominant imaginaries of each of our national cases and the implications of these for RRI uptake, we situate them in the wider evolution of paradigmatic models through which science and innovation have been governed at the international level and which have shaped the development of STI systems at the national level (see Flink and Kaldewey 2018; Macnaghten 2020).

The first paradigmatic science policy model is the 'linear model', most famously put forward by Bush (1945), following the end of the Second World War. It became the hallmark of American policy in science and technology, and the blueprint and justification for many decades of increased funding in American science (and beyond). Bush was a strong proponent of the state funding fundamental research, where new fundamental research was then assumed to stimulate applied research in a more or less linear way. This would in turn create societal value by being further developed and commercialised by private sector actors in a response to consumer demand. The autonomy of scientists in doing fundamental research is considered important in this model, as well as adherence to norms of 'good science', such as disinterestedness and organised scepticism (Merton 1973).

As science-based developments gave rise to a number of public controversies such as nuclear energy technologies, the BSE crisis in the UK and later GMOs, calls for an orientation of science towards public goals and values arose. An example of this is the Lund Declaration (European Commission 2009), stating that science should address the grand challenges of our time. In this 'science for society' model, society rather than scientists set the research priorities, and the value generated by research is in (also) addressing those priorities rather than (only) in addressing market demand. Generally, researchers in this model still have considerable autonomy on how to do their research, as long as it is directed in some way towards those priorities.

Both the 'linear model' and the 'science for society' model are often connected to a particular model of science communication, the 'deficit model'. The deficit model assumes that the kind of science communication needed by the public is fundamentally an explanation of science by scientific experts (Wynne 2006). If members of the public oppose particular scientific developments, this is because of lack of information or distrust, which can be remedied by experts explaining their science to the public in an open and transparent way. In both the 'linear model' and the 'science for society' model, scientists are thus presumed to be experts in doing 'good science', as well as in making science work to address societal challenges. Schot and Steinmueller's (2018) 'transformative change' model seems to be an example of this that focuses explicitly on those grand challenges that are posed or created by societal systems that require transformative change, though they do argue that forming networks of societal actors is necessary to achieve such change.

In a parallel development to the 'science for society' model and its focus on societal values, with neoliberalisation and a policy focus on economic growth and competitiveness came the recognition that furthering economic goals required more interaction between different actors in the STI system. This gave rise to the 'systems of innovation' model that emphasised the importance of coordination and learning between the different actors in the STI system (or, more specifically, the innovation system), rather than a linear progression from fundamental science to applications (Schot and Steinmueller 2018). This can involve a meshing of the STI system with the innovation system, e.g. in 'triple helix' collaborations that involve industry, the government and universities. Though not all national reports find strong connections between science and innovation systems, some do, or find the ambition to better connect those systems. Therefore, we mention the model here.

Social scientists have argued that, even if the 'science for society' model recognises the importance of scientific responsiveness to societal values, it doesn't yet recognise the degree to which science and social order co-constitute each other. For example, scientific knowledge and advice shape political debates and social institutions, but the STI system is also a social institution that does not serve all interests in society equally. Where previous models aim to minimise influence of the social environment on the scientific *process*, having it influence its *goals* instead, these social scientists argue that such an endeavour is not only impossible, but also dangerous, as it may obscure the social norms and values that inevitably co-constitute the STI system. This would risk obscuring the influence of powerful actors on the STI system. The alternative is a model in which this co-constitution of science and societal order is explicitly recognised and democratically governed: the 'RRI' model, or to contrast it with its predecessor, the 'science *with and* for society' model. Where the 'systems of innovation' model focuses particularly on economic goals and the inclusion of actors that contribute to the economy, the 'RRI' model focuses on societal goals (which may include economic ones) and the inclusion of all those for whom they are relevant. To show how this 'RRI' model fits the national sociotechnical imaginaries, we make short statements on how RRI fits each of the categories of the sociotechnical imaginary as set out above.

Policy structure:

(a) *STI policy goals*: Definitions of RRI range from the grand and abstract 'taking care of the future through collective stewardship of science and innovation in the present' (Stilgoe et al. 2013, p. 1570) to the concrete and instrumental 'Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)' (von Schomberg 2013, p. 63). Though RRI is mainly concerned with the research and innovation *process*, this process is (sometimes implicitly) supposed to further societal goals/challenges. Proposals for operationalisation include the anticipation, inclusion, reflexivity and responsiveness (AIRR) dimensions (Stilgoe et al. 2013) and the EC policy keys of ethics, gender, open access, public engagement, science education and governance.[3]

(b) *STI Framing*: Responsibility is the guiding concept within RRI. Crucial is a broadening of responsibilities of scientists from maintaining the quality and integrity of the research process to a broader concern with aligning research activities as well as their resulting products with societal values.

Policy culture:

(a) *Administrative style*: RRI emphasizes involving societal actors from an early stage onwards to come to a joint agreement on research governance. As such, its style is decentralized, egalitarian and consensus-oriented.

(b) *Public participation*: Public participation is core to RRI, and indeed, what sets it apart from the other discussed models of the relationship between science and society. Terms such as 'upstream engagement' (Pidgeon and Rogers-Hayden 2007) and 'co-production' (Jasanoff 2004) are often used in the context of RRI, indicating that public participation should start as early as possible, preferably at the problem definition stage, and that scientists and societal actors should aim for consensual solutions.

6.3 Data Used

Data used for this book part are primarily the twelve RRI-Practice national reports that have been created for the RRI-Practice project in the period November 2016–July 2018. Countries reported on are: Australia, Brazil, Bulgaria, China, France, Germany, India, Italy, the Netherlands, Norway, the UK and the US. The national discourse part of these reports has been based on interviews with science policy

[3] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation. Accessed 11 May 2020. RRI-Practice has investigated the dimensions as well as the keys, with the exception of the governance key. See the introduction to the RRI-Practice study in Part I.

stakeholders and a study of national science policy documents as well as on other sources: a specification of methodology can be found inside each report. These reports are referenced throughout the text as '[name country] report:' in each chapter each first mention of the report is accompanied by a full reference.[4] Report data has been supplemented with other relevant sources, such as the national case study reports from the MASIS project (EU only), OECD and World Economic Forum reports, and scientific literature where appropriate. As the RRI-Practice national case study reports have been the main source, this part of the book compares national STI imaginaries *as their elements have been described in those reports*. It is thus necessarily a selection and abstraction from very rich contexts in order to enable a high-level comparison.

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[4] All reports are available at: https://www.rri-practice.eu/publications-and-deliverables/.

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Chapter 7
Overview of National Sociotechnical Imaginaries

Abstract In this Chapter, we give an overview of national STI imaginaries by country. We provide information on policy structure and policy culture, and other aspects of national discourses and practices that are relevant to our study.

Keywords Sociotechnical imaginaries · Responsible research and innovation · STI policy goals · STI framing · Administrative style · Public participation

7.1 Australia

Characteristic of the Australian STI imaginary is that its science and innovation systems are relatively separate. There is the political ambition to move the innovation system towards a 'systems of innovation' model to strengthen the economy, but there is a lack of effective intermediaries, and of incentives for actors in the STI system to collaborate. Particular to this imaginary is attention to the inclusion of marginalised groups to increase their welfare and economic productivity. The STI system seems to be aligned with the 'science for society' model and an accompanying 'deficit model' of science communication. However, it is pushed in the direction of the 'systems of innovation' model by policy-makers intent on increasing public–private collaborations, and in the direction of the 'RRI model', because of attention to inclusion of marginalised groups and a realisation of the challenges this offers for non-localised research. These different directions are not necessarily in tension, as inclusion is also considered important in the innovation system.

Another characteristic of the Australian STI imaginary is the reason for public distrust in science. While many nations struggle with this phenomenon, the reason given in various national reports is scientific contributions to controversial technologies, such as nuclear energy or GMOs. The Australia report (Sehic and Ashworth 2018) claims that it is rather because of scientific contributions to an economy based on the resource-intensive sectors of industrial agriculture and mineral extraction, in a country characterised by water scarcity and fragile ecosystems. Here, it is thus not so much the technologies themselves, but the fit of the technologies with the local environment that generates controversy. The history of this imaginary seems to be similar to that of many Western countries: after the Second World War, spurred on

C. Wittrock et al., *Implementing Responsible Research and Innovation*,
SpringerBriefs in Ethics, https://doi.org/10.1007/978-3-030-54286-3_7

by scientists championing scientific autonomy, Australia adopted the 'linear model.' However, fundamental science never became as important as in e.g. the US, and Australia's government was quick to transition to the 'science for society' model to address societal and economic challenges. Finally, while the Australia report identifies involvement in resource-intensive sectors of the economy as a reason for current distrust in science, Gascoigne and Metcalfe (2017) suggest that it initially arose because of science moving out of the direct experience of many Australians (i.e. developing agriculture) into areas that were less visible in Australians' daily lives, such as computing and aeronautics.

Concerning *STI policy goals*, Australia adopted its overarching National Innovation Science Agenda (NISA) in 2015. It consists of four pillars, Culture and Capital, Collaboration, Talent and Skills and Government as an exemplar, all to drive innovation for jobs and growth (Australia report, p. 21). These priorities reflect current barriers to public–private collaborations, such as the lack of skilled personnel (including but not limited to technical skills). Other barriers are that researchers tend to have little interest in (and typically are not rewarded for) collaborations with industry, and that there is a lack of effective intermediaries. The NISA is thus trying to change the role of universities in society, orienting them more towards societal value. While economic value is a strong component of this, there is an ongoing discussion on the need to better include the Humanities, Arts and Social Sciences, and to stimulate multidisciplinary research (ibid., pp. 16–17). One source of friction regarding STI policy goals is that because Australia is hot, dry and an island, protection of the environment and natural resources, particularly water, is considered highly important. At the same time, Australia's economy is built on the resource-intensive STI-dependent sectors of agriculture and extraction of mineral resources. Those sectors compete to some degree, and agricultural intensification has led to loss of rural livelihoods, leading to loss of trust in the STI system that has supported those developments (ibid., pp. 75–76).

Concerning the *framing* of responsibilities of researchers, with the NISA this has increasingly moved from doing fundamental science to creating value for society, particularly economic value through public–private collaborations. One challenge for this is that researchers are expected to keep to the Australian Code for the Responsible Conduct of Research, while this code is not well adopted by the private sector with which researchers are supposed to cooperate. The Australia report also mentions that despite the long-term, overarching nature of the NISA, its operationalisation is often piecemeal and based on short-term political goals. One concern that researchers have raised is that long-term fundamental research might in the end lead to innovations with much higher societal value than applied research and innovation with quick impacts. However, a recent investment in fundamental research has included the *Responsible Innovation Initiative*, to apply RRI principles to this research, which suggests that a focus on RRI does not imply a focus on applied research only (Ashworth et al. 2019, pp. 335–336).

Concerning the *administrative style* of STI governance, responsibility for the STI system is pluralistic and distributed between various departments and agencies, with research institutions enjoying relative autonomy (Australia report, pp. 19, 22). On

a national political level, the Australian Parliament is influenced by that of the UK, and party politics tends to be a competition between two major parties.

Public participation in STI activities has traditionally been about creating awareness and understanding of (the importance of) science to create public support. Another goal of participation has been 'fostering the public's ability to critically assess the credibility of scientific information' (ibid., p. 26). One challenge here is distrust in science, witnessed by falling participation rates in science courses and political polarization of scientific topics, particularly climate change (ibid., pp. 26–27). Then again, societal engagement in research and citizen science initiatives are on the rise due to increasing interactions between universities and external partners, as well as between different scientific disciplines, stimulated amongst others by the NISA. Another cultural factor that stimulates participation is a political focus on inclusion. As the Australia report states, 'Australia is often classified as an immigrant and multi-cultural nation where diversity and inclusion have provided the backbone for international linkages, both economically and socially, and this has naturally diffused into most aspects of the Australian way of life' (ibid., p. 34). Inclusion in politics is often conceptualized through the idea of sustainable growth: helping marginalized groups to improve their welfare and their economic productivity at the same time.

In research, participation is typically about getting researchers not only to focus on politicians and decision-makers, but also on culturally, socially and linguistically diverse communities. However, this is not without its challenges. The geographical vastness of Australia and its cultural diversity creates difficulties for centralized policy-making and for non-localized research to have local added value (ibid., pp. 26–28). The 'gross under-representation of women and Indigenous Australians in science' also counts as a barrier here (ibid., p. 28).

On the fit of the Australian STI imaginary with the 'RRI model', NISA has created an opportunity for Australian research to become more oriented towards societal value, that is kept open amongst others through discussions on the role of the Humanities, Arts and Social Sciences, and on the importance of multidisciplinarity. However, without clarity on how exactly it will be operationalised, there is the risk of it unreflexively orienting research towards cooperation with the private sector and economic value creation. Another factor that might create an opening for RRI is public unrest regarding the environmental crisis and distrust in STI for its contribution to agricultural intensification and the extractive industries. These offer incentives to politicians and scientists to involve the public more intensively in STI governance. However, one risk is the contentious political culture that could lead to polarization and a focus on winning debates and votes rather than listening and striving for consensus.

Finally, opportunities for RRI lie in the decentralisation of responsibilities and the acknowledged importance of inclusion and diversity in its science and innovation systems.

7.2 Brazil

Brazil's national STI imaginary is shaped from five intersecting dynamics. First, there remains the pervasive adoption of the linear model of science policy, adhered to by scientific elites seeking to retain institutional autonomy in the face of political pressures and interference, and by a drive to improve excellence and prestige in science, particularly in international rankings. Second, there remains the strong endorsement of a systems of innovation model, particularly strong in the industrial South-East and in powerful funding bodies like FAPESP, seeking to use science in a strategic manner for economic growth and competitiveness. Third, there is a wider imaginary of national pride and self-sufficiency, including a marked ambivalence and resistance to the imposition of foreign ideas framed as colonial impositions and of taking advantage. Fourth, there is the problem of weak institutions, including government ministries and funding bodies, who prove unable to pursue and carry out long-term strategic investment. In this context, the funder FAPESP is an exception, with relatively constant and long-term funding written into its constitution. Fifth, there is the problem of the many Brazils, with very high indices of racial, social and regional inequality.

Brazil's national STI imaginary developed its *policy goals* broadly in three phases. Brazil's STI system is relatively young compared to industrialized countries, with its first modern university dating from the 1930s, and it was only in the second half of the twentieth century that more relevant investments were made to build scientific capacity and achieve greater technological independence, especially through the national security doctrines of the military dictatorship post–1964. Its first phase can be identified in the period of Brazil's military dictatorship (1964–1985), where significant investment in science and technology was aimed at producing technological independence, national security and the development of the interior, including the Amazon. This period was characterised by an economic boom: the 'Brazilian Miracle'.

Brazil's second phase follows democratisation in 1985 and lasts up until the end of Dilma's PT government in 2016. It is associated first with neoliberal reforms in the economy and, soon after, a focus on innovation for growth, on improving public–private collaborations, and developing the innovation capacity of private companies. These goals were only partially successful at either stimulating growth, or in developing better synergy between the provision of public funding and the market, or in increasing private R&D funding, not least due to macroeconomic instabilities, the political turmoil in Brazil, and excessive bureaucracy associated with policy regulations (Brazil report, Reyes-Galindo and Monteiro 2018, p. 23). Core documents on STI policy are the 'National Conferences on Science, Technology and Innovation' 'books' carried out after nation-wide stakeholder R&D exercises, leading to comprehensive national policy white-papers produced more or less every presidential cycle' (Brazil report, p. 14). During this period, STI policy has been aligned with more general political goals of several progressive governments, including the reduction of inequalities and the sustainable use of natural resources.

Brazil's third phase is from mid–2014 onwards and has been shaped by a rapidly changing external environment characterised by a deep and long-lasting recession, a series of major and systemic political corruption scandals, and a political shift to the right and more conservative political priorities. The recession and the political shift have led to drastic cuts in public STI funding, leading to heated and ongoing debates about the future of science in Brazil (ibid.)

In Brazil's STI imaginary, in its latest and ongoing iteration, the *framing* of the responsibilities of scientists occurs against this backdrop of drastic funding cuts and political instability. The Brazilian Academy of Sciences acknowledges 'quality of life' as an important concern of science, but configures the priority of societal challenges as secondary to 'the advance of knowledge' and 'economic development.' Societal challenges are thus rarely viewed as entwined with fundamental science or innovation for growth, but rather as a separate topic to be addressed by the social sciences (Brazil report, p. 24). This separation of issues can also be seen in the framing of responsibilities of the private sector, which has a narrow focus on creating jobs and economic growth (Brazil report authors, personal communication).

For scientists, an important responsibility lies in maintaining their autonomy, a traditional and long-standing frame that has been given topical relevance in the face of recent attempts aimed at political interventions and undemocratic influences. While in some cases this insistence on autonomy can be seen as a lack of responsiveness towards societal concerns, in Brazil rather the reverse is true: scientists and institutions wish to remain autonomous to avoid being captured by undemocratic forces in society. This creates a tension with the RRI ideal of making science more open and responsive to society (Brazil report, p. 4). For example, some institutions have resisted gender and diversity policies on the grounds that adopting criteria other than 'academic excellence' is outside their scope (ibid., pp. 74–77). Finally, Brazil's framing of the responsibility of scientists is shaped by its relation to Europe and North America. Ideologically seen, because of its colonial history, Brazil is reluctant to uncritically adopt European research policy frameworks such as the European Commission's framing of RRI, not least because it is not perceived as sensitive to Brazilian needs. For example, while the European Commission has designated 'gender' as an RRI key, considerations of racial and socio-economic inequality are seen as arguably more important for Brazil, yet have not received any special attention (Brazil report, p. 38).

The *administrative style* of Brazil's STI system is bureaucratic and top-down, which has long been recognised as a barrier to technological investment (ibid., p. 23). This has also been a barrier for discussing and implementing RRI: for example, in the RRI-Practice project, approaching relevant parties had to be done either through personal contacts or through the top management, and by the PI of the Brazil team rather than by the junior researcher.

The role of *public participation* in Brazil's STI imaginary is limited, in line with its top-down administrative style and an institutional desire for autonomy. Non-scientific stakeholders have traditionally had little involvement with STI policy development, in line with the 'science for society' model. Nevertheless, there are exceptions: crises

such as the Zika outbreak, for example, have brought scientists and societal stakeholders together (ibid., pp. 27–28). Moreover, in Brazil, there has been a tradition of a contentious style of public participation in STI matters through public protests and activism. Brazil is an ethnically very diverse country, due to its rich history, colonialism and trans-Atlantic slave trade, and a traditional openness to immigration. This diversity is accompanied by severe racial, social and regional inequalities (ibid., p. 13) which, in turn, has fuelled civil rights and gender equality activism that takes inspiration from similar movements in the US. With the recent political shift to the right, the (modest) progress made in the preceding years towards more inclusive and participatory policies is expected to be halted or even reversed. Thus, activism will likely remain the major channel of public participation for now. Paradoxically, in this situation the relative autonomy of universities can act as a driver as well as a barrier for inclusion. One the one hand, it has led to the reluctance of universities to engage with politicized issues such as inequalities. On the other hand, it can make existing affirmative actions within the universities more resilient against shifting political trends (ibid., p. 31).

On the fit of RRI with the Brazilian STI imaginary, Macnaghten et al. (2014) have written that RRI is 'a Northern political artefact' (p. 193). This means that it makes assumptions concerning the social and political order that might not fit with Brazilian reality, such as regarding which socio-economic inequalities should be addressed explicitly. It also means that uncritically applying the concept to the Brazilian context could constitute and be represented as an act of intellectual neocolonisation. This means that for RRI to make a meaningful contribution to the Brazilian STI system, the concept needs to not only be translated to the Brazilian context, but to be enacted (and owned) by actors within that system.

In this context, the strong adherence of Brazilian academia to autonomy offers both opportunities and challenges to RRI. On the one hand, its (partly historically justified) reluctance to let outsiders take part in the research process makes the adaptation of RRI dimensions such as anticipation, inclusion and reflexivity difficult. Co-creating solutions with societal actors has been done during times of crisis, however, and in specific cases such as UNICAMP's University Hospital (Brazil report, p. 37). On the other hand, academic autonomy can also be beneficial for those aspects of RRI that are strongly related to a progressive political agenda, especially in the current conservative political climate. This particularly holds for inclusion and gender. That insistence on autonomy is a double-edged sword is also argued by Monteiro (2020), who notes that in the current political climate, it may not be sufficient anymore to protect universities from powerful conservative political actors. Monteiro rather contends that in arguing for autonomy, universities need to rethink their responsibilities in how they respond to societal demands.

The top-down, hierarchical administrative style of the Brazilian public sector also influences RRI uptake, posing a significant challenge for dimensions that thrive on deliberation and interaction, such as inclusion and reflexivity. For the RRI keys, if higher management is convinced of their value, they can be relatively quickly implemented in Brazilian institutions by dirigiste injunction. However, without top-down authorisation, the room for experimentation and for alternative practices is

limited. Similarly, while national policies can be effective in creating change in the STI system, the lack of a national policy on relevant issues can be a barrier (e.g. ibid., pp. 29–30). Finally, though deliberative and participatory exercises are not widely spread, grassroots movements, civil rights and gender activism all influence institutional policies on RRI-related topics. And though Brazil would be reluctant to adopt EC policy goals, its scientists are both aware of and sensitive to relevant developments in the international scientific community (ibid., pp. 38–39). Thus, this combination of bottom-up pressure and top-down standards of good practice can be an incentive for institutional change.

7.3 Bulgaria

The Bulgarian STI imaginary is formed by three forces that are all to some degree in tension with each other. The first is the relative autonomy of research institutions and their orientation towards the global research system. The second is the development of Bulgaria's market economy to be more competitive and innovative following a 'systems of innovation' model. In this Bulgaria shows a strong orientation towards Europe, even if its lack of competitiveness on the European market has had negative effects, particularly regarding the migration of young Bulgarians to more competitive economies. The third is a movement towards the 'RRI model' to increase public trust in science and thus generate legitimacy. Historically seen, a turning point in Bulgaria's STI imaginary is the fall of the Communist regime in 1989 (Bulgaria report, Damianova et al. 2018, p. 14). This marked the beginning of a difficult transition to a market economy, with related mass emigrations. For the STI system, this has resulted in chronic underfunding, with a relatively low percentage of Bulgaria's GDP going to R&D.

Concerning *STI policy goals*, where Western countries have a strong focus on maintaining or improving economic competitiveness, Bulgarian STI policy is rather concerned with building up competitiveness. One important aspect of this, which of all project reports is most prominent in the Bulgarian one, is avoiding the negative effects of being not as competitive as its Western European counterparts, such as the aforementioned 'brain drain' of young Bulgarians. (Bulgaria report, pp. 14–17). Regarding more specific STI policy goals, the National Strategy for Development of Scientific Research in Bulgaria 2017–2030 mentions raising its international authority in science, but also increasing the responsibility of Bulgarian science towards society and vice versa. Furthermore, the Strategy aims to change the reward structure of researchers, moving from impact factors and citations more towards social impact indicators. However, policy-makers lack a uniform vision on how to implement this, so that this is mostly left to the discretion of research organisations and individual researchers. Chronic underfunding of and distrust in the research system remain problematic (ibid., pp. 18–21).

Concerning the *framing* of the responsibilities of researchers, there is no unified code of conduct for the Bulgarian research system to explicitly frame them. However,

responsibility itself has been mentioned as a concept to legitimize institutional policies, expand professional responsibilities of researchers, and overcome mistrust by engaging society more actively in research (ibid., p. 20). As said, however, operationalising and implementing these responsibilities is left mostly to organisations and individual researchers.

Concerning Bulgaria's *administrative style*, responsibility for STI is divided between the Ministry of Education and Science (science) and the Ministry of Economy (innovation). In line with the earlier observation regarding operationalisation and implementation of responsibilities, the report notes that: 'overall, the structure of the public universities and research institutes is decentralized, thus allowing the organisations to act autonomously' (ibid., p. 15). Furthermore, one challenge to maintaining and operationalising a stable, long-term STI imaginary is that ministers of Education and Science tend to hold office for only a short time (on average less than two years over the past two decades). Therefore, those ministers tend to look for quick wins and usually do not take a longer-term perspective (ibid., pp. 26–27).

Concerning *public participation*, the Bulgaria report mentions that public participation is widely regarded as something that should be facilitated and encouraged. Not so much to create 'better' research, but to secure public trust in science and to generate legitimacy for STI policy. Participatory exercises are (still) uncommon, and there is scepticism whether 'the public' is knowledgeable enough to engage in a meaningful dialogue with scientists or policy-makers. However, the National Strategy for the Development of Scientific Research has set a positive precedent (ibid., pp. 22–23). Similarly, Bulgaria's innovation strategy, the Innovation Strategy for Smart Specialisation (IS3) has involved consultations with key stakeholders (ibid., pp. 14–17).

Concerning the fit of the Bulgarian STI imaginary with the 'RRI model', the national report does identify a number of opportunities for Bulgaria to move into an RRI direction. Concerns about low economic competitiveness and youth migration (including young scientists), and especially about public distrust of the STI system and a perceived lack of legitimacy, all create opportunities for a more collaborative and deliberative reform of the STI system. And indeed, participation and consultation of stakeholders has played a role in recent science and innovation policies, even though they have been developed by different ministries. However, there are challenges in the combination of decentralised governance, quick succession of ministers and the chronic underfunding of the STI system: these factors raise the question whether policy ideals will indeed be translated into more reflexive and inclusive institutional practices, or whether Bulgaria's research conducting organisations will mostly keep following more stable and established 'global' indicators of scientific quality such as impact factors and citations.

7.4 China

RRI in China has to be contextualized through its interaction with an STI imaginary that emphasizes contributions to economic development and the socialist society as defined by the Chinese Communist Party. The unique characteristics of the Chinese STI imaginary indicate both potential for adoption but also reinterpretation of RRI in the Chinese context. On the one hand, the Chinese STI imaginary converges with RRI in its strong emphasis on the applied and societal orientation of research at the expense of ideals of value-freedom and neutrality of science. On the other hand, the Chinese STI imaginary contrasts with deliberative and participatory traditions of RRI in emphasizing the centralized power of the Chinese Communist Party in defining societal goals and ensuring compliance through tight control of the STI system.

The Chinese STI imaginary has evolved through changing *policy goals* in three phases. All three phases can be located in a Chinese governance tradition of emphasizing applied science in the service of society while shifting priorities of societal contribution (Guo and Ludwig forthcoming). While the first phase builds on "Dialectics of Nature" (Engels 1883/1925) as an alternative to bourgeois science in the service of communist society, the second phase ("Reform and Opening-Up" policy of Deng Xiaoping (1978–2012)) expands beyond communist science by focusing on the contribution of the Chinese STI system in developing a successful market economy. The 'New Era of Socialism with Chinese Characteristics' under Xi Jinping (2012–) continues to focus on economic development while also increasingly emphasizing the need to control science in ensuring its contribution to socialist society and Chinese values. As the China report (Zhao et al. 2018) notes, current emphasis on both economic growth and societal contribution can create tensions: 'On the one hand, the pursuit is towards the socialist ideal of national development, common prosperity, social harmony and improved quality of life; on the other, it focuses on the philosophy of the market economy, featuring individual achievements and fair competition. These two aspects stand in conflict yet have common grounds, such as the pursuit of economic development (China report, pp. 11–13).

RRI converges with the policy goals for Chinese science through its emphasis on societal contribution and therefore creates a fruitful ground for exchange between Chinese and Western perspectives on the governance of science. At the same time, RRI creates clear tensions with the *administrative style* of STI governance in China that is focused on tight control and censorship by the Chinese Communist Party. The Chinese STI system is structured by the centralized power of the party and government not only in the control but also in the definition of societal goals and values. As the report puts it: "*Core socialist values are the soul of the Chinese nation and serve as the guide for building socialism with Chinese characteristics […] We should promote prosperity, democracy, civility, and harmony, uphold freedom, equality, justice and the rule of law and advocate patriotism, dedication, integrity, and friendship, so as to cultivate and observe core socialist values'* (Hu 2012, p. 13)."

While convergence in societal orientation creates opportunities for dialogue between RRI and the Chinese STI imaginary, divergence in administrative styles

indicates friction that makes adoption of frameworks in deliberative and participatory traditions such as AIRR (Stilgoe et al. 2013) unlikely and raises wider questions about responsible governance of science in contexts "where liberal democratic values are not taken for granted" (Wong 2016, p. 154). As mentioned, RRI is part of the 13th Five-Year National Science and Technology Innovation Plan (2016–2020). Chapter 7, article 24 (Creating A Social and Cultural Atmosphere for Encouraging Innovation) mentions: "*promoting responsible research and innovation, strengthening research ethics, enhancing research ethics education, raising science and technology personnel's awareness of scientific research ethics, and guiding enterprises to pay attention to and undertake social responsibility for protecting ecology and ensuring safety in technological innovation activities.*" (China report, p. 15). What complicates interpreting these policy priorities is that there are no clear and easy equivalents of Western concepts (and their associated intellectual history) of 'responsibility' and 'ethics' in Mandarin (ibid., pp. 14–16). For example, in policy documents ethics is more widely used as 'adherence to moral norms', but those norms are not explicated in those documents. Also, they seem to refer more to Confucianist norms for the appropriate social and family relations than to Western-style rules for resolving the value conflicts that innovations can give rise to. An exception is norms in the biomedical field, which is quite strongly regulated (ibid., pp. 12; 15–17).

An important recent *framing* of the role of STI in China is the 'Chinese Dream.' Formulated by president Xi Jinping in 2012, it envisions science and technology (as well as institutional reform) to rejuvenate the Chinese nation by increasing productivity, facilitating global cooperation and meeting people's needs. Concerns regarding societal and ethical aspects of technologies are often framed in terms of risk management, to be addressed by the Chinese Academy of Science and Technology for Development (CASTED) (ibid., pp. 15, 47–48). This, in addition to the strong emphasis of RRI in China on research integrity, implies that the responsibility of scientists is so far primarily seen as for doing good science.

On the fit of RRI with the Chinese STI imaginary, Gao et al. (2019) argue that there are certainly various entry points for RRI into 'a quickly developing country in the midst of a complicated transformation' (abstract). Those include the change of focus from economic to sustainable development, driven by increasing environmental problems and social inequalities; the continued importance of science education/communication and experiments with more interactive models; and criticism of ethical research regulations that are often more quick fixes than clear and structural norms.

However, the adoption of RRI in the Chinese STI governance system is by no means guaranteed. Its explicit incorporation in the 13th Five-Year Plan is a case in point: Gao et al. (2019) point out that it's currently a slogan without much clarity on its implementation. Worse, Mei et al. (2020) argue that the formulation stresses the responsibility of individual researchers (and enterprises) to behave in an ethically responsible way, where RRI should be about structural transformation of STI systems to make them more open and inclusive. The meaning and institutional function of RRI in China is therefore still in the making. On the one hand, RRI could function as a mediator between Chinese and European STI imaginaries that share an orientation

towards societal goals while facilitating conversations about thorny issues such as deliberation and participation in the Chinese context. On the other hand, "RRI with Chinese Characteristics" may take a shape that is very different from dominant European framings in emphasizing compliance with socialist society and Chinese values as defined by the centralized power of party and government.

7.5 France

France's STI imaginary seems to align strongly with the 'science for society' model. In public policy, the emphasis is very much on autonomous experts addressing societal needs, and innovation policy for economic goals is relatively detached from science policy. As in other countries studied in the RRI-Practice project, the 'science for society' model has so far not been able to decisively address public distrust. Much like in other Western European countries, this distrust arose in the 1970s in response to controversial technological developments, in France's case, particularly its nuclear energy strategy. What does stand out in the France report (Grinbaum et al. 2018) is that this public distrust has, amongst others, resulted in protest groups disrupting participative exercises, which they perceived as window-dressing.

Prominent *STI policy goals* in France are excellence and freedom of research, in line with France's rationalist and humanist tradition. More recent policy documents stress the importance of making science intelligible for citizens to restore trust, as a response to controversies on scientific expertise in realms such as GMOs, nuclear power and nanotechnology (France report, pp. 13–14). The goal of restoring trust, together with a suggestion of an underlying 'deficit model', is also present in a 2017 Assemblée Nationale resolution, which states that science is 'a common good which widens cultural perspectives of all citizens looking for a better understanding of the world' (ibid., p. 14).

Concerning the *framing* of the responsibilities of researchers, 'responsibility' is often mentioned in the context of Corporate Social Responsibility (CSR), sustainable development and UN 'universal' values. In addition, there have been debates on the societal responsibility of researchers, which have touched upon improving social wellbeing, but also on resistance against those who threaten it, e.g. by advancing independence and general over specific interests. RRI as a concept is being investigated more and more because of the abundant French participation in EC projects. However, there are concerns that this focus on societal responsibility and public engagement might lead to a loss of research autonomy (ibid., pp. 16–18, 34–35).

The *administrative style* in the STI system is relatively top-down and formal, with policy prescriptions providing not only general goals, but also their operationalisations. The France report authors mentioned about this that for organisations to implement a measure, they would like to see either its added value for the organisation, or the legal document that would oblige them to do so (personal communication). While this provides research institutes with clear and specific instructions, it can come at the cost of flexibility and responsiveness.

This brings us to *public participation* in France's STI imaginary. French STI policy documents 'constantly highlight' the importance of public engagement and citizen science (ibid., p. 22). However, in line with the 'science for society model' and the 'deficit model', debates tend to be framed (by both scientists and the public) as between 'experts' and 'lay persons'. In several instances societal groups have even stopped or perturbed societal debates that they perceived as mere window-dressing, so that they could not take place. Various institutions have instigated public engagement missions or pilot projects to circumvent the limitations of a societal debate, La Paillasse having become an international exemplar as a biotechnology lab accessible to the public and open to experimentation and alternative visions of technology (ibid., pp. 22–25). Art & science initiatives and NGO-developed initiatives have also proven to be effective and powerful tools for engagement (ibid., pp. 71–73).

Regarding the fit of France's STI imaginary with RRI, the French imaginary is mostly aligned with the 'science for society model', but also perceives a need to restore trust in science. While activism in response to scientific and technological developments has been signalled in other reports (e.g. Brazil, the US), only the French report signals a structural disruption of participation exercises that are being perceived as window-dressing. Responses can be found in official STI policy, that stresses the importance of making science intelligible, and how science is a common good for all citizens. However, these mostly seem to perpetuate the 'science for society model' and the 'deficit model.' France's formal administrative style helps to offer clear prescriptions on how to operationalise these responses, but at the same time, risks precluding responsiveness and creativity. In practice there are also participation experiments more aligned with the 'RRI model', such as La Paillasse's open laboratories, and art & science initiatives.

7.6 Germany

Typical about the German STI imaginary is a strong focus on sustainability (*Nachhaltigkeit*). This concept, already used in Germany in the eighteenth century with respect to forest management (Grober 2009), was successfully brought into the political mainstream by social and environmental groups in the 1970s and 1980s. This happened during broader debates about the legitimacy of science, fuelled by concerns about controversial technologies such as nuclear power and later genetic engineering (Germany report, Hahn et al. 2018, p. 20). The sustainability concept covers not only environmental concerns, but also responsibilities of scientists towards society and the future.

The dominant role of sustainability in the German STI imaginary allows for different interpretations. On the one hand, the Germany report suggests that RRI are largely redundant as the RRI dimensions are already covered by the sustainability concept. Moreover, this concept is already well-established, operationalised, and connects to global debates and concerns such as the Sustainable Development Goals

(ibid., pp. 18–19). On the other hand, there are also differences in RRI and sustainability discourses that point towards particular characteristics of how responsibility is organised in the German STI imaginary. For example, the Sustainable Development Goals (SDGs) illustrate how sustainability discourses tend to emphasize outputs such as "no poverty" (SDG1), "affordable and clean energy" (SDG7), or "life on land" (SDG15) while RRI tends to be more focused on how such outputs are negotiated through anticipatory, inclusive, reflexive, and responsive processes.

Anticipation is the most clearly articulated RRI dimension in the German STI imaginary. While one dominant framing in science regulation is that of 'risk assessment', particularly with regards to health and the environment, anticipation activities are also undertaken by the social sciences and the German Parliament's Office of Technology Assessment, which has been active for over 25 years (ibid., p. 25). Moreover, while in many of the studied countries national ethics committees mostly focus on new developments in the life sciences, in Germany national ethics committees have been set up to work on new technological developments such as the phase-out of nuclear energy and autonomous driving. Thus, narrow framings of anticipation in terms of risks are complemented by institutionalised mechanisms to consider other social and ethical aspects of innovations.

Another defining characteristic of the German STI imaginary is its focus on democracy and participation. Democratic values are core to the German constitution, drawn up shortly after the defeat of the Nazi regime in 1945. Like the sustainability concept, the mainstreaming of participation in STI took off in the 1970s as a result of social and environmental activism. Especially in the 1990s scientists began to open up to the public through technology assessment exercises and citizen science. Participation is also present in current German science policy and in the sense of responsibility of many researchers towards society. This is exemplified by Germany's 2014 High-Tech-Strategy, 'the main document to lead public research and innovation' (ibid., p. 15). Its main aims are maintaining Germany's global competitiveness, dealing with global challenges and securing future well-being. However, it places clear demands on the processes needed to achieve those aims: they should take into account social as well as technological innovations, achieve social benefit, engage civil society in innovation processes, and be transparent (ibid., p. 16).

The aspects of sustainability and participation in the German STI imaginary work through *framings* of how scientists perceive their responsibilities. This is in terms of the need to communicate and interact with society, to align scientific and societal aims, besides in terms of responsible conduct of research (ibid., p. 17). However, it is unclear what the actual impact of participation on decision-making or agenda-setting is; and research organisations 'tend to coordinate their research programmes directly with policy makers as elected representatives, without involving other representatives of civil society' (ibid., p. 21).

Germany is (together with France) a prominent country in our study on scoring high on economic indicators, but that showing little concerns about science policy being used to disproportionately advance economic rather than societal goals. The authors of their reports have suggested that this is because French and German

research institutes and industry operate relatively autonomously (France/Germany report authors, personal communication).

While the *concept* of RRI thus seems to find little traction in Germany, many of its *contents* are already advanced by the well-entrenched sustainability concept. The sustainability concept most clearly converges with the dimension of anticipation in RRI through the shared goal of creating responsible futures through risk assessment and wider considerations of social-environmental impact. At the same time, the sustainability focus of the German STI imaginary diverges from RRI in being less concerned with procedural guidance of how to negotiate those futures. While Germany has strong participatory traditions, it also continues to highlight institutional autonomy and freedom of research that tend to give actors such as universities or states considerable procedural independence in how they approach socially negotiated sustainability goals. The sustainability focus of the German STI imaginary does therefore not lead to a full congruence with dominant framings of RRI but also highlights different cultures of organising social responsibility within the European context.

7.7 India

The Indian STI imaginary aligns with the 'science for society' model and has been very stable since India's independence in 1947. It originates in the vision of India's first Prime Minister, Jawaharlal Nehru, who saw STI as 'vehicles for national development and social transformation' that would help in building an independent post-colonial state (India report, Srinivas et al. 2018, p. 9; cf. Chakraborty and Giuffredi 2019). The national development aspect is not only economic, but also social, and generally organised in a centralised, top-down way. Likewise, the social transformation aspect is about inclusion and access. One of the reasons for the stability of the Indian STI imaginary seems to be that, unlike other national reports, the India report does not signal significant public distrust in or contestation of science. While there has been contestation around infrastructural projects, or access and inclusion aspects of new technologies, these tend to be aimed at political choices regarding the implementation of technologies, rather than at the system that has designed and developed those technologies.

Concerning *STI policy goals*, the currently most important policy document is the 2013 S&T and Innovation Policy that aims for sustainable and inclusive growth and public engagement through science and technology. However, critics have argued that this policy is too technocratic and relying on experts. Moreover, 'the Policy has not been followed up with any strategy. Hence it is difficult to assess as to whether the objectives have been met and if so to what extent' (ibid., p. 12). This lack of overall strategy has created a void filled by lower-lev el policies: sectoral visions; science academies' visions; State Councils on S&T; and increasingly ambitions of private sector actors (ibid., pp. 12–13). While RRI does not explicitly appear in Indian science policy, in 2017 Prime Minister Modi issued a call for Scientific Social

Responsibility in Indian science institutions, in line with the existing concept of Corporate Social Responsibility, to connect all stakeholders and share ideas and resources (ibid., p. 21). However, while this concept could signal a move towards the 'RRI model', it is not clear (yet) how it would be operationalised.

Concerning the *framing* of the responsibilities of researchers, contributing to socio-economic development has traditionally been more important than science for the sake of science (ibid., p. 21). However, scientists are presumed to be able to autonomously identify and address the needs of society in line with the 'science for society' model. The public is seen as lacking the capacity to engage with scientists and policy-makers, and in need of scientific education, in line with the 'deficit model' of science communication (ibid., pp. 26–28). The combination of socio-economic policy goals, deference to scientific experts and a relatively top-down governance style has led to 'STI', much like the notion of 'development', being regarded as so undeniably good that critical voices have been muted.

Concerning the *administrative style* of India's STI governance, India's central government has law-making and regulatory powers over STI and a top-down governance style. Its vision on science governance is technocratic, expert-driven and very stable over time (ibid., pp. 12–13). As the report notes, 'in all the science departments [of the federal government], the Secretaries are technocrats or scientists and it has been the practice since the 1950s' (ibid., p. 14). Because of the abovementioned factors, 'Public engagement in theory and practice is yet to be considered important in research and innovation' (ibid., p. 19) and there is a subsequent lack of procedures or guidelines for public engagement. While in several other countries public controversies have led to more engagement with the public in STI development and governance, this is less evident in the India report. For example, it claims that most political parties share the same STI imaginary. Nuclear energy has by and large not spurred controversies. And GM controversies are more about seed pricing and environmental effects than about the technology itself. Thus, STI projects are generally not scrutinised in the same way as the infrastructural and industrial projects sometimes have (ibid., p. 19).

Concerning the fit of the Indian context with the 'RRI model', the Indian STI imaginary shares RRI's orientation at meeting societal needs, and the idea that researchers have responsibilities towards society, not just for doing good science. However, when it comes to the means, both are very different. Where the 'RRI model' emphasises inclusion and public engagement, the Indian STI imaginary, in line with the 'science for society model', lets scientists discharge their responsibility through top-down, technocratic research and policy-making, sometimes demanding sacrifices from citizens in the name of the public good. While there have been policy initiatives to promote public engagement, these are often not operationalised or translated into specific strategies. In this context, the India report authors have indicated that RRI has been valuable to them particularly by opening up a space for reflexive discussions between stakeholders that would not normally engage in conversation on the topic of STI governance (personal communication).

7.8 Italy

Typical of Italy's STI imaginary is that there are few connections between its science and innovation systems. Its innovation system is partly decentralised, making room for diversification and experimentation, occasionally moving from a 'systems of innovation' model into an 'RRI model'. Centralised governance of the S&T system tends to follow the 'science for society' model, with an emphasis on economic goals and supporting Italy's manufacturing and export-oriented industries, but also with a clear role for researchers as experts who work for and inform the public. Historically seen, from the Second World War onwards the Italy STI imaginary followed a similar pattern to other Western European countries, starting with reconstruction and modernisation of the STI system, transitioning in the 1960s and 1970s into a 'science for society' model for the STI system and a 'systems of innovation' model for the innovation system. This transition was heavily contested in the STI system by researchers fearing for the autonomy and integrity of science, according to Pancaldi (1980).

In the past decades, Italian STI policy has taken steps towards decentralization: it used to be the responsibility of the national government, but in 2001, it was shared between national and regional governments. However, in recent years, regulation and control of higher education has been centralised again. This centralisation is particularly visible in the set-up of the independent public body ANVUR, which is responsible for evaluations of and setting up parameters for the distribution of public funds among higher education institutions, amongst others (Italy report, Neresini and Arnaldi 2018, p. 10). While Italy has universities and research centres comparable to most other nations, particular to Italy are the foundations, institutions 'to coalesce local public and private partners around research and technology transfer ventures' (ibid., p. 11). These can be funded by the (regional) government, but also by savings banks. The latter are required by law to invest their profits in projects and investments to benefit local and regional communities.

For Italy's innovation system, decentralisation has led to diversification and some regional governments adopting RRI or similar frameworks for their innovation policy, affecting both public and private sector innovation. The clearest example is Lombardy, which explicitly promotes RRI in the form of open science, social innovations that meet social needs, and an advisory board to the regional government of experts in STI-society relations (ibid., p. 18). The latter is considered especially important by Arnaldi and Neresini (2019): they argue that much private-sector innovation in Italy takes place in SMEs that often struggle to survive in a competitive market environment. These SMEs don't have the resources to do RRI themselves and need intermediaries to support them to incorporate RRI into their operations.

Among Italy's STI *policy goals*, economic growth is prominent. At the same time, there are political concerns about potential negative consequences of innovation, particularly regarding automation. According to 2014 Eurobarometer research, job creation and health are also considered priorities for STI by the Italian public (Italy report, p. 12).

Concerning the *framing* of responsibilities of researchers, ANVUR is a powerful actor as it determines the criteria by which higher education institutions are evaluated. These include what it calls the 'Third Mission', which involves creating value from research (*valorizzazione*) and producing public goods. In this framing, creating value is thus a task separate from research and teaching activities, and also subservient to them. Moreover, the choice of indicators (such as patents obtained and spin-offs generated) reflects a focus on commercialisation more than on the creation of public goods. Finally, unlike research and teaching, the Third Mission is framed as a responsibility of research organisations rather than individual researchers, and thus also evaluated on an organisational rather than an individual level. (ibid., pp. 21–22).

Concerning Italy's *administrative style* of STI governance, as written before, the decentralisation of STI policy has created spaces for RRI initiative such as Lombardy's RRI-oriented innovation policy. At the same time, the evaluation of higher education institutions has been centralised in ANVUR. While this centralisation could in theory facilitate the Third Mission across Italy, the abovementioned factors show that the Third Mission does not (yet) share RRI's more transformative aims. Moreover, 'the risk of bureaucratization is high' (ibid., p. 23).

Concerning *public participation* in STI, the Third Mission does promote this under the heading of 'creating public goods.' The emphasis of the Third Mission is on commercialisation of knowledge and the continuation of existing practices that would more appropriately be labelled 'science communication' according to the 'deficit model.' This fits the general trend in the imaginary of scientists being cast as experts, according to the 'science for society' model. Nevertheless, it could provide an opportunity for research institutions to reflect on what 'public goods' they create for society, and how (ibid., pp. 22–23). In addition, public participation manifests itself in the expression of public concerns, such as regarding the disruptive effects of digitisation and automation (ibid., p. 77). Or in full-blown public controversies that challenge the 'science for society' model, of which the most recent one was on a 2017 law mandating infant vaccination. This debate proceeded in an adversarial, contentious way, displaying a widespread distrust in experts, industry and regulators who were in favour of the law, and little inclusive interaction or consensus-seeking (ibid., 12–14).

Concerning the prospects of RRI in Italy, while the Third Mission does have potential to further RRI at research institutes, the way it has been designed now promotes commercialisation and knowledge transfer over more inclusive and reflexive research. Moreover, it focuses on the institutional level, leaving the practices of individual researchers largely untouched. Thus, so far, the 'science for society' model and the 'deficit model' of science communication seem dominant in institutional organisations and researcher practices. Nevertheless, the vaccination debate has exposed a distrust in experts and government, that in theory could provide a motivation for experimenting with more responsive public engagement activities. One unique feature of the Italy report is its identification of the industry sector as promoting some of the most promising initiatives in RRI in the country. Where reports of countries such as the Netherlands, the UK and the US expose concerns of over-reliance on private sector STI activities to achieve public goals, the Italy report

notes that some of the most promising RRI activities are taking place in the private sector. Examples are the work of the foundations that bring public and private partners together and Lombardy's regional innovation policy that promotes open science, social innovations and societal engagement.

7.9 The Netherlands

The Netherlands' STI system imaginary is an unusual combination between the 'systems of innovation' and 'RRI models'. While science and innovation policies are strongly linked in order to achieve economic goals (and have been criticised for that), participation and consensus are important parts of Dutch culture, opening up space for the discussion of societal concerns in policy-making. Historically, Dutch science policy after the Second World War was in line with the 'linear model', with the addition that it was intended to train skilled personnel for industry as much as to do fundamental research. Rising costs and involvement in OECD science policy, which emphasised the societal importance of science, led to an (explicit) shift in policy in 1974 from 'science for truth' to 'science in the service of humanity', or from the 'linear model' to the 'science for society model'. For some time, Dutch innovation policy was separate from science policy, but these were increasingly merged around the turn of the millennium, with a focus on economic goals. This merger was accompanied by an increasing transition in innovation policy from the 'linear model' to a 'systems of innovation' model. In 2015 science policy turned back towards societal goals with the National Science Agenda (Harkema 2017).

Concerning STI *policy goals*, the Netherlands' STI system imaginary has a strong international and economic orientation. The 2025 Vision for Science from the Ministry of Education, Culture and Science aims to 'further strengthen the "worldwide significance" of Dutch science in terms of its quality and productivity' (MECS 2014, 11; from Netherlands report, van der Molen et al. 2018, p. 20). Innovation policy has aimed to realise this by the creation of the Top Sector approach, that promotes public–private R&D collaborations in sectors of the economy that the Netherlands has traditionally been good at, such as Agri&Food and Chemistry. The Netherlands is one of the few countries were RRI has explicitly been incorporated in the STI system: the Dutch research funder NWO has had an RRI programme (called *maatschappelijk verantwoord innoveren,* or *MVI*) since 2008. This programme builds on earlier programmes that stimulated reflection on societal and ethical aspects of research and innovation. However, since 2016 it has been fully linked to the Top Sector programme and requires co-funding by private partners (Netherlands report, pp. 81–82). Thus, the RRI funding programme is considered partly the (financial) responsibility of the private sector, and it is also used as a way to boost innovation for economic purposes.

Concerning the Netherlands' *framing* of the responsibilities of scientists, this focus on productivity and economic value is also visible there, though after the responsibility to do good science. A key term used in Dutch science policy is *valorization*, which means utilising knowledge for solving societal problems and creating economic value (Netherlands report, p. 20). With regards to societal goals, solving societal challenges such as the Sustainable Development Goals is one envisioned role of science. With regards to economic goals, both national welfare and international competitiveness are stressed. This strong economic orientation has been criticised by several actors in the Dutch academic system, such as the Science in Transition network (van der Molen et al. 2019). Their counter-imaginary envisions more attention to social rather than economic value creation, and a university based on democratic governance, trust and more versatile assessment criteria of research, rather than one that is bureaucratic, hierarchical and obsessed with producing publications (ibid., p. 19). Thus, this critical response does not focus on returning to the autonomy of science in line with the 'linear model' (Bush 1945), but on trust, democracy and societal goals. This is not to say that these are totally lacking in the Dutch context: trust and collaboration have been named as factors that have enabled the Dutch STI system to be relatively efficient and effective. Moreover, there is evidence that the Dutch STI system is moving in the direction of the 'RRI model', for example through the consideration of broader research assessment criteria (Netherlands report, pp. 20–21).

Concerning the Netherlands' *administrative style*, a major part of the Netherlands STI imaginary is its focus on participation and consensus in decision-making, known as the Dutch 'Polder model'. The story is that the model originated in the Middle Ages, when management of Dutch waterways—much of the Netherlands is below sea level—required the participation of all. Though this story may be more myth than actual history, the Polder model itself can be seen in Dutch politics, as well as throughout the Dutch STI system. Concerning Dutch politics, the system of proportional representation in the Dutch government enables many parties to enter parliament. Because of this, the government can only effectively be formed by coalitions of different parties. However, government prefers its policies to have broad public support (*draagvlak*). Hence it often engages in consensus-oriented deliberative exercises with experts and societal actors to feed into policy (Netherlands report, p. 18).

Concerning *public participation in* the STI system, public engagement is a 'key objective in Dutch science and innovation policies' (ibid., p. 23). One example of this is the National Research Agenda, an agenda for research endorsed by a broad coalition of organisations and drawn up by public consultation. Together, the Top Sectors and the National Research Agenda are currently the most important frameworks for prioritising research funding (ibid., pp. 20–21). A number of factors have been mentioned to facilitate the Polder model of participation in research, such as the Dutch' tendency to freely speak their minds, and the Dutch having high trust in each other (ibid., pp. 18–21; OECD 2016). Moreover, while the RRI funding programme has been used as a way to boost innovation for economic goals, RRI is by no means only instrumentalised: more and more interactive and participatory

notions of research are rising to prominence, e.g. through living labs and citizen science (Netherlands report, pp. 23–24). These two parts of the Netherlands STI imaginary, the economic orientation and the importance of participation, seem to be tied together by the assumption that participation and consensus will best serve productivity and competitiveness, which in turn will help to solve societal problems.

Concerning the fit of the Netherlands STI imaginary with the 'RRI model', the imaginary is still linked strongly to the 'systems of innovation' model, due to the interlinkages between science and innovation policy, and the orientation towards economic goals of the latter. Yet the National Research agenda suggests a shift towards the 'RRI model', one that is facilitated by a number of factors, such as the Netherlands' administrative style of participation and consensus, the importance of public engagement in science and innovation policies, and RRI-compatible counter-imaginaries by actors within the Dutch academic system. The tension between both models remains, however, and this is likely to affect the form and degree of uptake of further RRI ideas.

7.10 Norway

Norway's STI system imaginary has in recent years moved from a 'science for society' to an 'RRI' model, which fits well with its small, networked, collaboration-based economy. However, this move has exposed two tensions. The first is with Norway's ideal of excellent science and corresponding institutional evaluation systems, that compete for time and effort with RRI activities. The second is with Norway's separation of science and innovation systems, which has led to the criticism that societal and especially business actors are not sufficiently involved in innovation, even as initiatives are undertaken to involve them more in science. After the Second World War, inspired by Bush (1945) and a desire to modernise industry and defence capabilities, Norway adopted the 'linear model'. From the 1950s and onwards a comparatively large institute sector of independent research institutes was developed to work (but also compete) with universities and industry. However, where the motivation in other countries was to stimulate the economy, in Norway this was less of a priority, as Norway's economy has traditionally run on resource (petroleum) extraction. Here, rather, the motivation was to better meet societal needs. Because of this focus on societal needs, the 'systems of innovation' model in Norway seems to have been largely overlapping with the 'science for society' model (Gulbrandsen and Nerdrum 2009). Changes in more recent years are described in the 'framing' section.

Concerning *STI policy goals*, the main objectives of current Norwegian research policy are: 'To strengthen competitiveness and innovation capacity; to solve major challenges to society; and to develop high-quality research groups' (Norway report, Egeland et al. 2018, p. 12). Research policy in Norway is historically fragmented due to the sector principle. This principle was developed due to Norway having a relatively small STI system, which means that it has traditionally focused its research

on a few sectors relevant to its society and economy, rather than doing research 'across the board.' The sector principle means that 'each ministry has the responsibility for policy development and long-term knowledge development in their respective areas' (ibid., p. 11). One consequence of this is that research policy has been developed much further than, and apart from, innovation policy. There is thus no integrated STI imaginary, and sectors such as healthcare have complained that Norwegian research policy is not aligned sufficiently with the needs of Norwegian businesses, even though some sectors might have more cooperation than others (Gulbrandsen and Nerdrum 2009; Norway report, pp. 12–13). One specific policy challenge for Norway is that traditionally, much of Norway's wealth has come from exploiting its oil reserves. Consequently, much of its research has been focused on supporting the petroleum sector. This makes it particularly challenging for Norway to map a new direction for its research and innovation system for after the oil age (ibid.).

Concerning the *framing* of the responsibilities of scientists, the Norway report distinguishes three major relevant policy developments from 2000 onwards. Throughout all of these, excellent science remains an important constant. Policy from 2000–2008 was primarily aimed at 'competence and knowledge building, emphasizing new and emerging technologies as a tool for value growth and establishing new areas of scientific excellence' (ibid., p. 15). The 'deficit model' was implicit in this policy, which emphasised responsibility for good research practices, and involvement of the public being limited to 'dissemination' and 'informing.' In 2008–2012, global societal challenges came to the fore and remained there, alongside the continued excellence agenda. The period 2012–2015 saw an increased focus on values important for RRI such as transparency, interdisciplinarity and, in some S&T areas, deliberative practices. The Research Council of Norway (RCN) seeks to put these policy trends to practice through certain funding schemes (ibid., pp. 15–16). RCN explicitly endorses Responsible Research and Innovation, though Åm (2019) has cautioned that without corresponding institutional opportunities and incentives, appeals to individual researchers to do RRI will lead to accommodation rather than proper enactment.

Typical for Norway's *administrative style* is that it has a 'small, networked, collaboration-based economy' (Norway report, p. 13). As many actors in the research system know and trust each other, coordination within the system tends to happen through informal, dialogical communication (ibid., p. 14), just as much as through formal governance and steering. Like the Netherlands, the collaborative and networked nature of the economy has been suggested to be responsible for the relative efficiency of Norway's STI system, though the report acknowledges other possible explanations (ibid., p. 13).

Concerning *public participation*, Norway has since 1999 had a Parliamentary Technology Assessment Board that extensively use public participation models. However, public participation is seldom well-operationalized or rewarded within research conducting organisations. More recently there has been increased interest for citizen sciences approaches, triggered by Norwegian and European funding mechanisms.

On the fit of Norway's STI imaginary with RRI, an area of overlap is the administrative style, which generally involves collaboration and dialogue, and might also be responsible for its relatively efficient innovation system. The strength of the Norwegian social science and humanities community is also a factor that could help to further RRI aspects, such as anticipation and reflexivity. Policy framings of responsibilities of scientists are also quite in line with RRI suggestions, though these aren't necessarily translated (yet) into institutional incentives or opportunities, due to policy and institutional priorities given to excellent science and its accompanying metrics. Finally, the transition towards the post-oil age and an increased focus on sustainability requires a rethinking of the focus of Norwegian STI and this is increasingly reframing the responsibilities of scientists. However, it remains to be seen whether this will create opportunities to rethink the role of public participation. There is also a risk in this transition: science and innovation could historically work towards societal goals as the economy was fuelled by resource extraction. If Norway's economy is becoming less oil fuelled, this could well give rise to tensions between economic and societal goals, as can e.g. be seen in the Netherlands and UK reports.

7.11 The United Kingdom

The UK's STI imaginary has been built out of the following intersecting elements: a proud tradition of excellence and autonomy in basic science and discovery, a set of world-leading elite universities configured around the London–Cambridge–Oxford golden triangle, a long-standing culture of deference towards science and expertise, the rise of a pro-market STI policy regime aimed at stimulating economic growth through strategic investment, a growing emphasis on a 'triple helix' of government–industry–university relations and on the entrepreneurial university, and a residual tension between a 'systems of innovation' model aimed at improving productivity and growth and a 'science for society' model aimed purposely at societal challenges.

One salient aspect about the UK's STI imaginary is that the goal of STI policy has been strongly focused on the economy and market governance. This imaginary developed through four intersecting phases. First, following the Second World War, STI policy followed very much the linear model that privileged discovery and the pursuit of pure knowledge with the assumption that these would lead to application and societal benefit. Following the end of the war, science was held in high regard, having played a formative role in the war effort. This status was reinforced by the belief that science was objective and impartial, upheld by adherence to the Mertonian norms, and reflective broadly of the principles of modern liberal democracy (UK report, Pansera and Owen 2018, p. 19). Up until the 1970s, STI policy was informed by Keynesian ideas on an interventionist economy, aimed at producing and supporting 'national champions' with control over strategic industries to advance the interests of the nation. This frame portrayed innovation policy as providing incentives to tackle market failures through government funding of basic research, subsidising R&D and strengthening Intellectual Property Regimes (IPR).

From the 1960s, the 'national champions' framing started to fade, and two policy frames began to run in parallel. The first derived from the Thatcher-era of neoliberalisation and market governance of government research funding, with has been retained up until the current period. Second, 'this was accompanied by more pluralistic views giving greater emphasis to learning processes, collaboration and cooperation that eventually crystallised in the notion of Innovation Systems at the end of the 1990s' (ibid, p. 15). This latter move shifted the focus from technology to innovation, and then to systems of innovation, with the aim of encouraging linkages between universities and business, and aimed at driving the public sector into a major driver of innovation, productivity and economic growth. This model remains a strong driver of STI *policy goals*, with the UK report reporting that 'the current dominant political narrative is one where research and innovation are aimed at national competitiveness, economic growth and increasing national productivity through a technological innovation systems paradigm' (UK report, p. 5). This is witnessed by the titles of STI policy reports. such as the 2014 *Our plan for growth: science and innovation*, or the new Industrial Strategy that envisions a strong interaction between science, industry and society for a more productive economy that 'works for everyone' (ibid., pp. 17–18). This preoccupation with the economy is spurred by factors such as a stagnating economy, an ageing population (ibid., p. 12), a flat productivity and economic uncertainties due to the Brexit (ibid., p. 79).

These final frames have been challenged, mostly by academics, and from the 1980s onwards, who have developed counter-imaginaries arguing that innovation should be much more oriented at societal rather than economic challenges; and that its governing framework should move from collaborative innovation systems through one focused on transformative change (Schot and Steinmueller 2018). The crucial difference is that the hegemonic imaginary focuses on increasing the *rate* of innovation, while the counter-imaginary focuses on which *direction* innovation should take. This counter-imaginary overlaps with the RRI imaginary and fits the RRI AIRR dimensions, even if RRI focuses more on the process (and the dimensions of inclusion and responsiveness), and transformative change focuses more on its goals (and the dimensions of anticipation and reflexivity). However, so far these counter-imaginaries have not structurally changed the UK's STI imaginary (ibid., pp. 15–18).

This focus on productivity and growth is also visible in *framings* of the responsibilities of scientists in the UK, that follow those of the OECD. Closely linked to the phasing of the policy goals set out above, the dominant imaginary of responsibility in science has shifted from internalist considerations of research integrity and the endorsement of Mertonian norms, to considerations of the risk and safety implications of research and innovation, to responsibilities to disseminate and aid in the public understanding of science, to more dialogic and two-way forms of communication that involve both listening and including citizens in the research and innovation process.

The role of *public participation* in the UK's STI imaginary is similarly shaped by the demands of its economic goals and market governance. After the Second World War, researchers were more or less autonomous and largely unaccountable to the

public. The state was responsible for science education. After the 1960s, however, neoliberalisation and societal controversies such as the BSE crisis led to calls for accountability and a focus on societal goals (the 'science for society' model). The result was that scientists were encouraged to address societal goals, to demonstrate impact and to engage in science communication and education of the unknowing public (the 'deficit model' of science communication). Scientists remained largely autonomously responsible for the research process.

Further work by the Economic and Social Research Council (ESRC) challenged the deficit model, suggesting that trust and a meaningful dialogue with scientists were more relevant to positively influence the public attitude to science. A 2000 House of Lords report titled *Science and Society* endorsed this and stimulated more upstream engagement and participatory activities to that end. Several public engagement initiatives were started, such as the National Coordinating Centre for Public Engagement. Moreover, 'more direct and deliberative forms of democracy and public participation' have been foregrounded by modern information technology (UK report, p. 23). Responses among the scientific community were mixed: some see this as an additional burden and responsibility, but recognise the social 'license to operate' that these developments provide. The Engineering and Physical Sciences Research Council (EPSRC) is a driver for RRI in this context: it has explicitly institutionalised the concept and its dimensions (as the AREA framework) in its funding calls and Centres for Doctoral Training (ibid., p. 11).

Nevertheless, despite the existence of transdisciplinary and public engagement initiatives in the spirit of RRI, the dominant model of public participation in the UK's STI imaginary is the triple helix model of university–industry–government relations. While this model urges scientists to engage with a limited set of stakeholders (namely public servants and private parties, on who they are increasingly reliant for funding), it is rooted in the 'systems of innovation' model and its rationale of growth and increased productivity, rather than in the 'science for society' model and its rationale of addressing societal goals, as it 'privileges certain stakeholders, interests and ways of producing knowledge' (ibid., p. 23).

Finally, the *administrative style* of the UK's STI imaginary is not explicitly mentioned in the report, but Jasanoff (2005) identifies it as an informal involvement of experts who are consulted by policy-makers if the need arises. This fits with the dominant role of policy-makers in goal-setting for the STI system that is apparent from the report, as well as with the expert-driven governance that was historically dominant in the system, and still is in the triple helix model. Moreover, STI governance is relatively decentralised: autonomy is considered an important value for research institutions, particularly universities, which explains the resistance to calls for public engagement. (Calls for industry engagement do not provoke so much resistance, as 'industry represents an important, and growing source of income for research in an era, particularly since 2008, where public research funding in the UK has flatlined, and declined in real terms.' (UK report, p. 23).)

To conclude, despite RRI having a firm foothold in the EPSRC, and public engagement activities and calls for accountability being a recurring policy theme, the UK's STI imaginary is currently not particularly conducive to RRI. Its strong focus on economic growth and productivity, coupled with uncertainties about Brexit and conservative political priorities, tends to eclipse more societal goals. Moreover, the triple helix model seems to function as a 'lightning rod' for calls for public engagement: it enables policy-makers to claim that societal goals are being addressed and that societal stakeholders are being included in research, but in a way that is aligned with and subservient to the goals and framings of the dominant STI imaginary rather than to those of RRI.

7.12 The United States of America (US)

The US has been the subject of a number of studies on sociotechnical imaginaries, such as biotechnology (Jasanoff 2005) and nuclear energy (Jasanoff and Kim 2009). In that sense, this section can serve not only as a documentation of a national STI imaginary, but also as (part of) a replication study. The US STI imaginary is characterised by three strong and interlocking components. The first is a focus on excellent research institutions, a heritage of the 'linear model', which has informed US science policy-making for decades. No other country in the world spends as much on R&D in absolute terms as the US, and it is home to many prestigious universities and generates a significant amount of often-cited publications (US report, Doezema and Guston 2018, p. 8). The second component, also a heritage of the 'linear model', is a reliance on market governance of STI, with a minimal guiding role of the government as risk assessor. The third component is a contentious civic epistemology, where epistemic or value conflicts are 'won' or 'lost' in either a court of law or by political majority.

While these components have been relatively stable, historically seen, two developments are relevant to note here. The first is an increasing push for researchers to be more attentive to societal and especially market demands. A crucial enabler here has been the 1980 Bayh Dole Act, which incentivises commercialisation of publicly funded research (US report, pp. 13–14). Rather than moving towards a 'systems of innovation' model, which would involve government interventions to make research institutions collaborate with industry, in line with the 'linear model' the emphasis is on strengthening the connection between the lab and the market and to remove 'regulatory barriers' (ibid.). The second and more recent development, that is in tension with the first, is an increasing politicisation of the STI system; for example, the Obama administration supported public engagement to make government, including public research, more transparent, participatory and collaborative (ibid., pp. 19–20), and the Trump administration's perceived rejection of policy-relevant expertise, leading to a sense of crisis among scientists (ibid., p. 41).

Concerning *policy goals,* US policy is grounded in Enlightenment values, particularly those of justice and liberty. As written, US STI policy emphasises market

governance as the best way to ensure that STI activities translate into societal benefits. This is also visible in more recent policy documents, such as the 2012 Bioeconomy Blueprint, that envisions markets and technological innovation to help achieve societal goals (ibid., pp. 13–14). This is not to say that the government does not imagine any role for itself in STI governance, but its technology regulation system focuses heavily on risk. Moreover, the government regards scientists as 'the best knowers of what should be debated, and how issues should be framed in advance of any public deliberation' (ibid., p. 23). This sentiment is particularly visible in public engagement initiatives in technology regulation, where agencies such as the EPA and FDA 'frequently solicit public comments on regulatory decisions, but then reject as irrelevant the vast majority of the comments that the public makes, because they are insufficiently responsive to the narrow concerns of the parameters of environmental assessments and risk-based decision-making' (ibid., p. 43).

This system of market governance and risk-based regulation does not fit well with the RRI model. While market governance is responsive to some (consumer) concerns, it is not necessarily inclusive or reflexive: because not all societal concerns are market or risk concerns, and because of relatively high and growing levels of financial and social inequalities along class, gender and race lines that affect market access (ibid., p. 8). Market governance also offers limited anticipation, because future concerns can only indirectly affect today's markets. What further erodes the ability of market governance to create societal benefits is the fact that major economic actors have incentives to, and indeed successfully do, use their economic power as a political tool to put their own interests ahead of societal concerns (ibid., p. 44). An example is the Trump administration's market interventions to support coal-based energy rather than address the wider societal issue of climate change (US report, p. 13).

The *framing* of the responsibility of scientists in US national science policy 'is primarily understood in terms of responsible conduct of research' (ibid., p. 14). Thus, responsibility of scientists is focused inwardly on research integrity, rather than outwardly, on societal effects, as these are supposed to be governed by the market. This framing, however, has been challenged from several directions. From the 70s onwards, integrity scandals have been a serious concern. Institutional pressures have been blamed for this, such as researcher evaluations based on impact factors and the volume of publications, stimulating researchers to cut corners and prioritise quantity over quality. More recently, discussions have arisen with regards to the responsibility of researchers for societal engagement. This is partly because of the Obama administration's agenda to make government and public research more open and participatory; partly because of a perceived anti-science sentiment evidenced and fuelled by the Trump administration, which researchers hope to address by more science communication and education (ibid., pp. 19–20; 41). This phrasing from the report tentatively suggests a 'deficit model' than an 'RRI model' in the making, but how this will further develop, remains to be seen.

Concerning *administrative style*, the US has a formal, contentious civic epistemology (Jasanoff 2005). What this means is that conflicting truth claims are characteristically settled in a court of law, whose ruling is consequently codified (US report, p. 13), rather than through reasoned deliberation (ibid., p. 43). Jasanoff (2005) has

shown how this meant that deciding on the role of biotechnology in society has essentially been treated as settling a number of legal questions rather than societal ones. In that way, the US's contentious civic epistemology does not fit well with the RRI model either, as RRI advocates a broader role for society in science governance. This legalistic process of settling truth claims is in principle inclusive, as everyone can participate in the process. However, in practice there are various barriers to participation, and the contentious nature of legal conflicts does not encourage reflection on the merits of other viewpoints. Furthermore, though legal measures can advance substantive topics such as gender and ethics, the legalistic culture also incentivises organisations to take measures to avoid liability rather than to tackle the issue at hand (ibid., pp. 27–30).

Concerning *public participation,* as we noted, contestation is (increasingly) the way to settle not only epistemological, but also political issues, rather than RRI's focus on consensus-building. This has led to a strong politicisation of societal issues, and an inclination of both parties in the US's de facto two-party republic to go against or discontinue policies of the other. For example, participation in science and public affairs, driven by activist movements from the 1980s onwards, was encouraged by the Obama administration to make government more open, transparent, participatory and collaborative. A wide variety of engagement activities has resulted from this. However, indifference of the Trump administration has slowed this development (ibid., pp. 19–23). Gender is the most political of the RRI keys, and in the US particularly it has deep roots in struggles for the rights of women and marginalised groups. However, as these struggles are aligned with a progressive political agenda, the Trump administration has undone several equality-promoting measures of the Obama administration. Nevertheless, the national report notes that sexism and racism in the STI system are increasingly being acknowledged and addressed (ibid., pp. 24–30).

In summary, the RRI model does not fit well with the US's sociotechnical imaginary of the STI system. At the heart of this seem to be very different views about the role of society in STI. While RRI imagines engaged citizens at the heart of science governance, the US's imaginary focuses on science governance by the market (and thus consumers) and the legal system. Moreover, contestation and politicisation lead to citizens increasingly identifying themselves (or being identified) as affiliated with a certain party, and thus, as being in a contest with the other party. Nevertheless, the US has a long history of counter-imaginaries being put forward, notably by the civil and women's rights movements. And while groups fighting for gender and racial (particularly black) equality have occasionally betrayed each other, both are broadly aligned and have achieved a number of changes compatible with the RRI model in the STI system. That, and the lack of interest of the Trump administration in STI in general (ibid, p. 18), currently seem to offer the best opportunities for RRI to develop in the US.

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Chapter 8
Comparison of Imaginaries Across Countries and Wider Implications

Abstract In Part II of the book we asked why RRI develops differently in different national contexts. We argued that this is because RRI can be regarded as a model of the relation between science and society. As all studied countries have established STI systems, all of them have different imaginaries that cover this relationship, though these are not always fully explicit. National imaginaries have different features for different reasons. They cannot simply be ordered on a linear scale of 'progression' towards RRI (Mejlgaard et al. 2018). RRI promotors have to engage with these imaginaries in order to properly align RRI with them. We have illustrated our claim by studying twelve countries' sociotechnical imaginaries on STI in Chap. 7, using RRI-Practice's national reports as data. In this chapter we compare and abstract from the national sociotechnical imaginaries on STI. While some policy goals and participation models are common across many countries, there are also salient differences with regards to policy goals, framings of the responsibilities of scientists, administrative styles and public participation goals and mechanisms. We sketch salient differences and how they matter for the implementation of the 'RRI model'.

Keywords Sociotechnical imaginaries · Responsible research and innovation · STI policy goals · STI framing · Administrative style · Public participation

8.1 STI Policy Goals

When looking at STI policy goals, there is a salient difference between policy goals aimed at economic growth and international competitiveness, and non-economic societal goals, such as sustainable development. Though both kinds of goals are intended to ultimately benefit society, they can be in tension, as shown in the reports of Australia (Sehic and Ashworth 2018), China (Zhao et al. 2018), Italy (Neresini and Arnaldi 2018), the Netherlands (van der Molen et al. 2018), the UK (Pansera and Owen 2018) and the US (Doezema and Guston 2018). All these reports identify concerns that an overly dominant focus on economic goals could be at the expense of societal values or, in academia, critical thinking and curiosity-driven research. The US is the most competitive economy in the world (World Economic Forum 2018)

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and also the one that spends the most on research in absolute terms (US report, p. 8). Yet its reliance on market governance mechanisms in technology assessment leaves little room for discussion on which societal values innovation should advance. At the same time, the political power of some economic actors has distorted both market governance and the democratic process (ibid., p. 44).

With regards to the fit of policy goals to those in the RRI imaginary, in principle both economic and societal goals can fit with the RRI imaginary, as economic goals tend to be ultimately adopted for their societal value (e.g. for creating jobs, or goods or services to meet societal needs as expressed on the market). However, several national reports note that a lack of reflexivity on economic goals can lead to other societal values being (implicitly) marginalised. For example, the Netherlands report mentions critical discussions among academics on the risk of commodification and 'economic salvation' of research (pp. 19, 28). The UK report has identified the single-minded political focus on productivity and economic growth as a great challenge to RRI more generally (p. 29). And the US report shows the shortcomings of the US's market governance system of STI, highlighting how market governance mechanisms do little to facilitate discussions about desirable futures (p. 43). A counterexample to this trend is the Italy report, that shows that good examples of reflexive governance can come from the private sector, such as responsible innovation certification (pp. 23–24). However, no report signals a reverse situation, where a focus on societal goals threatens to eclipse economic development. This suggests that economic goals tend to have an unquestioned primacy in policy-making that, especially in a 'systems of innovation' model, and can easily eclipse societal goals, while at the same time being resistant to public scrutiny and reflection. For further research, it would be interesting to explore what RRI could mean for research in economics as a scientific discipline, as well as for economic policy-making.

8.2 STI Framing

Most of the national case study reports present several framings of the goals of STI policy and the responsibilities of scientists. A prominent frame is the pursuit of scientific excellence, as evaluated by metrics such citation count or journal impact factor. Societal value/valorisation of research/contribution to socio-economic development is also prominent, though both its focus and its mode of operationalisation differs per country. In some countries, the focus lies more on economic value, for example, in the Netherlands, the UK and the US. In other countries the focus lies more on societal values, for example, France (Grinbaum et al. 2018), Norway (Egeland et al. 2018) and Germany (Hahn et al. 2018). In some countries, the preferred method of creating societal value aligns with the 'science for society' model, for example, in Brazil (Reyes-Galindo and Monteiro 2018) and India (Srinivas et al. 2018), while in others public participation plays a strong role, for example, in the Netherlands and Germany.

The reports also show that countries struggle to align their STI imaginaries with the local institutional realities of scientists, especially regarding the core criteria by which research organisations evaluate their researchers. As Part I shows, national policies can be very effective drivers for RRI adoption in organisations. However, many national reports highlight policies or framings that stress the importance for scientists to create societal value, but that leave their operationalisation to individual scientists. This can lead to confusion among scientists regarding what is expected of them, or to the implementation of policies in a superficial way that has little effect on existing practices: see for example the reports of Bulgaria (Damianova et al. 2018), China, Germany, India and Norway; see also Åm (2019). Making societal value creation the responsibility of research institutions also carries a risk, as it may disconnect this responsibility from the daily practices of researchers (see the Italy report). And a clear policy that offers prescriptions for operationalisation can lead to a lack of creativity and reflection on these operationalisations (see the France report), or to the perception that these responsibilities are a bureaucratic box-checking exercise rather than a vital part of research, as has been especially noted regarding ethics in research, in the comparative study of the ethics key in the RRI-Practice project (Hennen and Ladikas 2018).

The reports also show consistent concerns of scientists regarding these policies, particularly how they might affect their autonomy as researchers, and their ability to engage in fundamental research. These concerns may be brought up for different reasons, depending on the specific context of the country. For example, autonomy in Brazil is considered especially important to distance research institutions from 'undemocratic' influences, and fundamental research may be seen as an aim in itself, but also as contributing more societal value in the long run than applied research (see the Australia report). Another concern for scientists, that has received little attention in research, is whether research policies aimed at societal value creation, the implementation of which would require structural changes to institutions and research practice, are integrated parts of long-term, stable imaginaries, or rather fashions that will pass with the next election (Kaltenbrunner 2020). This holds particularly for countries where political regimes tend to change quickly (for example, Brazil and Bulgaria) or that are otherwise perceived to focus on short-term goals over long-term strategy (for example, Australia). Stability in research policy is crucial for structural implementation and this holds also for the RRI agenda.

8.3 Administrative Style

RRI tends to invoke consensus as the aim of (participative) decision processes on innovation. Ideally, all involved stakeholders come to agree on a given direction for an innovation (even if that means abandoning that innovation, as was the case for the SPICE project in Stilgoe et al. 2013). However, consensus may be difficult to obtain in practice (Blok 2014; Van Oudheusden 2014), and contention, conflict and

struggle can have their own advantages, such as sharpening arguments and encouraging the participation of more diverse viewpoints (Swierstra and Rip 2007; Blok 2019). These different styles of interaction have been analysed in the sociotechnical imaginaries under the heading of 'administrative style'. As a general observation, the *administrative styles of the participating countries differ widely*. Some are quite consensus-oriented, such as Germany, the Netherlands and Norway. Others have a more contentious style: especially if consensus-oriented participation opportunities are limited (the US), or there is high distrust in politicians and experts (Brazil and France, and in certain areas Italy). Some reports do not mention a particularly contentious or consensus-oriented style, sometimes because there is a one-party system, or because there is little interaction of experts with the public to begin with (China, India).

The national case study reports show that *having an open, deliberative, consensus-oriented administrative style (e.g. Germany, the Netherlands, Norway) tends to align best with RRI ideals*. For example, the Dutch National Research Agenda is a good example of including stakeholders and societal actors in science policy-making, that fits in the Dutch tradition of collaboration and deliberation (Netherlands report, pp. 20–21). Getting people to speak frankly about their hopes and concerns facilitates the discussion of values and possible futures; the interaction of people with different interests and viewpoints, particularly if more critical parties are involved, facilitates reflexivity.

While in theory a country could combine a contentious administrative style with more open and deliberative procedures, in our case studies there was a correlation between countries having a contentious administrative style and expert-driven decision-making (and, conversely, between countries having a consensus-oriented administrative style and more participatory modes of decision-making). This is hardly surprising: if a county relies on expert-driven decision-making, it has no need for deliberative fora. Moreover, many countries with a contentious administrative style had a de facto two-party system (Australia, Brazil, the UK, the US), where RRI-relevant topics such as gender, inclusion and social justice have become politicised and associated with one of the main parties. In those countries, there is the risk of RRI becoming increasingly aligned with the STI imaginary of one political party, rather than with a national imaginary that transcends party politics. Nevertheless, various reports (Brazil, France, Italy, the US) show that a (perceived) lack of proper participation channels, whether through expert or party dominance of STI governance, can give rise to public contestation and activism.

8.4 Public Participation

RRI assumes that research processes should be participatory, involving societal actors throughout the research process alongside STI (policy) experts. This is in contrast with earlier science governance models such as the 'linear model' and the 'science for society' model, as explained in the 'methodology' section. While no country

in our study clearly adheres to the 'linear model', as witnessed by the sections on 'public participation' in the national sociotechnical imaginaries, the 'science for society' model is particularly visible in Brazil, India and the US. The 'deficit model' of science communication similarly assumes that participation is redundant: either the public doesn't understand the scientists, in which case it needs to be informed, or it does understand them, in which case it will immediately see the value of their work. This model is visible in STI governance in at least Australia, China, France, India, Italy, Norway (until 2008) and the UK (until the 00's).

That those models tend not to be sufficient to convince society at large of the value of STI, is shown by the fact that (perceived) distrust in science, and concerns about this among scientists and policy-makers, is widespread and has been noted in at least the reports of Australia, Bulgaria, China, France, Italy and the US. In several cases this distrust is fuelled by scientists having been involved in the development and implementation of socially controversial technologies, such as GMOs (China), nuclear technologies (France) or vaccines (Italy). This distrust can be a driver for a national STI imaginary to become more aligned with RRI: the reports of Germany and the UK show how policy measures have been taken in the past to increase public participation, as an explicit means of addressing this distrust.

More worrying cases of distrust in science are presented by the US and Brazil reports (and particularly in Monteiro 2020), where this distrust is actively promoted by dominant political parties to further their political agendas. While in both cases this has led to an awareness of the urgency of the issue by involved scientists, this policy pressure has also created very unfavourable conditions for a proper transition towards a more inclusive and reflexive relationship between science and society.

Concerning the participation of private actors in the STI system, while the RRI-Practice project has not investigated private sector STI activities, it has noted that participation of non-academic actors in STI activities often involves public–private collaborations or triple-helix collaborations (for example, Italy and the UK). In no participating country is extensive public participation a structural part of the STI system, though the practice is relatively widespread in the Netherlands. However, experiments and examples of good practices can be found almost anywhere. As an aside, an STI system with little participation is not necessarily problematic for the RRI keys. As some reports illustrate (for example, Brazil), top-down policy-making by experts can quickly and effectively advance RRI keys in organisations, if those experts endorse them. However, in our case studies, *the RRI imaginary aligns less well with those STI imaginaries in countries with more expert-driven decision-making, than with those in countries with more participatory decision-making procedures.*

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Part III
Conclusion

Chapter 9
Conclusion to the Book

Abstract In this section, we reflect on our combination of methodologies, the implications of our work for the global governance of STI and the international research system, and for RRI practitioners and those who aim to implement RRI in their organisations.

Keywords Methodological pluralism · International research system · Global governance of STI · RRI practitioners

9.1 The Combination of Methodologies

This book has combined two methodologies. In Part I we analysed the structural, cultural and interchange dimensions of RRI implementation in organisations, drawing on neo-institutional theory. In Part II we analysed the national sociotechnical imaginaries of STI systems as both constraining and enabling the uptake of RRI, drawing on Science and Technology Studies. While both methodologies have been chosen to fit their respective units of analysis—the level of organisations and national policy-making respectively—they share commonalities and differences that we expand upon below.

First, what makes this book more than the sum of its parts is the recognition that analyses at the level of organisations and national policy-making are both necessary to understand the barriers and drivers of RRI uptake. Part I noted that organisations do not operate in a vacuum through the importance attached to the interchange dimension, including how national policies can be powerful drivers for organisational change. At the same time, national sociotechnical imaginaries are necessarily a product of institutional work. While the methodology of imaginaries focuses on larger trends and patterns, these can be visibly adjusted by powerful institutions, such as FAPESP in the Brazil case, or even by individuals, such as the distinctive contribution by Vannevar Bush in shaping US science policy after the Second World War through his formative report *Science: the Endless Frontier* (Bush 1945).

Second, there is a distinction in the methodological approaches that warrants consideration. While both approaches seek to analyse *structural* and *cultural* dimensions of governance (in organisations and in national STI systems respectively),

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sociotechnical imaginaries are shaped by, but do not explicitly recognise, the *interchange* dimension. Partially, this is because nation-states, which are typically but not exclusively the focus of the imaginary methodology, tend to influence the form and direction of STI activities within national boundaries. Vice versa, ambitious STI projects are often undertaken in the service of strengthening statehood (Jasanoff 2015). Nevertheless, we have found that national sociotechnical imaginaries are shaped by and responsive to international developments, and that an analysis of this interchange dimension is a useful extra tool in the imaginaries toolkit. We reflect further on the role of the international governance role of STI systems below.

9.2 The International Research System

In Parts I and II we described organisational and national conditions for the implementation of RRI. As indicated, national conditions affect organisations through the interchange dimension. However, the wider environment of research organisations—particularly for research conducting organisations—is found not only in national conditions, but also by the institutionalized international research system. When we find so many similarities across organisations from five continents, it is because there are shared institutional norms and values that operate at an international level. Research is inherently international and there is a global labour market for researchers, who win positions based on their merits regarding publications in 'top' international journals, commonly defined by metrics such as impact factors. Researchers often have a keen interest in developments in the international research system (see, for example (Reyes-Galindo and Monteiro 2018)), and may adopt norms of research ethics or open access publications, even in the absence of local institutional incentives, to keep up with international standards. Conversely, we find in this book that current high-productivity based notions of excellence are among the greatest barriers to RRI. As long as these remain international standards, organisations and even national STI systems cannot easily change these criteria by themselves.

While we did not study the international research system in the RRI-Practice project, this could be an important next step. Taking an international perspective poses a wider challenge for the 'RRI model': while RRI advocates the wider democratic governance of science systems, in our current world democratic systems typically operate at national and local levels. Hence, it is not immediately clear what the democratic governance of science would mean at a global level, and how (new collectives of) institutions could take on this responsibility at this scale in pursuit of RRI. This makes it important to investigate the nature and influence of existing international research governance activities and the models of the relationship between science and society that are implicit in them. International agreements such as the Berlin Declaration on Open Access and Plan S would be clear examples, but also the policies of international institutions such as the OECD, the importance of which is emphasised in the UK report (Pansera and Owen 2018), and UNESCO.

One clear international driver for change may be the current policy focus on sustainability and the Sustainable Development Goals (SDGs). Several national reports mention these as informing national science policy goals, for example, China (Zhao et al. 2018), France (Grinbaum et al. 2018), Germany (Hahn et al. 2018) and India (Srinivas et al. 2018), but they are relevant for processes in the international research system as well. One example is SDG 8 on decent work. If this could stimulate more thorough assessments of the social sustainability of the current research system, with its high proportion of temporary contracts, chronic underfunding (see reports from Brazil (ibid), Bulgaria (Damianova et al. 2018) and Italy (Neresini and Arnaldi 2018)) and high expectations of scholarly publishing alongside normal teaching obligations at universities, this could both contribute to improved mental health among PhD candidates (Woolston 2018) and academic staff, and help align science systems with RRI. As set out in the findings of Part I on organisational barriers, RRI activities are typically seen as an 'extra' to mainstream research, teaching and management tasks. When combined with the fact that many researchers are already overworked with their 'core' tasks (Åm 2019), this almost ensures limited uptake of RRI ideas. The fundamental challenge that the 'RRI model' offers to the 'science for society' model holds for the international research system as well: if science and social order fundamentally co-constitute each other, whose social order underlies, and is propagated by, the norms of the global scientific community? Whose interests are served more by those norms, and whose less?

One well-documented phenomenon is the conflation of 'global' with 'Western' norms and interests, excluding or marginalising work from the global South (see Rathore 2017; Katzav and Vaesen 2017). To illustrate this point, reports from the US (Doezema and Guston 2018), Brazil and India all note that the EC conceptualisation of RRI through the RRI keys does not address some of their key priorities, such as socio-economic or ethnic inequalities. As Part I notes, the EC could learn a lot about diversity from those countries, which have been grappling with the issue for centuries. This raises a paradox for RRI, namely that if we insist on a model of co-creation for RRI, in which RRI and social order are inevitably intertwined, RRI cannot be straightforwardly implemented by universal edit, but has to be adapted to the local context (and vice versa), to enable 'RRI' to work effectively. Doezema et al. (2019, p. 324) describe this as a process of transduction rather than translation: "*Transduction highlights the ways that the introduction of a term, tool, technology or concept into a different context creates new meanings around that entity, transforming both the object and context at the same time.[…] In this sense, transduction of RRI does not only involve the production of new concepts but also the (potential) transformation of practices in institutions such as funding bodies and universities in context-dependent ways not prescribed as part of RRI, but as an outcome of local engagement with the questions RRI inspires.*" Not coincidentally, there is not only a lack of ethnic diversity in the international research system, but there are also severe gender imbalances, especially at the upper management level (see, Hennen et al. (2018) on the Gender Equality and Diversity key). While these issues go beyond the scope of this book, they reinforce the point that the current international research

system has constructed a rather one-sided and biased social order; it is also structurally biased (though not necessarily intentionally) towards particular interests as well.

9.3 Implications for RRI Practitioners

The assumption that science and social order fundamentally co-constitute each other has implications for what it means to be an RRI practitioner. Most importantly, it shows that being a change agent in an organisation is not an instrumental role, in the sense of getting policy prescriptions implemented as efficiently as possible, but rather a political[1] and normative one. Even if some changes are not perceived as political, this is not because they are not, but likely because they align with the dominant social order within the organisation, or with established norms external to the organisation. Here we discuss three specific implications for RRI practitioners.

Considering the lessons learned from the organisational and national studies, RRI practitioners must take the organisational and national contexts into account when implementing RRI ideas. The first important consideration is to negotiate the extent to which local contexts need to be changed to fit RRI, and how much the RRI ideas need to be changed to fit the context. As the book shows, RRI can mean different things for different national science systems, and different systems offer different opportunities for RRI implementation. Different strategies carry different opportunities and risks: as we found, changing organisations to fit RRI is a long, intensive and difficult process that may well provoke resistance and encounter inertia. We need a theory of change tailored to local circumstances, and a keen eye for opportunities to align institutions with RRI, such as the capacity to learn from crises or to develop new policy priorities. Alternatively, we need targeted mobilisation efforts aimed at aligning top management with influential stakeholders in the institution, and capitalising on narratives or ideas external to the institution that can be framed as relevant for (aspects of) RRI by change agents. Adapting RRI ideas to national and organisational contexts promotes change and is to some degree necessary. However, the risk, well-documented in neo-institutional research, is that ideas are adopted in a superficial way and decoupled from actual research practices, while being rhetorically broadcasted as reform efforts and used to legitimise business as usual.

A second consideration is whether RRI requires incremental improvements or transformative changes to STI systems. The risks are similar to the above: transformative change is more difficult to and more likely to provoke resistance; while incremental change is easier to bring about and it remains uncertain if they accumulate and add up to the more transformative change envisioned by the 'RRI model'. Here, again, an appropriate theory of change is needed, and a vision on what change is needed, which may be specific to national styles of policymaking. This theory of change

[1] If we understand 'political' in a general sense, as having an influence on existing power structures, rather than in the specific sense of being affiliated with some political party.

becomes much more complex, however, because it requires many different organisations to change in ways that are somewhat in unison, and—crucially—requires a change of taken for granted assumptions of proper conduct at a societal level.

A third consideration concerns the relation that RRI practitioners seek to forge between the demands of RRI and those of the international science system. As the RRI-Practice project shows, the RRI model can and has provoked resistance among researchers. This is partly because of structural features of organisations (such as a lack of incentives to engage in public engagement), but it is also partly rooted in the values underlying the international science system. In RRI-Practice, value concerns included concerns that RRI could threaten scientific autonomy and delegitimise fundamental and curiousity–driven research. An encouraging finding was that RRI may appear to be better aligned than imagined with Enlightenment ideals about the role of science in cultivating engaged and critical citizens, for example in the notion of 'Bildung.' This shows that, while RRI practitioners should take those value concerns seriously, there is quite some common ground between them and RRI values. Proper engagement with these concerns, however, requires theoretical and practical reflection, and there is still much research to be done on how all these considerations for RRI practitioners could best be addressed.

In Part I, we examined barriers to and drivers for the uptake of RRI in research conducting and funding organisations. In Part II, we examined the potential for the uptake of RRI in different national contexts. One clear lesson of our research has been that, even in the presence of powerful drivers (such as funding programmes for organisations and public distrust in science for national STI systems), implementing RRI is never straightforward, nor a matter of changing the context to fit the concept. At both levels there are *coordination issues*, such as between organisational departments, or between innovation and research policies, and *tensions between goals*, such as between doing excellent science and creating societal value for researchers. This makes implementing RRI a strategic puzzle, but also one that necessitates discussions about the values underlying institutional arrangements, that may lead to an adaptation of the concept as well as the context. It requires anticipating concerns and relevant developments, including relevant stakeholders, reflecting on values and goals and being responsive to external developments. In short, there is no implementing RRI without doing RRI.

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