Metrics and indicators of Responsible Research and Innovation

Progress report D3.2

Monitoring the Evolution and Benefits of

Responsible Research and Innovation (MoRRI)

This report is part of a series of documents produced as part of the European Commission's service contract RTD-B6-PP-00964-2013, "Monitoring the evolution and benefits of responsible research and innovation".

The following deliverables have been produced so far:

- **Citizen engagement and participation of societal actors in research and innovation,** Task 2, Analytical report, Deliverable D2.1, April 2015
- **Science literary and scientific education**, Task 2, Analytical report, Deliverable D2.2, April 2015
- **Gender equality,** Task 2, Analytical report, Deliverable D2.3, April 2015
- **Open access**, Task 2, Analytical report, Deliverable D2.4, April 2015
- **Ethics,** Task 2, Analytical report, Deliverable D2.4.1, April 2015
- **Governance,** Task 2, Analytical report, Deliverable D2.4.2, April 2015
- Synthesis report on existing indicators across RRI dimensions, Task 3, Progress report, Deliverable D3.1, May 2015
- **Metrics and indicators of Responsible Research and Innovation**, Task 3, Progress report, Deliverable D3.2, September 2015

Disclaimer

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

Authors:

Tine Ravn, Mathias W. Nielsen, Niels Mejlgaard

Contributors:

Suzanne Bührer, Rodrigo Costas, Kerstin Goos, Erich Griessler, Andrea Leitner, Ralf Lindner, Bea Mahieu, Nikos Maroulis, Ingeborg Meijer, Ed Noyons, Viola Peter, Xavier Potau, Ismael Rafols, Jack Stilgoe, Andrew Stirling, Larissa Talmon-Gros, Thomas Teichler, Richard Woolley, Angela Wroblewski

Executive Summary

This deliverable is the second of two reports within Task 3 of the MoRRI project. The objective of Task 3 is to construct, identify, and specify relevant metrics and indicators to be used in the subsequent RRI monitoring. Whereas the purpose of the previous report (D.3.1) was to synthesise and assess existing indicators and data on RRI, this report (D.3.2) will [a] pin down the final, core set of 36 RRI indicators, [b] provide as detailed descriptions of each indicator as possible, and [c] specify the primary and secondary data guiding the data-collection in Task 4.

The first part of D. 3.2 (i.e. Chapter 2) describes and discusses the methodological approaches and classificatory schemes applied - and the various analytical considerations involved - in the selection of the final 36 RRI indicators. Moreover, this part accounts for the structure and content of the data collection fiche providing transparent and detailed instructions for the collection of primary and secondary data in Task 4.

The second part of the report (i.e. Chapters 3 and 4) specifies the rationales for selecting the final set of indicators for each RRI dimension, including considerations on [a] EU 28 coverage, [b] the possibility for sustained or repetitive data collection, [c] RRI conceptual coverage, [d] general quality assessment criteria, and [e] feasibility concerns. Likewise, this part, on the basis of the data collection fiches, details the characteristics of each indicator with respect to: [a] general indicator specifications, [b] assessment regarding the analytical distinctions and quality parameters specified in the context of the MoRRI project, and [c] specifications related to data collection.

Finally, the third part of the report (i.e. Chapter 5) compiles and specifies the empirical programme for harvesting the primary and secondary data across the 6 RRI dimensions. Feasibility and data administration issues related to the altogether five proposed methods for primary data collection are discussed in detail, and the final eight sources of secondary data are recapitulated. Of the 36 final RRI indicators, 23 are based on primary data and 13 on secondary, existing, data.

Content

Executive Summary 3
1. Introduction – descriptions of RRI metrics and indicators 6
2. Methodological specifications for indicator selection 8
2.1 Outline of the preceding activities of the MoRRI project 8
2.2 Classificatory Schemes applied in MoRRI 10
2.2.1 The Intervention Logic Model 11
2.2.2 Levels of aggregation 11
2.2.3 Conceptual categories providing specification on each RRI dimension 12
2.3 Synthesis and assessment of existing indicators across RRI dimensions 16
2.3.1 Assessment of indicators on three parameters: 17
2.3.2 Main conclusions from the synthesis and assessment, Deliverable 3.1 19
2.4 Construction and compilation of 6x10 RRI indicators 21
2.5 Main criteria for selecting indicators 23
3. Composition of a core set of RRI indicators 26
3.1 The Gender Equality Dimension 26
3.2 The Dimension of Science Literacy and Scientific Education 27
3.3 The Dimension of Public Engagement 28
3.4 The Dimension of Open Access 28
3.5 The Dimension of Research and Innovation Ethics 30
3.6 The Dimension of Research and Innovation Governance 31
3.7 Overview of the 36 RRI indicators 32
4. Description of metrics and indicators of RRI 34
4.1 Description of the template for data collection fiches 34
4.2. Compilation of data collection fiches 36
4.2.1 Gender equality 37
4.2.2 Science literacy and science education 49
4.2.3 Public engagement 56
4.2.4 Ethics 71
4.2.5 Open access 77
4.2.6 Governance 85
5 Compilation of data collection methods 89
5.1 Data collection: Primary data 89
5.1.1 Science in Society actor survey 89
5.1.2 Research Performing Organisation (RPO) survey 89

5.1.3 Research Funding Organisation (RFO) survey 90
5.1.4 Register data 90
5.1.5 Desk research and qualitative interviews 91
5.2 Data collection: Secondary data 91
6. References 92

1. Introduction – descriptions of RRI metrics and indicators

This deliverable is the second of two reports within Task 3 of the MoRRI project. In short, the objective of Task 3 has been to construct, identify, and specify relevant metrics and indicators to be used in the subsequent RRI monitoring. Whereas the previous report (D.3.1) synthesised and assessed existing indicators and secondary data, this report (D.3.2) will [a] pin down the final, core set of RRI indicators, [b] provide detailed descriptions of each indicator, and [c] specify the primary and secondary data and procedures guiding the data-collection in Task 4. It should be noted that the indicators selected and presented in this report tap into RRI practices that could be used for monitoring the evolution of RRI across Europe. Later tasks of the MoRRI project will develop indicators focusing specifically on the societal benefits and impacts of such RRI practices. The structure and focus of the report is outlined below:

- Chapter 2 presents the methodological approach and accounts for the analytical considerations underlying the selection of the final set of RRI indicators, including the three specific classificatory schemes applied in MoRRI, i.e. [a] the intervention logic model [b] the various levels of aggregation and [c] the conceptual categorisations defined within each RRI dimension (see section 2.1). Likewise, the main selection criteria used to identify, assess, and construct the final set of RRI indicators, and the need for secondary and primary data, will be specified. Finally, Chapter 2 accounts for the structure and content of the data collection fiche which. This fiche has been developed to ensure transparent and detailed instructions for the harvesting of data in Task 4. When constructing RRI indicators and monitoring the evolution and benefits of responsible research and innovation, a number of key discussions relating to empirical matters emerge. The previous report, D.3.1, touches upon several of these discussions. A central issue in this regard concerns the implications of the above-mentioned classificatory schemes, e.g. whether to focus exclusively on the input and output indicators; whether indicator data need to be aggregated to the national level to allow for cross-country comparisons, and to which extent internal and external interlinkages within and across dimension categorisations need to be taken into account when constructing the indicators. These discussions will be continued throughout this report. Moreover, the double role of the governance dimension, which operates both as a separate dimension and an overarching 'umbrella' concept for the remaining dimensions (European Union, 2012), will be addressed.

- Chapter 3 accounts for the underlying rationales leading to the identification and selection of the final 36 indicators. These rationales include considerations of [a] EU28 coverage, [b] the possibility of repetitive data collection, [c] RRI conceptual coverage, [d] general quality assessment criteria, and [e] feasibility concerns.

- Chapter 4 provides detailed descriptions of each of the 36 final RRI indicators on the basis of a tailored data collection fiche encompassing information on the following matters: [a] general indicator specifications, [b] indicator assessment regarding the analytical distinctions and quality parameters specified in the context of the MoRRI project, and [c] specifications related to data collection.
- Chapter 5 compiles and specifies the empirical programme for harvesting primary data across the six RRI dimensions. Feasibility and data administration issues related to the altogether five proposed methods for primary data collection will be discussed in detail, and the eight final sources of secondary data are recapitulated.

2. Methodological specifications for indicator selection

The main objective of Chapter 2 is to account for the methodological strategy and the analytical approaches employed in the identification and selection of the final set of altogether 36 indicators that will be used in 'Monitoring the Evolution and Benefits of Responsible Research and Innovation' (MoRRI).

The chapter is structured as follows: Section 2.1 briefly accounts for the preceding tasks of the MoRRI project leading to the development of the final, core set of RRI indicators. Section 2.2 provides an introduction to the basic classificatory schemes of the project, i.e. the **intervention logic model**; b) the distinction between various **levels of aggregation**; and c) the underlying **conceptual categorisations** connected to each of the six RRI dimensions. Section 2.3 to 2.7 elaborate on the different procedural steps and selection criteria employed in the identification, assessment, and construction of the 36 RRI indicators. Moreover, this part accounts for the different types of data (both the harvesting of secondary data and the collection of primary data) needed to adequately cover the final set of indicators. Finally, Section 2.8 describes and discusses the tailored data collection fiche developed to provide transparent and detailed instructions for the data collection activities in the subsequent steps of the MoRRI project (specifically Task 4).

2.1 Outline of the preceding activities of the MoRRI project

As outlined in Table 2.1, which accounts for the preceding activities of the MoRRI project, the first procedural step (Task 1) was to identify the relevant literature and documents dealing with RRI issues. A systematic review covering a variety of RRI related documents, including academic literature, EC and other policy documents, conferences and on-going projects, provided central insights into each of the six RRI key dimensions[1], their policy context and main definitional elements.

Informed by the theoretical and conceptual explorations of Step 1 (Task 1), the main objective of Step 2 (Task 2) has been to develop a functional vocabulary covering each of the six RRI dimensions. Moreover, this procedural step has involved a stocktaking and assessment of all existing data sources considered relevant in the monitoring of the six RRI dimensions, including reflections on data gaps and assessments of the need for primary data collection in the subsequent tasks of the project. A written outline of Step 1 and 2 is available in the six analytical reports targeting each of the RRI dimensions (D.2.1-2.4.2 [for specifications see European Commission 2015a, 2015b, 2015c, 2015d, 2015e, 2015f]). The six reports collectively form the main output of Tasks 1 and 2 and have resulted in a tentative list of altogether 98 existing indicators / data sources considered potentially useful in measuring and capturing core aspects of RRI.

[1] I.e. public engagement, science literacy and scientific education, gender equality, ethics, open access, and governance.

The main objective of the third procedural step (Task 3.1) has been to classify and assess these promising 98 existing indicators and data sources with respect to their *relevance*/*proximity* and *robustness*/*quality* as individual measures of RRI at specified dimensions and levels of analysis. Moreover, an aggregate assessment and classification of the overall *relevance*/*proximity*, *robustness*/*quality*, and *data richness* of the available indicators have been conducted (more on this below).

Finally, the fourth procedural step (Task 3.2.), which is the main focus of this report, aims to pin down the final, core set of 36 RRI indicators (existing and new) and compile a systematic empirical programme for harvesting secondary and primary data across the six RRI dimensions in the project's data collection phase. The following section accounts for the basic classificatory schemes and conceptual categories which are considered pertinent for understanding the rationales leading to the selection of the final, core set of indicators.

Table 2.1. Procedural steps of the MoRRI project

Procedural steps	Main tasks
Step 1/Task 1 **State of the art review**	**Making use of EC material, scientific literature and on-going research projects to:** 1) Define the policy context of RRI, both in Europe and elsewhere 2) Assess comparatively several RRI dimensions, and weigh-up advantages and disadvantages of available options 3) Conduct a preliminary assessment on the availability of empirical evidence on the dimensions 4) Finalise the definitions and properties of the RRI key dimensions 5) Finalise the definitions and properties of additional factors that may be relevant for RRI monitoring
Step 2/Task 2 **Stocktaking and assessment of existing empirical data on the six targeted RRI dimensions**	**Providing a platform for subsequent definition of metrics and indicators for the six RRI dimensions on the basis of six analytical reports. Each report includes:** 1) A functional vocabulary for the relevant RRI dimension 2) A review of existing EC reports and other studies of relevance to the RRI dimension 3) Assessment and categorisation of the available data for the relevant RRI dimension 4) Tentative reflections on the need for primary data collection to cover the relevant RRI dimension in the subsequent tasks 5) A compilation of promising indicators based on existing empirical

Procedural steps	Main tasks
	information identified throughout the individual reports
Step 3/Task 3.1 **Synthesising and assessing the capacity, coverage and applicability of the identified RRI indicators**	**Providing a systematised and structured assessment of the altogether 98 tentative RRI indicators identified in the six analytical reports by:** 1) Evaluating and classifying each of the proposed 98 RRI indicators with respect to their *relevance* and *robustness* *2)* Conducting an aggregate assessment and classification of the available indicators for each of the six RRI dimensions with respect to overall *relevance*, *robustness* and *data richness* in covering RRI ***3)*** Identifying data gaps to guide and direct the need for collecting primary data and supplementary, secondary data when constructing the core set of RRI indicators
Step 4/Task 3.2 **(This report)** **Pinning down the final, core set of RRI indicators**	**Pinning down the final, core set of RRI indicators providing detailed descriptions of the selected indicators and specifying the primary and secondary data sources covered, by:** 1) Accounting for the preceding analytical steps leading to the selection of the final set of RRI indicators 2) Highlighting key discussions relating to the empirical aspects of monitoring RRI, and the coverage of the indicators across different levels and areas of analysis 3) Presenting the final set of indicators forming the basis of the data collection, and accounting for the underlying rationales leading to the selection of these particular indicators 4) Constructing a tailored data collection fiche providing transparent and detailed instructions on the data collection related to each indicator. 5) Compiling and specifying the empirical programme for harvesting secondary and primary data across the six RRI dimensions.

2.2 Classificatory Schemes applied in MoRRI

As described in section 2.1, the initial steps of the MoRRI project (Tasks 1 and 2) have resulted in a tentative list of altogether 98 existing indicators and data sources deemed useful in measuring and capturing core aspects of the six RRI dimensions. The identification and classification of these indicators and data sources have been structured around two classificatory schemes and a number of dimension-specific

conceptual categories creating a systematic, specified and consistent assessment of all indicators addressing one or more aspects of RRI.

2.2.1 The Intervention Logic Model

To develop a solid conceptual framework capable of addressing the complex nature of RRI in the best possible manner, the MoRRI project borrows ideas from the evaluation literature. More specifically, it introduces the 'intervention logic model' as a starting point for monitoring various types of impacts and benefits of RRI. The intervention logic model is based on the explanatory idea that complex policy problems are characterised by a series of issues or problems that need to be addressed, a set of **inputs** which are applied to a series of activities, which generate **outputs** which in turn lead to **outcomes** or the resolution of the problems. This logic informs and relates to a 'theory of change', i.e. an assumption or hypothesis of why an intervention will succeed in producing desired outcomes and impact(s). A 'theory of change' specifies how activities are expected to lead to interim and longer term outcomes. The elaboration of the theory of change can strengthen the case for attributing observed changes to an action and is thus an important aspect of the method of approach to the evaluation. An important aspect of the logic model is the identification and description of key **contextual**, external factors that could influence the intervention either positively or negatively (MoRRI Proposal 2014). [2]

The main characteristics of the four elements of the intervention logic model applied in the MoRRI project can be summarised as follows: *context indicators* provide information on the environment and overall situation in a country and across countries; *input indicators* concern the activities carried out, measures taken, structures created and resources allocated to promote RRI. Moreover, this type of indicators focuses on the system and consistency of the RRI related initiatives. *Output indicators* address the immediate and direct results of these activities, while indicators of outcome scrutinize the more far-reaching and long-term achievements and perceived benefits of the RRI work (MoRRI Proposal 2014: 64).

2.2.2 Levels of aggregation

Another important classificatory scheme applied in the identification and assessment of promising RRI indicators, concerns the determination of the level of analysis or degree of aggregation characterising the available indicators. The MoRRI project distinguishes between the following levels of aggregation: the global, the national, the regional, the institutional, the programme/project and the individual level. The **global level** concerns indicators and data types that [a] exceed the national level as the smallest unit of analysis, [b] includes countries not associated with the EU, and [c] data that cannot be specified in terms of national, regional and institutional variation. The **national level** covers indicators providing information on country-level variations among the EU member states and associated countries. Such indicators may draw on data that can also be analysed at smaller units of analysis (e.g. Eurobarometer data).

[2] This paragraph includes a slightly modified version of the description of the intervention logic model included in the MoRRI project proposal (2014: 42)

The **institutional level** comprises all data types and indicators enabling analysis of variation on RRI parameters across institutions (e.g. research performing organisations, research funding organisations). The **programme/project level** has been used to classify data on RRI accessed via research programmes and projects (e.g. the EU FP7 framework). In most cases, this level of aggregation does not leave space for meaningful analysis at institutional and national levels of aggregation. Finally, data at the **individual level** covers information related to citizens' individual performance (e.g. in the PISA studies) and perceptions or opinions (e.g. in the Eurobarometer) on RRI related issues.

2.2.3 Conceptual categories providing specification on each RRI dimension

In the six analytical reports forming the main output of Tasks 1 and 2 (for specifications see Section 2.1.), a number of theoretically-derived dimension-specific conceptual categories have been carved out to conceptualise and operationalise each RRI dimension. These categories enable a systematic and functional approach to the monitoring of RRI. The following conceptual categories have been deemed central in assessing the coverage and relevance of promising indicators connected to each of the six RRI dimensions.

Public engagement

Within the public engagement (PE) dimension, PE mechanisms and initiatives have been classified according to 1) their aim/objective and 2) the direction of the flow of information. The five categories are outlined in table 2.2., below. Apart from tapping into the distinction between horizontal (culture-oriented activities) and vertical (policy-oriented) engagement, the typology is also indicative of possible intersections with other RRI dimensions. PE activities aiming "to inform and/or educate citizens' (*public communication*), for instance, often share objectives and features with those related to the dimension of science literacy and scientific education. Further, the categories *public activism*, *public deliberation* and *public activism* interrelate with aspects of participatory governance of research and innovation (EC 2015a: 14-15).

Table 2.2 Public engagement categorisations

Categorisations
Public communication – *the aim is to inform and/or educate citizens*. The flow of information constitutes one-way communication from sponsors to public representatives, and no specific mechanisms exist to handle public feedback (examples include public hearings, public meetings and awareness raising activities).
Public activism – *the aim is to inform decision-makers and create awareness to influence decision-making processes.* The information flow is conveyed in one-way communication from citizens to sponsors but not on the initiative of the sponsors, which characterise the 'public consultation' category (examples include demonstrations and protests).
Public consultation – *the aim is to inform decision-makers about public opinions on certain topics.* These opinions are sought from the sponsors of the PE initiative and no dialogue is implemented. Thus, in this case, the one-way communication is conveyed from citizens to sponsors on the initiative of sponsors (examples include citizens' panels, planning for real, focus groups and science shops).

Categorisations
Public deliberation – *the aim is to facilitate group deliberation on policy issues, where the outcome may impact decision-making.* Information is exchanged between sponsors and public representatives and a dialogue is facilitated. The flow of information constitutes two-way communication (examples include 'mini publics' such as consensus conferences, citizen juries, deliberative opinion polling).
Public participation – *the aim is to assign partly or full decision-making-power to citizens on policy issues.* Information is exchanged between sponsors and public representatives and a dialogue is facilitated. The flow of information constitutes two-way communication (examples include co-governance and direct democracy mechanisms such as participatory budgeting, youth councils and binding referendums).

Source: EC 2015a: 14-15; the categorisation was originally developed by the PE2020 project (see www.pe2020.eu)

Science literacy and scientific education

The science literacy and scientific education (SLSE) dimension applies a tripartite categorisation to operationalise the multifaceted field of science literacy. Three aspects are identified within this general notion; *science education, science communication* and *co-production of knowledge* (see table 2.3 below). As specified in the analytical report covering this dimension, 'science literacy as it is defined in the context of the MoRRI project is generated through activities aiming to provide citizens with a deeper understanding of science, to shape their attitudes towards science and to develop their abilities to contribute to science and science-related policy-making. Including the co-production of knowledge in the dimension of SLSE, alters the way we think about the public and its role in science and innovation, from a mere receiver and customer to an active agent of change' (EC 2015c: 15). The aspect of *co-production of knowledge* is clearly interlinked with mechanisms and activities carried out within the field of public engagement. Crowd-sourcing, science shops, open innovation (e.g. co-creation spaces) are examples of PE mechanisms with co-production of knowledge as distinct objectives.

Table 2.3 Science literacy and scientific education categorisations

Categorisations
Science education: Science education aims at educating (especially young) citizens about scientific facts (textbook knowledge), the norms of science and the way science is 'done' as well as at conveying a positive 'image' of sciences. However, it also provides the opportunity to reflect and question science and the 'truths' it produces critically. It takes place in institutions in early childhood education and care, the school system, higher education, vocational education and training as well as in lifelong-learning. Science education is the basis for science literacy.
Science communication: Science communication activities aim at educating citizens of all ages about science and generating awareness of science-related issues and a positive image of/attitude towards science. These activities can take direct forms (for instance through open days, museums or science centres) or be more indirect with mediators between the scientists and the public (e.g. via science journalists and their products such as TV programmes or media articles etc).[3] Generally, a large number of different institutions are involved in science

3 One activity that is often mentioned in the context of science communication are public relations activities of research institutions. For this project however, we explicitly exclude this type of activities for our definition of science communication.

Categorisations
communication. Science communication produces linkages between science and society by creating or enabling transmission of knowledge about science and technology. This transmission can be both one-way (for instance in pure information formats) and two-way (e.g. in dialogue-oriented formats).
Co-production of knowledge: Co-production of knowledge is a relatively new aspect of science literacy. It is characterised by a co-creation of knowledge through cooperation of scientific experts and non-experts. One well-known example is Citizen Science. This type of coproduction has been defined as 'research collaborations between scientists and volunteers, particularly (…) to expand opportunities for scientific data collection and to provide access to scientific information for community members' (The Cornell Lab of Ornithology, 2015). Other types of co-production include open-innovation, crowd science, or user-driven innovation.

Source: EC 2015c: 15

Gender equality

The dimension of gender equality is defined according to a 'three dimensional construct' addressing 1) the (under-) representation of women in research and innovation with the objective to reduce gender segregation, 2) the structural and organisational changes in research institutions with the aim to break down structural gender barriers by means of action plans, gender budgeting, among others actions, and 3) the inclusion of gender in R&I content (EC 2015b: 17-18, and see table 2.4). As specified in the analytical report covering this dimension, gender equality has been perceived as closely connected with the ethics and governance dimension, moderately interlinked with science education and non-reciprocally connected to public engagement, whereas no connection exists to the open access dimension (EC 2015b: 20). While most large-scale data sets provide information on gender (e.g the gender of respondents), explicit gender issues are rarely included in the content (e.g. gender differences in stem research as an indicator). Potential interlinkages among dimensions will be explored further below.

Table 2.4 Gender equality categorisations

Categorisations
Horizontal and vertical participation of women in research: The first pillar comprises measures to promote women in fields, where they are underrepresented as well as to increase female participation in management and decision-making positions. The goal here is to reduce gender segregation.
Structural change in institutions: The second pillar comprises structural measures aimed at revising existing organisational arrangements to progressively eliminate barriers impeding women's advancement to top positions and factors inducing women to drop out of science.
Gender in research content: The third pillar of gender equality – the integration of a gender dimension in research and innovation content – is legitimised by the gender mainstreaming strategy on the one hand and by quality standards in science and research on the other (Caprile et al. 2012). Gender studies and gender and sex analysis are now either well-established or at least partly in place in almost all fields of research. Indeed, it is argued that research results are not valid or reliable if they only consider male research subjects.

Source: EC 2015b: 17-18, 44 – see this report for complete definitions

Ethics

Within the dimension of research and innovation ethics, three conceptual aspects have been identified. These relate to 1) *ethical governance*, with the main instruments being ethical commissions, ethical codes and soft law, 2) *ethical deliberation*, where the central instrument is Technology Assessment (TA) (or ethical constructive Technology Assessment (eCTA)), and 3) *ethical reflection* that stresses the public engagement aspect in deliberations on S&T ethics (EC 2015e and see table 2.4).

Table 2.5 Ethics categorisations

Categorisations
Ethical governance: I.e. "institutionalising ethics debate in terms of the implementation of standards in research ethics in science, technology and innovation policies" (Brom et al. 2015: 15)
Ethical deliberation: I.e. "institutionalising ethics debate that raise issues in science and technological developments in science, technology and innovation policies" (ibid.)
Ethical reflection: I.e. "institutionalising ethics debate that support critical reflection and engagement in debates on research standards, emerging technology issues and social justice in science, technology and innovation policies" (ibid.).

Source: EC 2015e: 6

Open access

Open Research Data is a relatively new and emerging field of scholarship, and systematized data sources are still fairly scarce compared to the data availability on issues related to *Open Access*. Research on open research data and data sharing have mainly been conducted as case studies, but growing efforts are made to systematise such sources with the objective of developing data metrics (EC 2015d: 35-36).

Table 2.5 Open access categorisations

Categorisations
Open Access (OA): Open access is the idea of making research results freely available to anyone that wants to access and re-use them. One of the main drivers of the OA idea is to make publicly funded research accessible to the general public. The term Open Access originally referred to the provision of free access to peer-reviewed academic publications.
Open Data (OD): Presently, the term [open access] also encompasses the free access to the research data that underpins publications or research projects, also referred on its own as Open Research Data (OD). Open Research Data is usually distributed with requirements of attribution and share-alike (copies or adaptations of the data need to be shared using the same principles as the source).

Source: EC 2015d: 18

Governance

Table 2.6 illustrates 'a typology of governance approaches that helps to structure discussions about changing governance. In this regard, it is important to note that incentives and moves to democratise governance of science and innovation must be understood in the context of other moves and pressures to close down governance in discretionary, corporatist and market ways' (EC 2015f: 10).

Table 2.6 Governance categorisations

Categorisations
Discretionary governance: Policies in this category are made without explicit interaction with 'the public'. Governance is presented primarily as a matter for government, which is seen as serving universal goals of progress.
Corporatist governance: This involves a formal recognition of differences of interest as an input to negotiation. As negotiation takes place within a closed or highly regulated space, the decisive feature of this mode is the admission of stakeholders.
Educational governance: This assumes that policies for science and technology have foundered on the shoals of public ignorance. Hence, it is necessary to create an informed citizenry.
Market governance: Science and technology are best regulated by demand and supply. The value of science comes from the surplus value created through its commercialization and contribution to the generation of wealth. The public participates as customers and consumers.
Agonistic governance: This form of governance occurs in a context of confrontation and adversity. The storage of nuclear waste in the UK is a case where policy seems to have stalled in the face of public opposition: opposition to GM foods has also taken agonistic form.
Deliberative governance: This rests on the assumption that open debate and engagement can create a satisfactory foundation for decision-making. In this mode, the public are not consumers of science, but rather 'scientific citizens'.

Source: EC 2015f: 10. The typology is adapted from Hagendijk and Irwin 2006

Against the backdrop of this brief introduction to the basic classificatory schemes and conceptual clarifications, the following section elaborates the main assessment criteria and analytical strategy employed in condensing and dissecting the first list of 98 promising existing RRI indicators.

2.3 Synthesis and assessment of existing indicators across RRI dimensions

As described in Section 2.1, the main objective of the third procedural step of the MoRRI project (i.e. Task 3.1) was to classify and assess each of the altogether 98 promising indicators and data sources identified by the six analytical dimension reports with respect to *relevance*/*proximity* and *robustness*/*quality*. Moreover, this procedural step involved an aggregate assessment and classification of the overall *relevance*/*proximity*, *robustness*/*quality*, and *data richness* of the available indicators within each dimension with respect to coverage of core RRI aspects. Finally, data quality, coherence and availability have been scrutinised according to the classificatory

schemes presented above, through a cross-reading of data explorations vis-à-vis the dimension specific conceptual categories.

The following paragraphs summarise and discuss the main outcomes of this classification and assessment process. Moreover, it accounts for data gaps and emerging requirements for primary data collection. However, before turning to this discussion, it is necessary to briefly introduce the basic assessment criteria structuring the analytical steps of this assessment exercise.

2.3.1 Assessment of indicators on three parameters:

As mentioned, step three (Task 3.1.) in the MoRRI project introduces three main parameters of assessment: [a] Relevance/Proximity, [b] Robustness/Quality and [c] Richness of data. The three parameters have been developed with the purpose of providing a systematic overview of the identified indicators (and data sources), in terms of their capacity, coverage and applicability in measuring and capturing aspects of RRI on various dimensions and levels of analysis. The following paragraphs briefly account for each of these parameters.

Relevance/Proximity:

The question of *relevance/proximity* concerns the relevance of the identified indicators and data sources in measuring RRI related aspects, and their proximity to the core content of the RRI concept. The assessment of the *relevance/proximity* parameter has been conducted at two separate analytical steps. As a first step, the relevance/proximity of each of the altogether 98 indicators has been assessed.

As a second analytical step, an aggregate assessment of the overall relevance of the available indicators with respect to [a] the coverage of the four dimensions of the intervention logic model (i.e. context, input, output, and outcome), and [b] the coverage of the six analytical levels of aggregation (i.e. global, national, regional, institutional, programme/project, and individual) have been made. The assessment of relevance/proximity has been based on the following three-point colour scale:

- Red (Weak relevance)
- Yellow (Medium relevance)
- Green (strong relevance)

Robustness

The parameter of *robustness/quality* concerns the validity and reliability of the identified existing indicators in measuring specified dimensions and analytical levels of RRI. The parameter represents a composite measure of the four aspects of robustness/quality outlined below.

1) *Content validity* concerns the extent to which the content or theoretical construct of the indicator matches the content domain it has been defined to measure (Hertog et al. 2014). The issue of indicator attribution constitute a crucial element in ensuring the content validity of the identified measures.

2) *Reliability* concerns the quality, consistency and comparability of the underlying data forming the basis of the identified indicators. As mentioned by Hertog et al. (2014: 8), one major issue, when drawing on secondary data is that 'each country uses its own specific data sets, measurement methods, and definitions. Although supranational organisations such as the OECD and EU have made great progress in unifying international data collection, substantial differences exist between countries. The basic problem is that it is sometimes difficult to tell whether (or to what extent) the differences in a model between countries are real or rather constructs due to differences in measurements'. In other words, it seems crucial to account for the actual consistency and comparability of the available aggregate data derived from the country-specific data-sets.

3) *Indicator coverage bias* aims to clarify whether a bias exists in the structure of the data itself (Hertog et al. 2014: 9). The lack of coverage of the humanities and parts of the social sciences in Thomson Reuters' Web of Science may for instance lead to structural bias in the otherwise highly relevant measures of developments in Open Access publications across scientific disciplines and countries.

4) *External validity* addresses the extent to which the data collected on the basis of the 98 indicators are providing information that is generalizable to a broader population of cases, situations or people.

The aggregate assessment of *robustness* is based on the following three-point scale:

- "no sign" (Weak robustness)
- + (Medium robustness)
- ++ (Strong robustness)

Richness of data

The parameter of *richness of data* concerns the potential capacity of the available data collected on the basis of the 98 indicators in covering the conceptual categories carved out for each of the six RRI dimensions. In opposition to the above-mentioned parameters (i.e. *relevance* and *robustness*), this assessment only took place at aggregated levels (i.e. the four dimensions of the intervention logic and the six levels of aggregation). In this regard, it is crucial to note that the *richness of data* parameter does not address questions of sample size and external validity of the available data, but merely concerns the indicators' capacity to capture the RRI dimensions at aggregated levels. The assessment of richness is based on the following three-point scale:

- 0 (Weak data richness)
- 1 (Medium data richness)
- 2 (Strong data richness)

Table 2.7 recaptures the three parameters of assessment employed throughout the analysis.

Table 2.7 Parameters of assessment

Parameter of assessment	*Relevance/Proximity* of indicator(s) as measure(s) RRI related aspects	*Robustness/Quality* of indicator(s) in measuring RRI	*Richness of data* in capturing aspects of RRI
Three-point assessment scale:	• Red (Weak) • Yellow (Medium) • Green (Strong)	• "no sign" (Weak) • + (Medium) • ++ (Strong)	• 0 (Weak) • 1 (Medium) • 2 (Strong)

2.3.2 Main conclusions from the synthesis and assessment, Deliverable 3.1

A main conclusion derived from the synthesis and assessment of the 98 promising RRI indicators communicated in Deliverable 3.1, is that the *input* and *output* dimensions of the intervention logic model comprise the most comprehensive and saturated indicators of RRI. Particularly the RRI dimensions of Public Engagement and Gender Equality contain highly relevant, robust and data rich **input level** indicators, whereas the available Open Access and Ethics indicators, while relevant, are more difficult to assess in terms of robustness and richness of data. Moreover a data gap exists for the Science Literacy and Science Education dimension at the input level.

Particularly the Open Access dimension comprises a saturated set of RRI indicators at the **output level**. Relevant but less robust and data rich indicators, however, also exist for the other dimensions. The overall robustness of the available indicators anchored in the dimensions of Science Literacy and Science Education, Gender Equality and Open Access, could however be further enhanced by reassigning the available outcome level indicators to the output level.

Consequently, the synthesis and assessment of the available indicators in Task 3.1 have resulted in the suggestion that it would be worthwhile considering, whether the collection of primary data and identification of additional secondary data in Task 4 of the MoRRI project should limit their focus to the input and output dimensions of the intervention logic model. It should be noted that the development of indicators and collection of data for RRI benefits in Task 6 onwards may better serve the potential need for focusing on the long-term outcomes.

Indicator/data availability at different levels of aggregation

Another main conclusion derived from Deliverable 3.1 concerns the determination of the main levels of aggregation characterizing the available indicators. Data availability is distributed highly unequal across the five levels of aggregation. The global level merely comprises indicators anchored in the Open Access dimension, which nevertheless are highly relevant, rich and robust. The national level contains the most comprehensive set of relevant RRI indicators; both across the four levels of the intervention logic model and the six RRI dimensions. In general the available indicators at this level are considered highly relevant and relatively strong in terms of data robustness and richness, and data gaps primarily exist for the Ethics dimension.

No data entries exist at the regional level. The institutional level is mainly populated by public engagement indicators. And half of these are only partially relevant to the MoRRI project. The project/programme includes a number of highly relevant Gender Equality indicators, whereas several partially relevant indicators connected to the dimensions of Public Engagement and Ethics are also available at the individual level.

From this we can conclude that the most saturated set of indicators across the six RRI dimensions is available at the **national level**, and Deliverable 3.1 therefore also puts forth the suggestion that the scope of data collection in the subsequent steps of the project could fruitfully be limited to indicators reflecting this particular level of aggregation. It should be noted that this level also seems particularly relevant for international learning and comparison, and thus for the overall objectives of the MoRRI project.

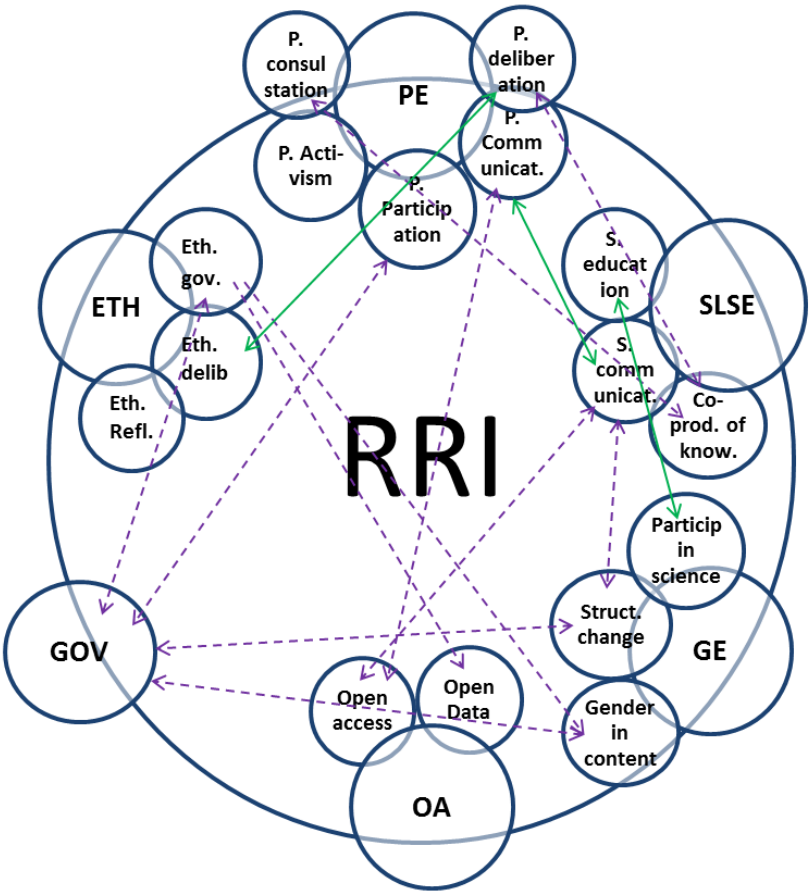
Interlinkages among RRI (sub-)dimensions/categories

In deliverable 3.1, an attempt has been made to account for the interlinkages among and between the conceptual categories of each RRI dimension. This part of the analysis highlights the following questions to be addressed in the subsequent steps of the project.

- Are the analytical sub-dimensions/categories within each RRI dimension sufficiently covered?
- When considering internal overlaps among sub-dimensions, and the relevance of each sub-dimension, do all categories need to be equally well covered?
- Do sub-categories need to be equally well-represented at all levels in the intervention logic model and across aggregation levels?
- To which extent do RRI dimensions and their respective sub-dimensions intersect, and how do such intersections influence data coverage?

To further guide the collection of primary and secondary data, while ensuring consistency across the six RRI dimensions at different intervention- and data levels, existing and potential interlinkages between RRI dimensions and sub-dimensions were also depicted (see figure 2.1. below). The coloured arrows reflect whether interlinkages are directly addressed (green) in the existing set of indicators, whereas the purple arrows display potential interlinkages that could be further explored. The direction of the arrows indicates whether the interrelations are reciprocal or non-reciprocal. Several of the indicators addressing the *Public Communication* aspect of PE, for instance, bear clear relevance to, and reveal actual overlaps with, the SLSE sub-category of *science communication*. Similarly, a range of other potential interlinkages could fruitfully be further explicated and explored when identifying and establishing the final set of indicators.

Figure 2.1. Existing and potential interlinkages/overlaps *between* RRI dimensions/sub-dimensions



Source: MoRRI deliverable 3.1

2.4 Construction and compilation of 6x10 RRI indicators

As outlined above, Deliverable 3.1 has provided a first stocktaking of existing RRI indicators, and a first mapping of key data gaps for the subsequent construct of new indicators. The report has also stimulated key discussions and critical reflection on the succeeding procedure of identifying and constructing a final set of proposed RRI indicators, while taking into consideration the three guiding classificatory schemes (see section 2.1). A central question raised in the assessment report concerns whether the following steps of the RRI monitoring should focus exclusively on input and output indicators (i.e. de facto activities/practises and the immediate impacts/effect of such activities). This question and other key issues and recommendations raised in Deliverable 3.1 became the starting point of a joint video-conference among the dimension leaders and dimension representatives in May 2015. The purpose of the conference was to establish mutual understanding and agreement based on careful deliberations on main selection and assessment criteria. The main conclusions of this meeting (see below) informed the subsequent step in the process towards reaching a

final set of RRI indicators. In this procedural step, the aim was to identify and construct 10 indicators within each dimension. The most qualified and relevant indicators identified among the first set of 98 existing indicators were selected, and new ones were constructed against the backdrop of Deliverable 3.1 and the deliberations made at the video-conference.

With regard to the latter, the main conclusions were as follows:

- Based on discussions about current indicator availability and the EC objectives for the study, it was decided to focus on fewer categories in the RRI monitoring part of the project (noting that an empirical programme will also be rolled out on impacts/benefits monitoring). Therefore, the indicators for RRI monitoring were to focus on the 'input' and 'output' categories of the intervention logic model. In relation to levels of aggregation, the final set of indicators will focus on the 'national' level in order to provide a foundation for potential cross-country comparisons.
- With regard to the conceptual schemes applied to individual dimensions, the final collection of indicators does not necessarily need to be proportionately distributed across these categories, but should adequately exhaust the concept. As figure 2.1 above illustrates, the (sub-)dimensions may be more or less closely linked to other (sub-)dimensions, and it is strongly recommended that these interlinkages enter into the set of selection criteria employed since they are considered a strength and valuable in getting beyond the "silo" thinking around RRI.
- The meeting also emphasised the importance of paying particular attention to populating the 'governance' dimension. While this dimension constitutes a separate dimension, it also functions as an overarching dimension or 'umbrella' concept for the remaining dimensions (European Union 2012). In this regard, a great number of indicators identified within the other five dimensions relate directly to governance of research and innovation, further indicating that this dimension can be treated 'as an overarching consideration across the other dimensions of responsible research and innovation' (EC 2015e: 31).
- A set of core indicators should be promising for over-time application also beyond the lifespan of the project and thus a main proportion of the final set of indicators should be relevant for future data collection performed by the EC or by member states.
- With regard to coverage, the project should aim to have a core set of indicators where data is available for all EU member states. This has implications for both new indicators and existing ones. Ideally, new indicators should be applicable across EU28. When it comes to existing indicators, many of these only partially cover EU. Therefore, procedures for collecting supplementary primary data (to fill the gaps of existing data) should be addressed in the data collection fiches describing each of the 10 indicators to be suggested. While it is preferred to proceed with a core set of indicators suitable for repetitive data collection and a core set of indicators covering EU28, it is very likely that a broader set of relevant indicators can be identified characterised by limited coverage and

where sustained data collection is not feasible. The specific procedure for managing the segregation into core – 'periphery' indicators will – as the above-mentioned considerations - be a recurring theme in the next procedural steps.

The 10 indicators proposed within each dimension share the following characteristics [a] all indicators can be aggregated at the national level; [b] most of them are candidates for time-series; [c] only the most promising indicators based on secondary data have been included [d] new indicators have been constructed for all dimensions, and in particular for the dimension of governance, where indicators were developed subsequent to the research process detailed in report D.3.1; [e] most indicators address the input and output level; and [f] many of the potential interlinkages between indicators relates to the governance dimension.

2.5 Main criteria for selecting indicators

The moderated list of indicators and the related assessment process gave rise to cardinal questions concerning the adequacy and accuracy of the individual and compiled set of indicators in covering the general concept of RRI and its six dimensions. These questions became the focal points in a joint workshop among the project partners in Brussels in May 2015. This workshop also addressed the following issues: [a] does the moderated list of indicators adequately cover potential indicator candidates for sustained data collection (i.e. time series data)? [b] Will it be possible to compile a set of data collection methods through which several metrics across dimensions can be harvested? [c] Does the moderated list of indicators fully capture EU28 while also adequately covering the concept of RRI?

The joint deliberations of the Brussels workshop resulted in a common understanding of the framework for the final indicator design, including the subsequent procedural steps. Against the backdrop of this meeting, and in view of a number of EC recommendations, the partners agreed upon the following main criteria to guide the identification and construction of the final set of indicators:

- **EU 28 coverage**: Ideally, the set of RRI indicators should adequately cover EU28 for the sake of representativeness. In a policy perspective, the comparative element also remains significant as a means to gain insights into country performance vis-à-vis responsible research and innovation.
- **Possibility for sustained data collection**: Indicators that could be candidates for long-term, repetitive data collection (beyond the life span of the project) should be pursued and taken into consideration in the design of the primary data collection. As illustrated in table 2.3.1, a few indicators are not considered well suited for sustained data collection. In most cases, however, these indicators are based on secondary data, which are fairly easy to harvest. At the same time they provide data of high relevance to the various RRI dimensions. The indicators based on MASIS data provide an indicative example.
- **RRI conceptual coverage**: The indicators should adequately cover all six dimensions. Ideally, a number of indicators should be 'multi-dimensional' in

character, since such indicators are considered better at capturing the core RRI notion. It should be noted that it will be empirically tested how indicators cluster together once the data is available.

- **Focus on input and output indicators:** Based on the assessment of existing indicators/secondary data, it is recommended that MoRRI should focus on the actually implemented RRI activities (inputs) as well as the outputs generated (output). In line with the RRI expert group (EC 2015g: 11), the partners support the argument of maintaining a focus on the 'short and midterm effects', while underlining that 'impact evaluation is shifting from (end)product to process, and from verdicts/judgments to learning and improving'.
- **Balance between targeted social actors**: Like the different RRI dimensions need to be adequately represented in the final set of indicators, so do the various societal actors and stakeholders, both individually and collectively. For instance, if the project is to reach a set of reasonably comprehensive RRI indicators, key social actors representing civil society, research communities, governmental institutions, business and industry, among others, need to be addressed with regard to their various roles in research and innovation processes.
- **Qualitative and quantitative data**: Considering the uncharted field of responsible research and innovation, and consequently the dearth of comprehensive sets of RRI indicators, qualitative data enabling in-depth understandings of the complex and multi-dimensional RRI field are seen as vital in the identification and construction of indicators. Such approaches do however 'rarely provide data that are straight-forwardly applicable in terms of benchmarking, and for the purposes of the monitoring study, it will be necessary to translate qualitative material into 'quantitative' indicators and measures that allow for comparisons across countries' (MoRRI Proposal 2014: 37).
- **General quality assessment criteria:** As specified in section 2.2, the criteria of *robustness/quality* concerns the validity and reliability of indicators in measuring specified dimensions and analytical levels of RRI. The issues of validity and reliability do however also constitute more generic quality criteria that need to be taken into consideration in the construction of RRI indicators in general. The most important aspects are restated below:

  Content validity concerns the extent to which the content or theoretical construct of the indicator matches the content domain it has been defined to measure (Hertog et al. 2014). The issue of indicator attribution constitute a crucial element in ensuring the content validity of the identified measures.

  Reliability concerns the quality, consistency and comparability of the underlying data forming the basis of the identified indicators. As mentioned by Hertog et al. (2014: 8), one major issue, when drawing on secondary data is that "each country uses its own specific data sets, measurement methods, and definitions. Although supranational organisations such as the OECD and EU have made

great progress in unifying international data collection, substantial differences exist between countries. The basic problem is that it is sometimes difficult to tell whether (or to what extent) the differences in a model between countries are real or rather constructs due to differences in measurements". In other words, it seems crucial to account for the actual consistency and comparability of the available aggregate data derived from country-specific data-sets.

Indicator coverage bias aims to clarify whether a bias exists in the structure of the data itself (Hertog et al. 2014: 9). The lack of coverage of the humanities and parts of the social sciences in Thomson Reuters' Web of Science, may for instance lead to structural bias in the otherwise highly relevant measures of developments in Open Access publications across scientific disciplines and countries.

External validity addresses the extent to which the data collected on the basis of the indicators are providing information that is generalizable to a broader population of cases, situations or people.

A number of indicators in the moderated set require primary data collection. To collect primary data, different approaches have been suggested. These include: desk research, register-based data collection, surveys and interviews. In this regard, it will be relevant to clarify whether several metrics across dimensions can be collected through the same fieldwork, and to which extent this would be feasible. To establish the subsequent process of identifying and constructing indicators, the research design for collecting primary data therefore requires a set of well-defined methods taking into consideration criteria such as appropriateness of methods (individually and collectively), issues of relevance, robustness, richness as well as feasibility concerns/data administration matters. These issues will be accounted for in the construction of the final set of indicators (see chapter 4). Specifications on the final set of data collection methods will be presented in Chapter 5.

3. Composition of a core set of RRI indicators

Chapter 3 accounts for the underlying rationales guiding the selection of the final set of RRI indicators (the actual indicators will be presented in Chapter 4). As mentioned above, these rationales include considerations on EU 28 coverage, the possibility for repetitive data collection, RRI conceptual coverage, general quality assessment criteria, and feasibility concerns. The specified rationales relating to each RRI dimension draw on specifications provided by the six dimension leaders. In the following, each of the dimension-specific rationales will be discussed separately.

3.1 The Gender Equality Dimension

The final set of indicators for the Gender Equality dimension has been developed to cover the following three sub-dimensions: [a] horizontal and vertical participation of women in research, [b] structural change in institutions, and [c] gender in research content.

To investigate national variations in the horizontal and vertical gender segregation of researchers, four indicators (three based on secondary data and one based on register data, all with full EU28 coverage and sustainable data collection in place) have been proposed. **GE2 - Share of female researchers by sector** accounts for the gender distribution of researchers across sectors (i.e. higher education, government and non-profit sectors), hereby providing basic information on sectorial variations with respect to women's opportunities and barriers. **GE4 - Dissimilarity Index** comprises information on the horizontal gender segregation of researchers in the higher education and government sectors. **GE6 - Glass Ceiling Index** addresses the issue of vertical segregation, by measuring women's chances of reaching the highest academic ranks relative to men's. **GE7- Gender Pay Gap** measures gender variations with respect to annual earnings, and will be used as a proxy for gender equality in the non-academic research sector. **GE10 - number and share of female inventors and authors** illuminates developments in women's representation across fields and sectors over time, on the basis of bibliometric data and patent counts.

The availability of indicators on the sub-dimensions of structural change and gender in research content is modest. In 2013, efforts were made by the ERA group to collect cross-institutional and cross-national data on these matters (EC 2014), but these surveys will not be continued. The following seven indicators will therefore be based on primary data collected via Research Performing Organisations (RPO) and Research Funding Organisations (RFO) surveys with full EU28 coverage and a possibility for repetitive data collection (see description of primary data collection methods in chapter 5).

GE8 – Share of female heads of RPOs and **GE9 – Share of gender-balanced recruitment committees at RPOs** will monitor female participation in decision-making, while **GE1- Share of RPOs with gender equality plans** measures institutional engagement in GE work.

Finally, **GE3 – Share of RFOs promoting gender content in research** and **GE5 – Share of RPOs with policies to promote gender in research content** investigate the extent to which RPOs and RFOs take actions to ensure the integration of the gender dimension in research content.

3.2 The Dimension of Science Literacy and Scientific Education

For the dimension of Science Literacy and Science Education four final indicators have been proposed. As science education is considered the most important aspect of this dimension, two indicators are allocated to this sub-category. For each of the other two sub-dimensions one indicator is presented. These four indicators cover all three sub-categories of SLSE: science education, science communication and co-production of knowledge.

In the following, selection rationales for each indicator (i.e. information about EU 28 coverage, the possibility for repetitive data collection, feasibility and general quality assessment) are presented,

SLSE 1 - Science curricula is the first of two indicators covering the sub-dimension of science education. It provides information on the extent to which societal aspects of science and technology are mentioned in the curricula as important aspects for teachers to include in their teaching. The indicator is based on primary data with expected EU28 coverage. Data collection by this approach is costly and could prove rather challenging due to varying educational systems across countries. This renders the indicator inappropriate for repetitive data collection. Hence, it is considered very useful as a one-off source.

SLSE 2 - RRI related training (i.e. the second science education indicator) focuses on young researchers in research performing organisations. The indicator provides information on whether and to what extent RRI-related aspects (i.e. ethical, economic, environmental, legal and social aspects (EEELSA), are included in the training of young researchers. SLSE 2 is based on primary data collected by means of the centrally administered RPO survey described in chapter 5. Full EU28 coverage is expected and repetitive data collection is possible. The general feasibility of the indicator is expected to be relatively high.

The sub-dimension of science communication is covered by **SLSE 3 - Science communication**. This indicator uses secondary data from the MASIS project to illuminate variations in the overall national science communication culture across EU28. Due to its complexity the indicator is not well suited for repetitive data collection but as a secondary one-off source, it is considered highly relevant and useful. Since data is readily available for all 28 member states, the general feasibility of this indicator is high.

The sub-dimension of co-production of knowledge is covered by **SLSE 4 - Citizen science**. This indicator aims to capture information about citizen science projects performed in RPOs within and across countries. It is based on primary data to be collected from the centrally administered RPO survey. The indicator is well suited for

repetitive data collection, and within an emerging field such as citizen science, changes may be considerable also in shorter periods of time.

3.3 The Dimension of Public Engagement

For the Public Engagement dimension a set of 10 indicators has been established. This is a fairly high number of indicators for this dimension, but as many as seven of these (PE1, PE2, PE3, PE7, PE8, PE9, PE10) relate to the Governance dimension, which has a limited set of targeted indicators. Hence, we consider it useful to sustain a broad range of indicators for PE, which on the conceptual level are closely related to governance. Hence, the indicators may also turn out to be empirically useful for the governance component of RRI. Collectively, the 10 indicators exhaust the most important components of the PE dimension and combine the use of existing, secondary data with collection of primary data. The indicators will allow for comparisons across EU28, and will be based on several different data collection methods.

PE1 - Models of public involvement in S&T decision making, **PE2 – Policy-oriented engagement with science**, **PE9 – R&I democratization index**, and **PE10 – National infrastructure for involvement of citizens and societal actors in research and innovation** are all focused on the sub-dimension of 'participation' in the conceptual specification of PE. Following discussions with the EC and reflections about the delineation between PE and SLSE, the aim has been to emphasize the participation element of PE, and these four indicators are tailored towards that purpose.

The remaining indicators, **PE3 – Citizen preferences for active participation in S&T decision making**, **PE4 – Active information search about controversial technology**, **PE5 – Public engagement performance mechanisms at the level of research institutions**, **PE6 – Dedicated resources for PE**, **PE7 – Embedment of public engagement activities in the funding structure of key public research funding agencies**, and **PE8 – Public engagement elements as evaluative criteria in research proposal evaluations** cover the remaining conceptual categories of the PE dimension, apart from the 'activism' dimension. This dimension has not been given priority in the development of the set, due to considerations of both relevance and feasibility in terms of data collection.

3.4 The Dimension of Open Access

For the Open Access dimension a final set of six indicators has been proposed. Together this selection of indicators provides a combination of output, outcome and context, covering both global up until institutional analyses. Four out of six indicators have some overlap with other RRI dimensions, although the overlap is sometimes weak. Two indicators (OA5 and OA6) are directly linked to governance. Dissemination via social media is in principle related to public engagement, as this is open to the wider society. Similarly, via social media there is more opportunity for scientific literacy, although the actual scientific education is not necessarily enhanced. Further justifications for and specifications on each indicator are listed below.

OA1 - Open Access Literature has been constructed to provide much needed information on the volume of freely accessible literature in Europe. There are two primary paths in OA: gold and green. For the gold (i.e. OA journals) the implementation is pretty simple (basically crossing lists of journals) but this is not the

case for the green path (i.e. self-archived publications). Therefore the green approach is crucial. The proposed solution will be to harvest publications in order to find self-archived copies anywhere online. The method will combine data collections about OA evidence from different sources: Gold OA (all possible/available sources, e.g. DOAJ, etc.), and Green OA. The green OA is the most difficult one and would be based on the querying of scientific publications in different sources that can provide information on the availability of OA versions of the articles. These sources include Mendeley, Altmetric.com, Arxiv.org, PubMedCentral and OpenAIRE. The advantage is that this process can be applied systematically to any set of publications (so it can be 'easily' updated and also applied to different collections of papers, e.g. individual countries, institutions, scientific journals, etc.). Final values can be validated using samples. The harvester method is similar to the approach described by ScienceMetrix.[4]

OA 2 - Data publications and citations per country: Data publications (i.e. datasets) are the basic unit in sharing and reusing data. When monitoring Open Research Data, it is important to know the volume of data made available across countries. From a 'responsible' point of view, data citations are important because this measure informs the attribution in the use of published datasets. This indicator will also inform the 'reputation' of a particular dataset (and by aggregation, those of a country). The Web of Science Data Citation Index (DCI) provides a single point of access to quality research data from repositories across disciplines and around the world. DCI fully indexes a significant number of the world's leading data repositories that are of interest to the scientific community, including over two million data studies and datasets. The records for the datasets, which include authors, institutions, keywords, citations and other metadata, are connected to related peer-reviewed literature indexed in WoS. Drawing on DCI, the idea is to create an indicator for data publications and citations providing specifications on country and year.

OA3 - Social media outreach will measure the use of social media tools in disseminating OA publications and Open Research data in Europe by combining data from Web of Science, Scopus, Mendeley and Altmetric. Measuring the number or proportion of papers/data disseminated in this way will capture take-up or outreach, but in a different way than (plain) citation.

OA 4 - Public perception of Open Access has been included for various reasons. It provides information on how the European public perceives the issue of open access of research results. This indicator relies on secondary data. It covers the whole EU28 (all Member States) and uses a well-established and robust methodology of traditional Eurobarometer surveys. Future Eurobarometer surveys could include this indicator again, along with other RRI related questions.

OA 5 - Funder Mandates covers an important aspect of OA, i.e. funder/institutional mandates and their numbers in the EU Member States. These mandates facilitate access to research results. Since 2009, Web of Science has included funding

[4] Composite indicator to measure the growth of Open Access. 28 April 2014, Deliverable 3.2 of RTD-B6-PP-2011-2: Study to develop a set of indicators to measure open access, report written by David Campbell, Aurore Nicol, & Éric Archambault of Science-Metrix.

acknowledgments as part of its registration of publication data, which makes it possible to investigate the presence and application of funding mandates for OA, allowing for additional time points after 2011. The funder mandate information could be organized through the EC- OpenAIRE project (CWTS is partner in that project), but may involve additional surveys via National Contact Points (NCPs) for a governance perspective.

OA 6 - RPO support structures for researchers as regards incentives and barriers for data sharing will use survey data collected as part of the MoRRI project to capture practices and perceptions of the incentives and barriers for and against data sharing in RPOs. The indicator is based on indicator proposals with regard to open access and open science presented in the report 'Indicators for promoting and monitoring Responsible Research and Innovation. Report from the Expert Group on Policy Indicators for Responsible Research and Innovation' (EC 2015g: 6, 32-33). Data will be collected as a (module of a) survey aimed at universities and major public research institutions (see chapter 5 for a full description of the primary data collection methods). The survey aims to cover a representative sample of RPOs in the 28 EU countries and repetitive data collection will be possible.

3.5 The Dimension of Research and Innovation Ethics

A final set of three indicators has been proposed for the dimension of Research and Innovation Ethics. The rationale underpinning this composition of indicators is the idea that every European country has its own ethics landscape, which is expressed in the existence and characteristics of the ethics infrastructure in RPOs, RFOs and ethics deliberation organizations.[5] Important selected aspects of this landscape can be captured by the following indices:

E1 - Ethics at the level of Universities is an index-measure using primary data collected via the RPO survey and a survey addressing national research integrity offices to investigate the ethics performance of European universities. The indicator aims for full EU28 coverage and includes the possibility of repetitive data collection. More specifically, this measure has been designed to provide information on the level of mechanisms that should safeguard the observance of ethical standards in research ethics and research integrity implemented within universities at the country level.

E2 - National Ethics Committees – is a composite-measure drawing on secondary data sources (i.e. MASIS, EPOCH and SATORI) to capture cross-country variations in national ethics committee infrastructure. The available data are qualitative (but can potentially be quantified) and include ample information for measuring the existence, output, impact and quality of national ethics committees across EU28 countries. Whereas time-series data would be possible via primary data collection, this would only make sense in large intervals because institutional changes on this matter are suspected to happen slowly.

[5] This idea originally emerged from the MoRRI project's initial literature review on research and innovation ethics (D. 2.4.1) as well as experiences from the Res-AGorA project (more specifically the case study on Austrian non-mandatory university ethics committees and results from RRItrends).

E3 - Research Funding Organizations Ethics Index will capture national variations in the input, output and context of mechanisms dealing with ethics and societal implications in public and private RFOs. This indicator is based on primary data to be collected through a survey covering a representative sample of RFOs in the EU28 countries. Repetitive data collection is possible.

In sum, the ethics indices focus on [a] ethics governance and ethics deliberation, [b] formal engagement with ethics (e.g. RPO and RFO policies and guidelines on research integrity; ethics advisory committees; ethics in agenda setting in science, technology and innovation), [c] Several types of organizations (i.e. RPOs, RFOs and governance bodies); [d] input, output and context levels; and [e] the national level, which will often imply an aggregation of data from organizations.

3.6 The Dimension of Research and Innovation Governance

As mentioned earlier, the dimension of Research and Innovation Governance assumes a double role in the MoRRI project. It both represents a separate dimension and an overarching 'umbrella' concept for the remaining dimensions (European Union 2012). As illustrated in Table 3.1, a great number of indicators identified within the other five dimensions involve a governance aspect, implying that the monitoring of this dimension will not confine itself to the specific indicators discussed below. Important information on matters of governance, will in other words, also be provided through the other sets of indicators.

Table 3.1 Indicators interlinking with the Governance dimension

Indicators interlinking with the Governance dimension
GE1, GE3, GE9, PE1, PE2, PE3, PE7, PE8, PE9, PE10, OA4, OA5, OA6, E1, E2, E3

GOV 1 – Composite indicator: Governance for responsible research and innovation will bring together the above-mentioned indicators on gender, public engagement, open access, and ethics in research and innovation to provide an evaluation of member state governance systems against a qualitative typology of governance approaches. This indicator could be represented as a radar chart, evaluating goverance multidimensionally, accompanied by a qualitiative typological evaluation.

GOV 2 – Existence of formal governance structures for RRI within research funding and performing organisations will determine whether RRI is seen as a priority issue for organisations and is supported by a formalised governance structure. The data for this indicator will be gathered through RPO and RFO surveys and will be presented at the aggregated national level as the share of organisations having a formalized governance structure. The exact operationalisation (in terms of questionnaire items) will be done in Task 4, but it could be considered to introduce gradations such as high, medium, low, absent for the individual organisations.

GOV 3 – Share of research funding and performing organisations promoting RRI will assess how widespread RRI governance is through national research and

innovation systems. The indicator captures the extent to which organisations explicitly apply and promote the RRI framework as stipulated through this report. The indicator is congruent with the present H2020 Key Performance Indicator for SWAFS.

Together, these indicators will be helpful in addressing the concept of governance. While the typology applied in the MoRRI conceptualisation of governance (see table 2.6) is illustrative as an example of governance types, the analyses of the empirical data collected in MoRRI may result in different schemes of categorisation. While GOV 1 addresses (based on data collected through several other indicators) the country level, the basic units of GOV 2 and GOV 3 are organisations, and will require aggregation in order to be used for cross-country comparison.

3.7 Overview of the 36 RRI indicators

In Chapter 4 below, we provide a detailed description of each of these 36 RRI indicators. However, for the purpose of providing a visual overview of the full set, Table 3.2 below summarizes the indicators and their main characteristics.

Table 3.2 Overview of 36 RRI indicators and selected characteristics

No.	Indicator full name	Primary/ secondary data	Time series	Potential time series	Analytical level	Linkage	Data collection method
GE1	Share of RPOs with gender equality plans	Primary data	No	Yes	Input, outcome	GOV	RPO-survey
GE2	Share of female researchers by sector	Secondary data	Yes	Yes	Input, output, outcome	-	-
GE3	Share of RFOs promoting gender content in research	Primary data	No	Yes	Input, output	GOV	RFO-survey
GE4	Dissimilarity index	Secondary data	Yes	Yes	Output	-	-
GE5	Share of RPOs with policies to promote gender in research content	Primary data	No	Yes	Input, outcome	-	RPO-survey
GE6	Glass ceiling index	Secondary data	Yes	Yes	Input, output, outcome	-	-
GE7	Gender wage gap	Secondary data	Yes	Yes	Output	-	-
GE8	Share of female heads of research performance organisations	Primary data	No	Yes	Input, outcome	-	RPO-survey
GE9	Share of gender-balanced recruitment committees at RPOs	Primary data	No	Yes	Input	GOV	RPO-survey
GE10	Number and share of female inventors and authors	Primary data	Yes	Yes	Input, output	-	Register data
SLSE1	Importance of societal aspects of science in science curricula for 15-18 year olds	Primary data	No	No	Input	-	Qualitative and desk-research
SLSE2	RRI-related training at RPOs	Primary data	No	Yes	Input	-	RPO-survey
SLSE3	Science communication culture	Secondary data	No	No	Output	PE	-
SLSE4	Citizen Science activities in RPOs	Primary data	No	Yes	Output	PE	RPO-survey
PE1	Models of public involvement in S&T decision making	Secondary data	No	Yes	Input	GOV	-
PE2	Policy-oriented engagement with science	Secondary data	Yes	Yes	Output	GOV	-
PE3	Citizen preferences for active participation in S&T decision making	Secondary data	Yes	Yes	Output	GOV, SLSE	-
PE4	Active information search about controversial technology	Secondary data	No	Yes	Output	SLSE	-
PE5	Public engagement performance mechanisms at the level of research institutions	Primary data	No	Yes	Input	SLSE	RPO-survey
PE6	Dedicated resources for public engagement	Primary data	No	Yes	Input	SLSE	RPO-survey
PE7	Embedment of public engagement activities in the funding structure of key public research funding agencies	Primary data	No	Yes	Input	GOV	RFO-survey
PE8	Public engagement elements as evaluative criteria in research proposal evaluations	Primary data	No	Yes	Input	GOV	RFO-survey
PE9	R&I democratization index	Primary data	No	Yes	Input	GOV	SiS actor survey
PE10	National infrastructure for involvement of citizens and societal actors in research and innovation	Primary data	No	Yes	Input	GOV	SiS actor survey
E1	Ethics at the level of universities	Primary data	No	Yes	Input, output, context	GOV, PE	RPO-survey
E2	National Ethics Committees Index (NEC index)	Secondary data	Yes	Yes	Depends on tailoring	GOV, SLSE, PE	-
E3	Research Funding Organisations Index	Primary data	Yes	Yes	Depends on tailoring	GOV, PE	RFO-survey
OA1	Open Access Literature (OAL)	Primary data	Yes	Yes	Output	-	Register data
OA2	Data publications and citations per country.	Primary data	Yes	Yes	Output	-	Register data
OA3	Social media outreach/take up of Open Access Literature and open research data	Primary data	Yes	Yes	Outcome	PE	Register data
OA4	Public perception of Open Access – PPOA	Secondary data	No	Yes	Output, context	GOV, PE	-
OA5	Funder Mandates	Secondary data	No	No	Output, context	GOV	-
OA6	RPO support structures for researchers as regards incentives and barriers for data sharing	Primary data	No	Yes	Input	GOV	RPO-survey
GOV1	Composite indicator of RRI governance	Secondary data	No	Yes	Input	GOV	-
GOV2	Existence of formal governance structures for RRI within research funding and performing organisations	Primary data	No	Yes	Input	-	RPO-survey, RFO-survey
GOV3	Share of research funding and performing organisations promoting RRI	Primary data	No	Yes	Input	-	RPO-survey, RFO-survey

4. Description of metrics and indicators of RRI

This Chapter provides a detailed description of each of the final RRI indicators on the basis of a tailored data collection fiche. The purpose of describing each indicator in a more systematic and schematic way through standardized data collection fiches, is to provide clear, specified, transparent and homogenous indicator descriptions that will help to ensure the best possible starting point for the data collection process in Task 4.

4.1 Description of the template for data collection fiches

The template for the data collection fiches (see table 4.1) has been designed to provide information on two main issues: [a] the general character of the indicators and [b] their specifications with respect to the analytical distinctions and quality parameters underpinning the MoRRI project (for instance with regard to the three classificatory schemes applied). Additionally, a third section in the template addresses data collection particularities such as method, selection and collection of samples, issues of representation and feasibility. Primarily, the data collection fiche is intended as an instrument that will guide the subsequent process of indicator construction. The descriptions included in the data fiches are therefore not self-sufficient, and further specifications are needed. Chapter 5 will open this task by providing initial specifications on the data collection design, thus preparing the ground for Task 4.

Table 4.1 Data collection fiche, template

Information item	Description
Indicator characteristics	This section includes general indicator specifications
Name of indicator	Please state an informative short name for the indicator
Primary/secondary data	Please state whether this indicator is based on secondary (already existing) data or on primary data that we will need to collect
Need for supplementary data collection	Please note if the indicator is based on secondary data with insufficient coverage, thus requiring supplementary data collection. A typical example would be non-exhaustive coverage of EU28 countries
Description	Please provide an accurate and thorough description of the indicator (what is it an indicator of, how does it capture information about the RRI dimension in question, in which context was the indicator developed (if secondary data) etc.)
Qual / Quant	Please specify whether the basic data are of quantitative or qualitative. In some cases, the basic data will be qualitative (interview transcripts, national reports or similar) which require coding / categorisation in order to be useful for monitoring purposes. Please specify
Source of data (specific references, page numbers, links, exact tables etc.)	If indicator is based on secondary data, please state the data sources for the indicator, including specification of database, specific page numbers, exact tables etc. If possible please provide direct links to the data source in question
Date	If indicator is based on secondary data, please note in which year data was most recently collected
Time-series	Are time-series data available? Please specify by yes/no and note the actual years for which data are available
Potential time series data	Could the indicator be a potential candidate for longitudinal data collection? Please specify. We hope that 2-3 out of 10 indicators for each dimension would potentially be interesting for over-time data collection
Measurement level	Please state the level of measurement (scales of measure), e.g. nominal, ordinal, interval
Unit of analysis	Please state the basic unit of analysis (e.g. countries, citizens, publications etc.)
Coverage (specific countries, institutions etc. covered)	If the indicator is based on secondary data, please state the specific data coverage. For instance, specify the actual countries covered, or institutions covered
Attributes	Please describe the specific indicator attributes
Assessment of RRI indicators	This section assesses the indicator on the basis of the analytical distinctions and quality parameters specified within the context of the MoRRI project
Analytical level (logic model)	Please specify the analytical level in the intervention logic model at which the indicator is oriented (i.e. context, input, output, outcome). Note that we aim for INPUT and OUTPUT indicators
Analytical level (aggregation)	Please specify the level of aggregation for the indicator (i.e. global, national, regional, institutional, project/programme, individual). Note that we aim for NATIONAL level indicators, but that the basic unit of analysis does not need to be countries. Individual level data could, e.g., be aggregated to the national level
Is indicator based on aggregation/disaggregation	Please state whether the indicator is based on aggregation or disaggregation of data
Sub-categorisation from dimension typology (functional vocabulary)	Please specify whether the indicator addresses a particular sub-category within the dimension typology (e.g. the 'public participation' category within the public engagement dimension). Furthermore, please state if the indicators *internally* relates to other sub-categories within the same dimension.
Interlinkages with other RRI dimensions	Please indicate to which extent the indicator *directly* relates to or overlap *externally* with other (sub)dimensions (e.g. an indicator measuring visits to science museums could be an indicator for both the

	PE subcategory 'public communication' and the SLSE subcategory 'science communication')
Data collection specifications	This section specifically addresses the procedure for collecting primary data, including collection of supplementary data when existing data has insufficient coverage. Please expand on each issue to the extent feasible in order to – as precisely as possible - direct the data collection process in task 4.
Data collection methods	Please note how data should be collected for this indicator (survey / questionnaire, data retrieved from databases, structured/semi-structured/explorative interviews, focus groups, desk research, document analysis, ethnographic field studies, etc.). Describe the respondents / informants, including the size of this population
Representation issues	Please reflect on the coverage of the available/proposed indicator and the potential data collection challenges that should be taken into consideration, e.g. would representative data, if relevant, be available for all European countries? How would institutions be sampled in order to be representative for a country etc.
Feasibility issues	Please address the feasibility of this indicator given the constraints on resources and time in the project
Additional points to pay attention to	
Comments/caveats	Additional comments/caveats can be specified here

4.2. Compilation of data collection fiches

In the following, data collection fiches for each of the altogether 36 final indicators covering the six RRI dimensions are listed.

4.2.1 Gender equality

Information item	GE1
Indicator characteristics	
Name of indicator	**Share of RPOs with gender equality plans**
Primary/secondary data	Primary data
Need for supplementary data collection	Data will be collected through a RPO-survey conducted within MoRRI
Description	The existence of a gender equality plan indicates institutionalised activities for gender equality. A gender equality plan is a consistent set of provisions and actions aimed at ensuring gender equality. Possible question: Has your organisation implemented a gender equality plan or equivalent?
Qual / Quant	Quantitative
Source of data	See above
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Metric - share of organisations (ordinal: adopted GEP, no GEP, GEP n/a)
Unit of analysis	RPOs / countries
Coverage	Research performing organisations in 28 EU countries
Attributes	Research performing organisations with GEPs (Existence of Gender Equality Plans Yes / No / Not known / Not applicable)
Assessment of RRI indicators	
Analytical level	Input- and outcome-related
Analytical level (aggregation)	National on the basis of information about organisations
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Sub-category "Structural Change"
Interlinkages with other RRI dimensions	Governance
Data collection specifications	
Data collection methods	Standardised survey
Representation issues	Response rate of an own online-survey are hardly predictable; telephone interviews might improve the coverage, but is expensive and it is questionable whether additional resources are available for such a task.
Feasibility issues	An own survey among RPOs could also be used to cover the other RRI dimensions and indicators and thus improve the overall empirical basis for the MoRRI project.
Additional points to pay attention to	

Comments/caveats	-

Information item	**GE2**
Indicator characteristics	
Name of indicator	**Share of female researchers by sector**
Primary/secondary data	Indicator is based on secondary (already existing) data
Need for supplementary data collection	No
Description	The percentage of female researchers depicts the (under-)representation of women in research. Its differentiation by sectors indicates different opportunities and barriers.
Qual / Quant	Quantitative
Source of data	Eurostat: Statistics on research and development
Date	Year in which data was most recently collected: 2011
Time-series	Most countries biennial – but data availability differs according to countries
Potential time series data	Yes
Measurement level	Metric – share of female researchers (interval)
Unit of analysis	Countries
Coverage	R&D statistics are currently available for EU Member States and Candidate Countries, EFTA Countries, the Russian Federation, China, Japan, the United States and South Korea. Regional R&D statistics are available for EU Member States, Candidate and EFTA countries. Besides national and regional statistics Eurostat calculates and disseminates aggregates at the EU-and Euro-area-levels (EU-28, EU-15 and EA-18) but data availability differs over the years.
Attributes	• Female researchers in Higher education sector • Female researchers in Government sector • Female researchers in Private non-profit sector • Female researchers in Business enterprise sector The Share of female researchers is presented in Head Counts – Full Time Equivalents would also be available.
Assessment of RRI indicators	
Analytical level	Input, output, outcome
Analytical level (aggregation)	NATIONAL level indicator
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Female Participation
Interlinkages with other RRI dimensions	-
Data collection specifications	

Data collection methods	-
Representation issues	-
Feasibility issues	-
Additional points to pay attention to	
Comments/caveats	Due to the high coverage, the available time series and the high level of acceptance among the relevant stakeholder, no own indicators should be developed

Information item	**GE3**
Indicator characteristics	
Name of indicator	**Share of RFOs promoting gender content in research**
Primary/secondary data	Primary data
Need for supplementary data collection	28 EU Member States
Description	This indicator illustrates the integration of gender as part of the research design and process. It entails sex and gender analysis being integrated into basic and applied research. Possible question: When allocating research and development funding in 2014, did your organisation include the gender dimension in research content? (Yes, in half or more of the projects/ programmes / Yes, in less than half of the projects/ programmes / No / Not known / Not applicable)
Qual / Quant	Quantitative
Source of data	See above
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Metric - share of organisations; ordinal (answer categories: yes, no, not known, not applicable)
Unit of analysis	RFOs
Coverage	28 EU Member States
Attributes	Share of RFOs which include the gender dimension in research content; Existence of gender content in research Yes / No / Not known / Not applicable
Assessment of RRI indicators	
Analytical level	Input- and outcome-related
Analytical level (aggregation)	National on the basis of information about organisations
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Sub-category "gender in research content"
Interlinkages with other RRI dimensions	Governance

Data collection specifications	
Data collection methods	Standardised survey
Representation issues	National correspondents will be asked to define the national population of RFOs which will be contacted. Response rate of an own online-survey are hardly predictable; telephone interviews might improve the coverage, but is expensive and it is questionable whether additional resources are available for such a task.
Feasibility issues	An own survey among RFOs could also be used to cover the other RRI dimensions and indicators and thus improve the overall empirical basis for the MoRRI project.
Additional points to pay attention to	
Comments/caveats	-

Information item	**GE4**
Indicator characteristics	
Name of indicator	**Dissimilarity index**
Primary/secondary data	Secondary (already existing) data
Need for supplementary data collection	No
Description	The Dissimilarity Index provides a theoretical measurement of the percentage of women and men who would have to move to another field of science to ensure a gender balanced distribution across fields. It measures the distance from balanced gender distribution across fields for horizontal segregation in research.
Qual / Quant	Quantitative
Source of data	SHE FIGURES 2012. Updated data could be used depending on the time of publication of SHE FIGURES 2015
Date	Year in which data was most recently collected: 2011
Time-series	SHE FIGURES: all 3 years (at least up to now) However, the indicator could be computed based on Eurostat statistics (WTS database) on research and development which is more frequently available.
Potential time series data	Yes
Measurement level	Metric – share of men and women for the distance of balanced gender distribution across fields (interval)
Unit of analysis	Countries
Coverage	2011: 29 countries; EU 27
Attributes	Higher education sector and government sector
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National level indicator
Is indicator based on aggregation/disaggregation	Aggregation

Sub-categorisation from dimension typology (functional vocabulary)	Female Participation
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	-
Representation issues	-
Feasibility issues	Feasible
Additional points to pay attention to	
Comments/caveats	Due to the high coverage, the available time series and the high level of acceptance among the relevant stakeholder, no own indicators should be developed.

Information item	**GE5**
Indicator characteristics	
Name of indicator	**Share of RPOs with policies to promote gender in research content**
Primary/secondary data	Primary data
Need for supplementary data collection	Data will be collected through a RPO-survey conducted within MoRRI
Description	This indicator summarizes activities to integrate the gender dimension in research content that can address research design and process gender analysis. Possible questions: Does your organisation include a gender dimension in research and innovation content of programmes, projects and studies? (Yes / No / Not known / Not applicable)
Qual / Quant	Quantitative
Source of data	See above
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Metric - share of organisations ; ordinal (answer categories: frequently, occasionally, no, not applicable)
Unit of analysis	RPOs / countries
Coverage	Research performing organisations in 28 EU countries
Attributes	-
Assessment of RRI indicators	
Analytical level	Input- and outcome-related
Analytical level (aggregation)	National on the basis of information about organisations

Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Sub-category "gender in research content"
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	Standardised survey
Representation issues	Response rate of an own online-survey are hardly predictable; telephone interviews might improve the coverage, but is expensive and it is questionable whether additional resources are available for such a task.
Feasibility issues	An own survey among RPOs could also be used to cover the other RRI dimensions and indicators and thus improve the overall empirical basis for the MoRRI project.
Additional points to pay attention to	
Comments/caveats	-

Information item	**GE6**
Indicator characteristics	
Name of indicator	**Glass ceiling index**
Primary/secondary data	Secondary data
Need for supplementary data collection	28 EU Member States, the respondents in the ERA RPOs survey 2014 account for about 31,6 of staff
Description	The Glass Ceiling Index measures the relative chance for women, as compared with men, of reaching a top position for vertical segregation. It compares the proportion of women in grade A positions to the proportion of women in academia (grades A, B and C).
Qual / Quant	Quantitative
Source of data	SHE FIGURES 2012. Updated data could be used depending on the time of publication of SHE FIGURES 2015
Date	Year in which data was most recently collected: 2010
Time-series	SHE FIGURES: all 3 years (at least up to now) However, the indicator could be computed based on Eurostat statistics (WTS database) on research and development which is more frequently available.
Potential time series data	Yes
Measurement level	Metric – share of women in grade A in relation to share of women in academia (interval)
Unit of analysis	Countries
Coverage	2010: 29 countries; EU 27
Attributes	A Glass Ceiling Index of 1 indicates equality between women and men being promoted, a score below 1 means an over-representation of women in grade A level and a score above 1 an under-representation of women in grade A.
Assessment of RRI	

indicators	
Analytical level	Input, output, outcome
Analytical level (aggregation)	NATIONAL level indicator
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Female Participation
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	-
Representation issues	-
Feasibility issues	Feasible
Additional points to pay attention to	
Comments/caveats	Due to the high coverage, the available time series and the high level of acceptance among the relevant stakeholder, no own indicators should be developed.

Information item	**GE7**
Indicator characteristics	
Name of indicator	**Gender wage gap**
Primary/secondary data	Secondary Data
Need for supplementary data collection	Not all EU Countries covered
Description	The Gender Wage Gap illustrates the observed unadjusted difference in average gross annual earnings of male and female paid employees as a percentage of the average gross annual earnings of male paid employees. Persons with tertiary education corresponding to the ISCED codes 5 and 6 who are employed in occupations in the major groups 2 ("Professionals") and 3 ("Technicians and Associate Professionals") of the ISCO classification are used as a proxy for defining researchers in the non-academic sector. The Gender Wage Gap can be interpreted as a synthetic indicator of multiple inequalities between men and women. It is determined by differences in educational attainments, labour market experience and tenure, sectoral affiliation and occupations, etc., as well as wage discrimination etc.
Qual / Quant	Quantitative
Source of data	MORE2 on the basis of the structural earnings survey
Date	2006
Time-series	Y – 2002, 2006, 2010
Potential time series data	Yes

Measurement level	Metric – difference in gross annual earnings between women and men in relation to male gross annual earnings (interval)
Unit of analysis	Countries
Coverage	17 EU Countries structural earnings survey 24 EEA countries It covers Researchers in the non-academic sector
Attributes	SES refer to enterprises with at least 10 employees operating in all areas of the economy except public administration
Assessment of RRI indicators	
Analytical level	Output indicator
Analytical level (aggregation)	National level indicator
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Female Participation
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	-
Representation issues	-
Feasibility issues	-Feasible
Additional points to pay attention to	
Comments/caveats	The indicator is suggested for the monitoring although the indicator covers not only researchers. The indicator based on MORE2 is selected due to the relevance of the topic and a lack of alternative data sources. It can be computed on the basis of the structural earnings survey.

Information item	**GE8**
Indicator characteristics	
Name of indicator	**Share of female heads of research performance organisations**
Primary/secondary data	Primary data
Need for supplementary data collection	Data will be collected through a RPO-survey conducted within MoRRI
Description	Proportion of organisations headed by women. This can be interpreted as an indicator for gender balance in decision-making and, therefore, structural setting for gender equality. Possible questions: Please specify the gender of the person who was head of your organisation at the end of the previous calendar year (Head of organisation: highest decision-making official in the organisation (e.g. rector or equivalent in the academy, president or equivalent in non-academic research organisations)

Qual / Quant	Quantitative
Source of data	See above
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Metric - share of organisations (nominal: yes/ no)
Unit of analysis	RPOs / countries
Coverage	Research performing organisations in 28 EU countries
Attributes	-
Assessment of RRI indicators	
Analytical level	Input- and outcome-related
Analytical level (aggregation)	National on the basis of information about organisations
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Sub-category "Female Participation"
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	Standardised survey
Representation issues	Response rate of an own online-survey are hardly predictable; telephone interviews might improve the coverage, but is expensive and it is questionable whether additional resources are available for such a task.
Feasibility issues	An own survey among RPOs could also be used to cover the other RRI dimensions and indicators and thus improve the overall empirical basis for the MoRRI project.
Additional points to pay attention to	
Comments/caveats	-

Information item	**GE9**
Indicator characteristics	
Name of indicator	**Share of gender-balanced recruitment committees at RPOs**
Primary/secondary data	Primary data
Need for supplementary data collection	Data will be collected through a RPO-survey conducted within MoRRI
Description	This indicator depicts the share of recruitment committees for internationally recognised researchers (e.g. team leaders, management positions, full professors, etc.) which are gender balanced (i.e. reach the threshold of 40% of the under-represented gender). It can be interpreted

	as an indicator for women in decision-making process. Possible questions: How many recruitment committees for leading researcher positions did your organisation set up in 2013 for the recruitment of researchers? Amongst them, how many recruitment committees for leading researcher positions reached the threshold of 40% of the under-represented sex?
Qual / Quant	Quantitative
Source of data	See above
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Metric - share of committees (nominal: yes / no)
Unit of analysis	RPOs / countries
Coverage	Research performing organisations in 28 EU countries
Attributes	-
Assessment of RRI indicators	
Analytical level	Input-related
Analytical level (aggregation)	National on the basis of information about organisations
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Sub-category "Structural Change"
Interlinkages with other RRI dimensions	Governance
Data collection specifications	
Data collection methods	Standardised survey
Representation issues	Response rate of an own online-survey are hardly predictable; telephone interviews might improve the coverage, but is expensive and it is questionable whether additional resources are available for such a task.
Feasibility issues	An own survey among RPOs could also be used to cover the other RRI dimensions and indicators and thus improve the overall empirical basis for the MoRRI project.
Additional points to pay attention to	
Comments/caveats	-

Information item	**GE10**
Indicator characteristics	
Name of indicator	**Number and share of female inventors and authors**
Primary/secondary data	Indicator is based on register data (Databases), but own compilation and

	analysis is necessary. For the identification of the respective women, the country-specific first names are used.
Need for supplementary data collection	No
Description	The analysis of the number and share of female inventors and authors researchers in different scientific and technological fields / disciplines, across EU28 and associated countries, over time, shows the (changed?) representation of women in the respective fields and sectors; if useful, also Non-European countries like US, Japan, China etc. can be integrated in the analysis
Qual / Quant	Quantitative
Source of data	Scopus, Web of Science, Patstat
Date	Start date has to be defined, recent end date for publication data is 2014, for patent data 2012
Time-series	Time series are possible
Potential time series data	Yes
Measurement level	Metric – number and share of female inventors and authors (interval)
Unit of analysis	Inventors in patent applications and authors of publications
Coverage	Has to be defined, EU 28 and Association Countries, but also cooperation patterns with other countries like US, Japan, China etc. are possible
Attributes	• Number of female authors in publications, by scientific discipline • Share of female authors in publications, by scientific discipline • Number of female inventors in patents , by sector • Share of female inventors in patents , by sector • Cooperation patterns of female authors Cooperation patterns of female inventors
Assessment of RRI indicators	
Analytical level	Input, output
Analytical level (aggregation)	Global, per sector and / or per nation
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	Female Participation
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	Analysis of female inventors and authors through patent and bibliometric analysis
Representation issues	This kind of analysis can be conducted for EU 28 and associated countries; according to technology fields and disciplines; and also with regard to typical cooperation patterns (with other countries, between academia and industry etc.)
Feasibility issues	Time series are possible, including a retrospective analysis of the past

	years; depending on the databank used, several disciplines might be slightly underrepresented (i.e. humanities within the Web of Science)
Additional points to pay attention to	
Comments/caveats	-

4.2.2 Science literacy and science education

Information item	SLSE1
Indicator characteristics	
Name of indicator	**Importance of societal aspects of science in science curricula for 15-18 year olds**
Primary/secondary data	Primary
Need for supplementary data collection	n/a
Description	Indicator providing information to which extent societal aspects of science and technology are mentioned in the curricula as important aspects that teachers should consider and teach. The indicator is inspired by and partly based on the FP7-funded project SECURE – Science Education Curriculum Research (project reference 266640). Several changes to the set-up of the project are proposed due to resource constraints. This indicator specifically looks at two controversial science topics, genetically modified organisms (GMO) and nuclear energy. It records whether social, economic, environmental and ethical aspects are taught and discussed in relation to these two controversial topics. Note: In case no information about GMO can be found, as an alternative the topic stem cell research can be analysed.
Qual / Quant	Qualitative
Source of data	Primary data(Desk research, interviews)
Date	n/a
Time-series	n/a
Potential time series data	No
Measurement level	Ordinal
Unit of analysis	Country (if due to the education system structure the unit of analysis is on the sub-country i.e. regional level, then the choice will be made in cooperation with the project team)
Coverage	n/a
Attributes	A qualitative assessment should be written based on the responses to the following questions. 1. Does the curriculum address the controversial character of either one of the two topics? "yes" "no" 2. Which of the following issues is addressed by the curriculum in relation to the controversial topic (GMO, nuclear energy)? a. social aspects, such as consequences for the society or agriculture b. environmental aspects, such as the effects of monocultures or resistances, atomic waste storage etc c. ethical aspects, such as development issues like the „golden rice", intergenrational fairness etc 3. To what degree are they covered? Are they important aspects of the topic or only mentioned in passing? Please briefly explain the reasons for your assessment. In practice, the research could be conducted as follows: For member states with a single curricula for the whole country: Country researcher please... 1. Identify all school curricula aimed at pupils between 15 and 18 years old for subjects such as biology, physics, chemistry addressing the controversial topics. 2. Answer the questions above 3. Contact an expert (for instance in the ministry or other

	curriculum setting body) to validate your findings. For member states without various regional curricula, country researcher please… 1. Validate whether there is a national body, which sets at least basic rules for curricula (for instance the Kultusministerkonferenz in Germany). If so, proceed with the aforementioned steps on this level. If there is no such body, choose the regions to be considered together with the project team and follow the steps mentioned above.
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	No
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the science education sub-category of the SLSE dimension.
Interlinkages with other RRI dimensions	n/a
Data collection specifications	
Data collection methods	Primary data will be collected via desk research and validation interviews at education ministries or other responsible actors. Specifically, country researchers are provided with a set of questions to be answered, either by desk research or a combination of desk research and telephone interviews.
Representation issues	In countries in which education policy it not decided at national but at regional level representation issues can arise if not all regions are covered by the desk research. In this case a small number of selected regions could be identified for which the data collection is conducted. The regions will be selected in cooperation with the project team.
Feasibility issues	The feasibility is expected to be comparably difficult, because a) it is not clear to what extent formalised national curricula for science (biology and physics in this case) exist in all countries in Europe and to what extent they are publicly available, b) the two topics (GMO and nuclear energy) are presumably taught in different years in the different member states. In case no information about GMO can be found, as an alternative the topic stem cell research can be analysed.
Additional points to pay attention to	
Comments/caveats	For a condensed overview, an indicator classifying countries depending on the role of societal aspects in science curricula could be constructed. For instance distinguishing countries depending on whether 1 – societal aspects of science and technology play no role in curricula 2 – societal aspects of science and technology play some role in curricula 3 – societal aspects of science and technology play a considerable role in curricula. The classification into these three groups could be based on for 1: if there is no information available for 2 and 3: an classification of the project team member (in comparison to other countries) based on the qualitative statements of the country researchers.

	Please note: The indicator is only based on the formal/written curriculum and not on the implemented or attained curriculum. However, due to resource constraints we believe that this is a informative and feasible first step.

Information item	SLSE2
Indicator characteristics	
Name of indicator	**RRI-related training at RPOs**
Primary/secondary data	Primary
Need for supplementary data collection	n/a
Description	Indicator providing information to which extent RRI-related aspects, thus ethical, economic, environmental, legal and social aspects (EEELSA), are part of the education of young researchers. The indicator is inspired by the suggestion by the Expert Group on Policy Indicators for Responsible Research and Innovation.
Qual / Quant	Qualitative
Source of data	Primary (Survey)
Date	n/a
Time-series	n/a
Potential time series data	Yes
Measurement level	Ordinal
Unit of analysis	Institution
Coverage	Research Performing Organisations
Attributes	1. Do RRI-related aspects, such as ethical, economic, environmental, legal and social aspects play a role in the education or training of young researchers, for instance PhD students? "yes", "no" 2. Are the trainings mandatory of voluntary? "mandatory", "voluntary" 3. If "voluntary", how many of your young researchers did participate in a such training? "Xx out of xx young researchers" Please provide a translation of the name of the training module in English.
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	No
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the science education sub-category of the SLSE dimension.
Interlinkages with other RRI dimensions	n/a
Data collection	

specifications	
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. In case of low response rates, the respective RPOs can be contacted again via phone, relevant experts can be identified and be guided through the survey via phone. The questions to be posed are described in the section 'Attributes'. Question 1 on the general existence of RRI-related training could serve as an overview indicator for the full set of questions.
Representation issues	n/a
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without large costs.
Additional points to pay attention to	
Comments/caveats	-

Information item	SLSE3
Indicator characteristics	
Name of indicator	**Science communication culture**
Primary/secondary data	Secondary
Need for supplementary data collection	n/a
Description	This composite indicator summarizes the overall national science communication culture. It was originally developed for the MASIS project. It builds on six parameters that collectively form a framework for describing the science communication culture of a specific country. These include • the degree of institutionalization (e.g. the presence of popular science magazines, regularity of science section in newspapers, dedicated science communication in television etc.), • political attention to the field, • the scale and diversity of actor involvement, • traditions for popularization within academia, • public interest in science and technology, and finally the training and organizational characteristics of science journalism in the country.
Qual / Quant	Qualitative
Source of data	Data from the MASIS project, specifically the publication Mejlgaard et al (2012), Locating science in society across Europe: Clusters and conferences, Science and Public Policy 39, pp. 741-750
Date	2011
Time-series	n/a
Potential time series data	No

Measurement level	Ordinal
Unit of analysis	Country
Coverage	EU-28 and Norway, Lichtenstein, Iceland, Switzerland, Montenegro, Serbia, Albania, Israel, Macedonia
Attributes	The attributes of the indicator are three categories of "science communication culture": consolidated, developing, fragile
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	No
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the science communication sub-category of the SLSE dimension.
Interlinkages with other RRI dimensions	There exist possible interlinkages with the dimension public engagement, specifically public communication.
Data collection specifications	
Data collection methods	n/a
Representation issues	-
Feasibility issues	The feasibility is expected to be high as data is already available for all Member States and beyond.
Additional points to pay attention to	
Comments/caveats	-

Information item	**SLSE4**
Indicator characteristics	
Name of indicator	**Citizen Science activities in RPOs**
Primary/secondary data	Primary
Need for supplementary data collection	n/a
Description	This set of five indicators captures information about citizen science projects in the RPOs of a country.
Qual / Quant	Quantitative and qualitative
Source of data	RPO Survey
Date	n/a
Time-series	No
Potential time series data	Yes

Measurement level	Interval and nominal
Unit of analysis	Country
Coverage	Research performing organisations
Attributes	1. Does the RPO conduct citizen science projects? "yes" "no" 2. How many citizen science projects did the RPO conduct in the last 3 years? „Number of citizen science projects" (Possibly a normalisation to the population size or research budget in order to allow for meaningful comparisons) 3. Please distribute the citizen science projects of your RPO among the following four project types, using rough percentages: **a. "Allowing"-projects:** Citizens allow researchers to use their property/infrastructure (like PCs). This category includes projects such as ‚passive sensoring', ‚volunteer computing' (more passive) **b. "Participating A"-projects:** Citizens take active part in the research work *without* prior training **c. "Participating B"-projects:** Citizens take active part in the research work *with* prior training covering projects such as 'volunteer thinking', 'environmental/ecological observation and monitoring' (active involvement) **d. "Initiating"-projects:** Citizens suggest and start new research activities or discussion about policy: covering projects of ‚civic/community science' (proactive)[6] 4. How many people participated in all of these citizen science projects? 5. What are the effects of citizen science projects? a. Availability of research data b. Emergence/change of research agenda c. Emergence/change of policy agenda d. Increased knowledge and skills of citizens Others (please specify)
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Yes, aggregation of project data
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the co-production of knowledge sub-category of the SLSE dimension. It is also closely related to the sub-dimension of science literacy in the SLSE dimension.
Interlinkages with other RRI dimensions	Public engagement
Data collection specifications	
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the

[6] Classification based on the classification by Hakley (http://www.wilsoncenter.org/sites/default/files/Citizen_Science_Policy_European_Perspective_Haklay.pdf) and adapted according to intensitiy of involvement.

	full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. In case of low response rates, the respective RPOs can be contacted again via phone, relevant experts can be identified and be guided through the survey via phone. The questions to be posed are described in the section 'Attributes'. To provide a general overview the combination of information from the first two questions could be constructed as a high-level indicator: Number of projects and number of participants per country.
Representation issues	Grass-root/bottom-up projects cannot be expected to be covered by this indicator. However, in the future they might be covered, e.g. by extending the data collection by desk research for 'classical' citizen science topics, as well as surveying national citizen science association.
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without large costs.
Additional points to pay attention to	
Comments/caveats	For the construction of a composite indicator the attributes of questions 3-5 could be also be defined numerically (from 1-n), whereas a higher number marks a more active in terms of involvement citizen science culture.

4.2.3 Public engagement

Information item	PE1
Indicator characteristics	
Name of indicator	**Models of public involvement in S&T decision making**
Primary/secondary data	Secondary data
Need for supplementary data collection	The existing data cover EU27 (except Malta). Croatia + 10 other countries associated with FP7 are also covered. The only need for supplementary data collection would thus be Malta.
Description	The indicator is two-dimensional. It taps into the degree of formalized structures / mechanisms at the national level for involving citizens in decisions around science and technology. Formalized structures could, e.g., be existing organizational bodies facilitating public involvement and legal frameworks mandating citizen participation in S&T decision making. Secondly, it taps into the degree to which citizens are de facto involved in making decisions. These two dimensions, each contributing to the overall democratization of science and technology decision making, are not always related in a straight-forward way. In the majority of countries, some formalized procedures for involving citizens in priority setting and assessment related to science and technology can be identified, but in some of these countries, the actual degree of public involvement is in fact considered to be low. Opportunity does not always imply action, and, in addition, different opportunity structures are not equally effective in creating a fertile context for citizen participation. On the basis of these two dimensions, countries can be grouped into four main categories.
Qual / Quant	The indicator is based on basic qualitative information provided by a network of national correspondents / experts across countries in the MASIS project. The qualitative information has been coded (using Nvivo) and the coding procedure resulted in the four categories / attributes specified below.
Source of data	Indicator presented in Mejlgaard et al (2012): 'Locating Science in Society across Europe – Clusters and Consequences', in *Science and Public Policy* 39(6): 741-50, p. 746, table 3.
Date	2011
Time-series	No
Potential time series data	The indicator could potentially be reproduced in future data collection. It does however involve a fairly demanding setup, both in terms of data collection (requires desk research / interviews by national experts in each country) and in terms of data analyses (coding qualitative data into quantitative categories).
Measurement level	Nominal
Unit of analysis	Countries
Coverage	The following 37 countries are covered: Belgium, Albania, Austria, Bulgaria, Denmark, Croatia, Iceland, Cyprus, Finland, Estonia, Czech Republic, France, Greece, Hungary, Germany, Latvia, Ireland, Italy, Montenegro, Israel, Lithuania, Poland, Lichtenstein, Norway, Portugal, Luxembourg, Sweden, Slovakia, Macedonia, Switzerland, Slovenia, Romania, Netherlands, Turkey, Serbia, UK, Spain.
Attributes	• Formalized / high involvement • Formalized / low involvement • Not formalized / high involvement Not formalized / low involvement
Assessment of RRI indicators	
Analytical level	Input
Analytical level	National

(aggregation)	
Is indicator based on aggregation/disaggregation	No
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the 'participation' category under the PE dimension.
Interlinkages with other RRI dimensions	The indicator is highly interrelated with the 'governance' dimension.
Data collection specifications	
Data collection methods	In order to recollect data across countries, a setup similar to the MASIS project would be required. This involves national experts conducting desk research and interviews in their respective countries. The guidelines from the MASIS project (which are available to us) could be adopted. A similar approach would characterize data collection for the one country (Malta) which is not covered by secondary data.
Representation issues	-
Feasibility issues	The indicator is very feasible as a one-off source (existing data cover very well across Europe), while future repetitive data collection would be very demanding.
Additional points to pay attention to	
Comments/caveats	-

Information item	**PE2**
Indicator characteristics	
Name of indicator	**Policy-oriented engagement with science**
Primary/secondary data	Secondary data
Need for supplementary data collection	No
Description	The indicator taps into actual engagement practice among citizens. The term vertical engagement is used to denote policy-oriented engagement. The indicator builds on individual-level data emerging from the 2010 Eurobarometer on 'Europeans, science and technology', specifically the following three items: 1) Do you attend public meetings or debates about science and technology', 2) Do you sign petitions or join street demonstrations on matters of nuclear power, biotechnology or the environment, 3) Do you participate in the activities of a non-governmental organisation dealing with science and technology related issues. Same response categories (yes regularly, yes occasionally, no hardly ever, no never, Don't know) apply to the three items. For each individual an index score (in the range from 0-6) is calculated based on assigning 2 points to 'yes regularly', 1 point to 'yes occasionally' and 0 points to other answers. The indicator is calculated as the mean national score.
Qual / Quant	Quantitative
Source of data	The source is Eurobarometer 340, wave 73.1 from 2010. Data is available to us.
Date	2010

Time-series	Only 2 out of the three items applied are time series (data available for 2005), while the third is not.
Potential time series data	The survey items could potentially be fielded in relation with future eurobarometers, or by national agencies.
Measurement level	Interval
Unit of analysis	The basic data unit is individuals, but the indicator is an aggregated measure at country level
Coverage	EU28 + Turkey, Switzerland, Norway, Iceland
Attributes	Numerical value (average score on index)
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Based on aggregation from individual level data
Sub-categorisation from dimension typology (functional vocabulary)	The indicator addresses the 'public participation' category within the PE dimension.
Interlinkages with other RRI dimensions	There is potentially a linkage to the 'governance' dimension
Data collection specifications	
Data collection methods	Survey with representative samples of citizens across countries
Representation issues	-
Feasibility issues	The indicator is feasible for application. However, continued future data collection would be expensive, unless aligned with the Eurobarometer series work
Additional points to pay attention to	
Comments/caveats	-

Information item	**PE3**
Indicator characteristics	
Name of indicator	**Citizen preferences for active participation in S&T decision making**
Primary/secondary data	Secondary data
Need for supplementary data collection	No
Description	The indicator taps into the desired degree of citizen inclusion in making decisions about S&T. It reveals preferences for participation. It is based on a specific item from the special Eurobarometer on RRI, which reads: 'What is the level of involvement citizens should have when it comes to decisions made about science and technology?' with the following response categories: 1) citizens do not need to be involved or informed, 2) citizens should only be informed, 3) citizens should be consulted and their opinions should be considered, 4) citizens should participate and have an active role, 5) citizens' opinions should be binding, 6) don't know. While response

	categories 1 and 2 assign a passive role to citizens, response categories 3, 4 and 5 assign an active role to citizens. The indicator reports the share of citizens at the national level expressing a preference for active participation.
Qual / Quant	Quantitative
Source of data	Data are from special Eurobarometer 401
Date	2013
Time-series	The 2013 item is a slightly modified version of an item which first appeared in special Eurobarometer 340 in 2010. It would be possible to use these after some modification as time series data
Potential time series data	The survey items could potentially be fielded in relation with future eurobarometers, or by national agencies.
Measurement level	Interval
Unit of analysis	The basic unit is individual citizens, but the indicator reports at the aggregated national level
Coverage	EU28 is covered
Attributes	Numerical value (share of citizens in a country opting for active participation)
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	The indicator is based on aggregation of individual level data
Sub-categorisation from dimension typology (functional vocabulary)	The indicator transverses two sub-categories of the PE dimension, namely 'participation' and 'consultation'.
Interlinkages with other RRI dimensions	The indicator has linkages to the 'governance' dimension. It could be possible to compute the indicator in slightly different ways to link up with the 'literacy and education' dimension.
Data collection specifications	
Data collection methods	Survey with representative samples of citizens across countries
Representation issues	-
Feasibility issues	The indicator is feasible for application. However, continued future data collection would be expensive, unless aligned with the Eurobarometer series work
Additional points to pay attention to	
Comments/caveats	-

Information item	**PE4**
Indicator characteristics	
Name of indicator	**Active information search about controversial technology**

Primary/secondary data	Secondary
Need for supplementary data collection	No
Description	The basis for this indicator is a composite measure based on three individual items from the 2010 eurbarometer on biotechnology targeting the individual level. It divides respondents into three categories depending on their responses to background items concerning 'having heard about', 'having talked with friends and family about' and 'having searched for information about' GM food. The three categories include "Have heard and talked and/or searched for information", "have heard but not talked or searched for information", and '"have not heard". The indicator taps into degrees of active information search, or what could be considered horizontal engagement, around controversial technologies. It should be noted that the exact same measure is available for four other technologies, namely animanl cloning for food production, nanotechnology, biobanks, and synthetic biology. The indicator we suggest concerns the share of citizens at the aggregated national level, who have heard and talked and/or searched for information.
Qual / Quant	Quantitative
Source of data	The source is Eurobarometer 341, wave 73.1 from 2010. Data is available to us.
Date	2010
Time-series	No
Potential time series data	The survey items could potentially be fielded in relation with future eurobarometers, or by national agencies.
Measurement level	Interval
Unit of analysis	The basic data unit is individuals, but the indicator is an aggregated measure at country level
Coverage	EU28 + Turkey, Switzerland, Norway, Iceland
Attributes	Numerical value (share of citizens who have heard and talked and/or searched for information)
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Based on aggregation from individual level data
Sub-categorisation from dimension typology (functional vocabulary)	The indicator relates to the 'public communication' category within the PE dimension
Interlinkages with other RRI dimensions	The indicator is closely interlinked with SLSE dimension
Data collection specifications	
Data collection methods	Survey with representative samples of citizens across countries
Representation issues	-
Feasibility issues	The indicator is feasible for application. However, continued future data collection would be expensive, unless aligned with the Eurobarometer series work

Additional points to pay attention to	
Comments/caveats	-

Information item	**PE5**
Indicator characteristics	
Name of indicator	**Public engagement performance mechanisms at the level of research institutions**
Primary/secondary data	Primary data (a pool of secondary data exists, covering however only 40 unspecified institutions across Europe and the quality of the data is not known – it is suggested to disregard these existing data, but to enter a dialogue with Bucchi/Neresini who conducted the existing study about operationalisation)
Need for supplementary data collection	-
Description	The indicator is based on data collection at the level of universities and public research agencies, which will be aggregated to the national level. Based on survey administered to full/representative sample of institutions, a measure of public engagement performance (to be specified in the questionnaire) is provided. The indicator will report the level of public engagement mechanisms implemented within universities and research institutions at the country level.
Qual / Quant	Quantitative
Source of data	The indicator is partly based on work performed by Neresini, F. and Bucchi, M. 2011: Which indicators for the new public engagement activities? An exploratory study of European research institutions. In: Public Understanding of Science, 20, 1, 64-79. The indicator is furthermore inspired by the study by Vargiu, Andrea (2014): Indicators for the evaluation of public engagement of higher education institutions. *Journal of the Knowledge Economy*. 5: 562–584.
Date	-
Time-series	No
Potential time series data	Yes, the survey intervention could be repeated
Measurement level	Interval
Unit of analysis	Institutions (will be aggregated to the national level)
Coverage	Institutions across EU28 (see the specific 'representation' column)
Attributes	-
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Based on aggregation from institutional level
Sub-categorisation from dimension typology (functional vocabulary)	In principle the indicator transverses the conceptual categories of the PE dimension.

Interlinkages with other RRI dimensions	Some interlinkage with the SLSE dimension (and potentially all three subcategories; 'science education', 'science communication' and ''co-production of knowledge').
Data collection specifications	
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. Questions tailored to capture the institutions' implementation of PE activities will be applied. Draft formulation of the question could be "which of the following mechanisms does your institution apply in order to interact with citizens and societal stakeholders? - Research projects in partnership with non-academic organisations - Collaboration with NGO's and local government bodies - Participation in EU projects/networks about PE - Community representatives in boards or committees - Specific activities with schools at research institutions - Organisation of meetings/conferences addressed to the public - Implementation of specific action plans targeting PE - Salary incentives for public outreach activities - Awards for science communication - Availability of a press and/or PR office As in the study by Neresini and Bucchi one could imagine the construction of a synthetic index of public engagement mechanisms that could be applied in order to assess and compare public engagement and outreach activities across European countries.
Representation issues	For countries in which the number of universities and major public research institutions does not exceed 20, the national correspondents will provide contact details for the full population. In countries in which the number exceeds 20, correspondents will provide a contact details for a sample of 20 institutions, representative in terms of size (turnover), university/ research institution distribution, and geographical location (finer details to be specified in the guidelines to correspondents).
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without huge costs.
Additional points to pay attention to	
Comments/caveats	In the specific survey design one could profitably design the specific question in an open-ended fashion that allow for descriptions and qualifications of the type of mechanisms applied.

Information item	**PE6**
Indicator characteristics	
Name of indicator	**Dedicated resources for public engagement**
Primary/secondary data	Primary data (a pool of secondary data exists, covering however only 40 unspecified institutions across Europe and the quality of the data is not known – it is suggested to disregard these existing data, but to enter a dialogue with Bucchi/Neresini who conducted the existing study about operationalisation)
Need for supplementary	-

data collection	
Description	The indicator is based on data collection at the level of universities and public research agencies, which will be aggregated to the national level. Based on survey administered to full/representative sample of institutions, a measure of resources dedicated to PE activities (to be specified in the questionnaire) is provided. The indicator will report the national average budget share reserved for PE activities within universities and research institutions at the country level.
Qual / Quant	Quantitative
Source of data	The indicator is inspired by work performed by Neresini, F. and Bucchi, M. 2011: Which indicators for the new public engagement activities? An exploratory study of European research institutions. In: Public Understanding of Science, 20, 1, 64-79.
Date	-
Time-series	No
Potential time series data	Yes, the survey intervention could be repeated
Measurement level	Interval
Unit of analysis	Institutions (will be aggregated to the national level)
Coverage	-
Attributes	Numerical value (budget share)
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Based on aggregation from institutional level
Sub-categorisation from dimension typology (functional vocabulary)	In principle the indicator transverses the conceptual categories of the PE dimension. It is however likely, that the question will mainly capture activities related to public communication
Interlinkages with other RRI dimensions	Some interlinkage with the SLSE dimension
Data collection specifications	
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. Questions tailored to capture the institutions' resources allocated to PE activities, as well as the overall institutional budget will be applied. Draft formulation of the question could be "Please indicate the institutional budget in Euros reserved for activities around public engagement and outreach, such as 'open university days', 'science festivals', 'conferences aimed at the general public' ETC", and a second question would identify the overall budget of the institution. The indicator will be calculated as the weighted (by budget size of institution) mean

	budget share allocated to PE activities across universities and research institutions in a given country.
Representation issues	For countries in which the number of universities and major public research institutions does not exceed 20, the national correspondents will provide contact details for the full population. In countries in which the number exceeds 20, correspondents will provide a contact details for a sample of 20 institutions, representative in terms of size (turnover), university/ research institution distribution, and geographical location (finer details to be specified in the guidelines to correspondents).
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without huge costs.
Additional points to pay attention to	
Comments/caveats	-

Information item	**PE7**
Indicator characteristics	
Name of indicator	Embedment of public engagement activities in the funding structure of key public research funding agencies
Primary/secondary data	Primary data will be collected through survey addressing key public research funding agencies. The sample, or full population of RFOs will be identified by the national correspondents across EU28
Need for supplementary data collection	-
Description	The indicator describes whether a country's largest and most prominent research funding agencies (typically research councils) allocate competitive funding to activities (mechanisms, programs, projects) where public engagement elements explicitly are targeted. These could, e.g., be specific research activities on public engagement, programmes supporting outreach activities etc.
Qual / Quant	The basic data will be quantitative
Source of data	The indicator is inspired by work performed in the MASIS project (2010-2012) and ResAGora project (2013-2016) which both – in different ways and to various extents - include a particular interest in national funding programmes targeting SIS research (MASIS) and Responsible Research and Innovation (ResAGora), respectively. References: MASIS: European Commission. 2012. "Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Final synthesis report." http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf ResAGora: http://res-agora.eu/
Date	-
Time-series	No
Potential time series data	Yes, the data collection procedure could be repeated
Measurement level	Depends on the items applied in the survey.
Unit of analysis	Research funding organisations
Coverage	Key national public research funding agencies across EU28
Attributes	-

Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National level
Is indicator based on aggregation/disaggregation	Yes, results will be aggregated to the national level.
Sub-categorisation from dimension typology (functional vocabulary)	The indicator could potentially tap into one or more of the four sub-categories 'public communication', 'public consultation', 'public deliberation' and 'public participation' depending on the type of PE activities supported/targeted. One could imagine activities broadly spanning from dissemination activities ('public communication') over the involvement of lay publics in research agenda setting processes ('public deliberation') to the inclusion of public representatives in (binding) decision-making processes ('public participation').
Interlinkages with other RRI dimensions	The indicator relates to the governance dimension
Data collection specifications	
Data collection methods	• Data will be collected through a survey. The data collection process includes the following • main procedural elements: • • Each national correspondent will identify the main national research funding agencies. The sample should ideally cover the full population, or at least the key public funding agencies for competitive funding (research councils) Specific items will be developed targeting the existence of funding schemes aimed at research with public engagement contents.
Representation issues	All relevant funding agency/research council will be carefully selected by means of each national correspondent's country specific knowledge and expertise to ensure that right institution have been selected. The sample will then include comparable data across EU28.
Feasibility issues	The indicator is very feasible as a one-off source as well as a repetitive data collection process.
Additional points to pay attention to	
Comments/caveats	The indicator is currently outlined as an indicator describing whether or not specific programmes exist that specifically target/support PE activities. The exact wording of the items need to be thought carefully through. It would also be possible to address the resources reserved for programmes with PE contents.

Information item	**PE8**
Indicator characteristics	
Name of indicator	Public engagement elements as evaluative criteria in research proposal evaluations
Primary/secondary data	Primary data will be collected through survey addressing key public research funding agencies. The sample, or full population of RFOs will be identified by the national correspondents across EU28
Need for supplementary data collection	-

Description	The indicator describes whether a country's largest and most prominent research funding agencies (typically research councils) take public engagement elements into account for the evaluation of research and innovation projects.
Qual / Quant	Quantitative
Source of data	The indicator is inspired by work performed in the MASIS project (2010-2012) and ResAGora project (2013-2016) which both – in different ways and to various extents - include a particular interest in national funding programmes targeting SIS research (MASIS) and Responsible Research and Innovation (ResAGora), respectively. References: MASIS: European Commission. 2012. "Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Final synthesis report." http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf ResAGora: http://res-agora.eu/
Date	-
Time-series	No
Potential time series data	Yes, the data collection procedure could be repeated
Measurement level	Depends on the exact wording of the items.
Unit of analysis	Research funding organisations
Coverage	Ideally full sample of national public research funding agencies across EU28
Attributes	-
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National level
Is indicator based on aggregation/disaggregation	Yes, will be aggregated to the national level
Sub-categorisation from dimension typology (functional vocabulary)	The indicator could potentially tap into one or more of the four sub-categories 'public communication', 'public consultation', 'public deliberation' and 'public participation' depending on the nature of the PE evaluative criteria.
Interlinkages with other RRI dimensions	The indicator relates to the governance dimension
Data collection specifications	
Data collection methods	• Data will be collected through a survey. The data collection process includes the following • main procedural elements: • • Each national correspondent will identify the main national research funding agencies. The sample should ideally cover the full population, or at least the key public funding agencies for competitive funding (research councils)

	Specific items will be developed targeting the role of citizens and CSOs in prioritizing research funding and in assessing proposals or in other ways participate in the decisions of the RFOs
Representation issues	All relevant funding agency/research council will be carefully selected by means of each national correspondent's country specific knowledge and expertise to ensure that right institution have been selected. The sample will then include comparable data across EU28.
Feasibility issues	The indicator is very feasible as a one-off source as well as a repetitive data collection process.
Additional points to pay attention to	
Comments/caveats	The exact items need to be developed.

Information item	**PE9**
Indicator characteristics	
Name of indicator	**R&I democratization index**
Primary/secondary data	Primary data
Need for supplementary data collection	-
Description	The indicator is based on a stakeholder survey among organisations centrally located in the broader 'science in society' field with a target population of 20-30 organisations in each country. The indicator will be a composite measure based on a limited number of survey questions all tapping into the role and responsibilities – or degrees of engagement - of citizens and societal actors in research and innovation processes. The specific items need to be tailored and tested ahead of fielding the survey, but preliminary question formulations include: 'Assess the extent to which: 1) mechanisms for efficiently involving citizens in decisions around research and innovation at the national level are in place, 2) civil society organisations are formally involved in decisions about research and innovation at the national level' and similar items with 5-point response scales. An index will be constructed based on such items, and the indicator will convey the national mean score on the index.
Qual / Quant	Quantitative
Source of data	The indicator is based on primary data collection. For identification of the respondent population, however, data collection will rely on harvesting lists of stakeholders from the national MASIS reports, available at https://morri.res-agora.eu/masis specifically tables 2.4.1 2.4.2, 2.4.3, and 2.4.4.
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Interval
Unit of analysis	The basic unit is organisations, specifically different stakeholder organisations, but the information will be aggregated to the national level
Coverage	-
Attributes	Numerical value (mean national score on index)
Assessment of RRI indicators	
Analytical level	Input

Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Aggregated from the institutional level
Sub-categorisation from dimension typology (functional vocabulary)	The indicator mainly concerns the 'participation' component of the PE dimension
Interlinkages with other RRI dimensions	The indicator relates strongly to the governance dimension
Data collection specifications	
Data collection methods	Data will be collected using web-based survey. The respondents will be identified based on the national MASIS reports. Each national MASIS report contains a listing of main national stakeholders around 'ethics in S&T', 'equality, diversity and inclusiveness in scientific institutions', 'science communication', and 'technology assessment', around 20-30 in total for each country, approximately 1,000 across the 37 reports, including web-links to all institutions. A contact person, preferably the Head, and contact details, email address specifically, should be collected for each of these app. 1,000 stakeholder organisations. In turn, a web-based survey will be administered to the identified respondent population. The indicator is based on a set of questions contained in the indicator.
Representation issues	The organisations identified in the MASIS reports are intended to be the most important 20-30 actors involved in the broader science in society field in each country. The degree to which these are representative of the full population of stakeholders in each country is questionable. It is however very likely that the representatives of these main stakeholders will be in a privileged position to assess the issues and respond to the questions posed in the survey. One point of observation should be noted. While the MASIS project covered 37 European country, one EU country – Malta – is not covered, which would implicate a special effort to identify 20-30 organisations in Malta following the initial scheme from the MASIS guidelines, which are available to us.
Feasibility issues	There will be some efforts needed to establish the contact details for the stakeholder organisation, but it should not be a complicated task, and it can be handled centrally. The web-based survey can likewise be administered centrally and is not demanding in terms of resources.
Additional points to pay attention to	
Comments/caveats	Note that the stakeholder survey could very well include modules targeting the other dimensions of RRI too.

Information item	**PE10**
Indicator characteristics	
Name of indicator	**National infrastructure for involvement of citizens and societal actors in research and innovation**
Primary/secondary data	Primary data
Need for supplementary data collection	-
Description	The indicator is based on a stakeholder survey among organisations centrally located in the broader 'science in society' field with a target population of 20-30 organisations in each country. The indicator will be a composite measure based on a limited number of survey questions all

	tapping into the organisational landscape – or infrastructure – for involving citizens and societal actors in research and innovation. The specific items need to be tailored and tested ahead of fielding the survey, but they will aim to tap into the presence and weight of institutions such as technology assessment institutions with citizen and stakeholder involvement, advisory boards and committees with citizen and stakeholder involvement etc. The indicator will summarize the degree of development of the national infrastructure for involvement of citizens and societal actors in research and innovation.
Qual / Quant	Quantitative
Source of data	The indicator is based on primary data collection. For identification of the respondent population, however, data collection will rely on harvesting lists of stakeholders from the national MASIS reports, available at https://morri.res-agora.eu/masis specifically tables 2.4.1 2.4.2, 2.4.3, and 2.4.4.
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Interval
Unit of analysis	The basic unit is organisations, specifically different stakeholder organisations, but the information will be aggregated to the national level
Coverage	-
Attributes	Numerical value (mean national score on index)
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Aggregated from the institutional level
Sub-categorisation from dimension typology (functional vocabulary)	The indicator mainly concerns the 'participation' component of the PE dimension
Interlinkages with other RRI dimensions	The indicator relates to the governance dimension
Data collection specifications	
Data collection methods	Data will be collected using web-based survey. The respondents will be identified based on the national MASIS reports. Each national MASIS report contains a listing of main national stakeholders around 'ethics in S&T', 'equality, diversity and inclusiveness in scientific institutions', 'science communication', and 'technology assessment', around 20-30 in total for each country, approximately 1,000 across the 37 reports, including weblinks to all institutions. A contact person, preferably the Head, and contact details, email address specifically, should be collected for each of these app. 1,000 stakeholder organisations. In turn, a web-based survey will be administered to the identified respondent population. The indicator will be based on a set of questions contained in the indicator.
Representation issues	The organisations identified in the MASIS reports are intended to be the most important 20-30 actors involved in the broader science in society field in each country. The degree to which these are representative of the full

	population of stakeholders in each country is questionable. It is however very likely that the representatives of these main stakeholders will be in a privileged position to assess the issues and respond to the questions posed in the survey. One point of observation should be noted. While the MASIS project covered 37 European country, one EU country – Malta – is not covered, which would implicate a special effort to identify 20-30 organisations in Malta following the initial scheme from the MASIS guidelines, which are available to us.
Feasibility issues	There will be some efforts needed to establish the contact details for the stakeholder organisation, but it should not be a complicated task, and it can be handled centrally. The web-based survey can likewise be administered centrally and is not demanding in terms of resources.
Additional points to pay attention to	
Comments/caveats	Note that the stakeholder survey could very well include modules targeting the other dimensions of RRI too.

4.2.4 Ethics

Information item	E1
Indicator characteristics	This section includes general indicator specifications
Name of indicator	**Ethics at the level of universities**
Primary/secondary data	Primary data
Need for supplementary data collection	Data will be collected as part of the RPO survey. The development of specific items will be informed by previous research within the following projects: • ENRIO (European Network of Research Integrity Offices www.enrio.eu). • EUREC (European Network of Research Ethics Committees, http://www.eurecnet.org/index.html) • SATORI project that conducted existing studies (www.satoriproject.eu)
Description	The indicator is based on data collection at the level of universities and national research integrity officers (RIO), which will be aggregated to the national level. Based on survey administered to full/representative sample of institutions, a measure of ethics performance (to be specified in the questionnaire) is provided. The indicator will report the level of mechanisms that should safeguard the observance of ethical standards in research ethics and research integrity (RI) that are implemented within universities at the country level. The indicator focusses particularly on research ethics committees (REC) and research integrity officers (RIO). RECs approve, monitor, and review (proposed) research projects or proposals in order to assess whether they comply with ethical standards (e.g. in clinical studies or other research that involves human subjects as well as animal testing) RIOs investigate research misconduct that violates good scientific practice and includes, e.g., plagiarism, fabrication of data or research results, non-transparency regarding conflicts of interest. Furthermore, they provide support to solve authorship disputes and data management issues (e.g., data security, access, etc.).
Qual / Quant	Quantitative
Source of data	The indicators are to some extent inspired by research currently carried out in the SATORI project, which is not yet in the public domain www.satoriproject.eu. Within the SATORI project comparative work on ethics assessment in a few selected European countries is being carried out. Contact with EUREC and ENRIO will help to identify further data sources. Data will be collected from a sample of universities.
Date	2015
Time-series	No
Potential time series data	Yes, the survey intervention could be repeated
Measurement level	Measurement level will depend on the specific items applied. As an index is envisaged, the measurement level will likely be interval.
Unit of analysis	Institutions (will be aggregated to national level)
Coverage	EU Member States
Attributes	The index is composed of several – mostly qualitative - indicators that capture the input, output and context of ethics infrastructure (REC and RIO) at universities
Assessment of RRI	This section assesses the indicator on the basis of the analytical distinctions

indicators	and quality parameters specified within the context of the MoRRI project
Analytical level	1. Number of universities with REC by total number of universities. (input) 2. Number of opinions per year by number of university staff. (output) 3. Can the REC take initiative to investigate a proposal? (context) 4. Are applications to REC obligatory or voluntary? (context) 5. Do applications cover all disciplines or do they miss in certain research areas? (context) 6. What do evaluation criteria cover? (context) 7. Are amendments requested? (output) 8. Are negative opinions issued? (output) 9. Are the opinions of REC non-binding recommendations? (context) 10. Existence of RIO on local level (universities). (input) 11. Are RIOs at universities ad-hoc committees or institutionalized as permanent boards? (permanent boards have more experience) (cpntext) 12. Total number of opinions per year in a country by number of university staff in a country. (output) 13. Can the RIO take initiative to investigate a case? (context) 14. Do complains to RIO cover all disciplines? The more disciplines the stronger. (context) 15. What do RIOs cover? (plagiarism, fabrication, fraud, authorship and intellectual property and citation/acknowledgement practices, scientific neutrality, conflicts of interest in peer review and scientific advice) (input) 16. Are opinions published in anonymized form after investigation? If not weak if yes strong (context) 17. Are the opinions of RIO non-binding recommendations? Non-binding weak, binding strong. (context) 18. Do RIOs take actions to raise awareness for the issue of RI? (output) 19. Do RIOs issue recommendations for researchers, policy makers and stakeholder? (output) Do RIOs provide training on RI? (output)
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Based on aggregation from institutional level
Sub-categorisation from dimension typology (functional vocabulary)	-
Interlinkages with other RRI dimensions	Some interlinkages with PE and GOV dimensions.
Data collection specifications	This section specifically addresses the procedure for collecting primary data, including collection of supplementary data when existing data has insufficient coverage. Please expand on each issue to the extent feasible in order to – as precisely as possible - direct the data collection process in task 4.
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (they will be defined in the guidelines to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population.

	Questions tailored to capture the institutions' implementation of ethics activities will be applied. Draft formulation of the question could be "which of the following mechanisms does your institution apply in order to safeguard ethics in research and research integrity at your university? 1. Number of opinions per year by number of university staff. A high number would be considered as strong, a low as weak 2. Can REC take initiative to investigate a proposal? The right of initiative would be considered as strong, no right would be considered as weak. 3. Are applications obligatory or voluntary? Obligatory would be considered as strong, not obligatory as weak. 4. Do applications cover all disciplines or do they miss in certain research areas? The more disciplines are covered the stronger 5. What do evaluation criteria cover? The broader the criterial (legal necessities, research ethics, societal impact) the stronger 6. Are amendments requested? If amendments are requested strong, if not weak. 7. Are negative opinions issued? If no negative votes weak if negative votes strong 8. Are the opinions of REC non-binding recommendations? Non-binding weak, binding strong. 9. Existence of RIO on local level (universities). 10. Are RIOs at universities ad-hoc committees or institutionalized as permanent boards? (permanent boards have more experience) 11. Total number of opinions per year in a country by number of university staff in a country. 12. Can the RIO take initiative to investigate a case? 13. Do complains to RIO cover all disciplines? The more disciplines the stronger. 14. What do RIOs cover? (plagiarism, fabrication, fraud, authorship and intellectual property and citation/acknowledgement practices, scientific neutrality, conflicts of interest in peer review and scientific advice) 15. Are opinions published in anonymized form after investigation? If not weak if yes strong 16. Are the opinions of RIO non-binding recommendations? Non-binding weak, binding strong. 17. Do RIOs take actions to raise awareness for the issue of RI? 18. Do RIOs issue recommendations for researchers, policy makers and stakeholder? Do RIOs provide training on RI?
Representation issues	Proper sampling methods will apply in order a random and stratified sample will be created.
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without huge costs.
Additional points to pay attention to	
Comments/caveats	It has to be decided how to weigh the different indicators in the index.

Information item	**E2**
Indicator characteristics	
Name of indicator	**National Ethics Committees Index (NEC index)**
Primary/secondary data	Secondary Data
Need for supplementary data collection	No

Description	The index captures qualities of national ethics committee infrastructure in a country. The index measures existence, output, impact and quality of NECs. It looks at the output in terms of opinions but also in terms of contributing to public debate, policy making. It particularly looks at the role of the public in NECs by measuring the publication of work results, the organisation of public events, classification of existing public involvement mechanisms, involvement of target groups and the existence and quality of websites. Moreover it will survey whether and to what extent the output of NECs has an impact on RECs.
Qual / Quant	Basic data is qualitative and include reports from • MASIS: https://morri.res-agora.eu/masis • EPOCH (https://epochconference2012.wordpress.com/about) • SATORI (www.satoriproject.eu) Specific operationalisation remains to be done in Task 4.
Source of data	Data for the index is available for 32 countries (EPOCH). There should be also some most recent information from the SATORI project on a few countries. • EPOCH: Mali, Franc; Pustovrh, Toni; Groboljsek, Blanka; Coenen, Christopher (2012): National Ethics Advisory Bodies in the Emerging Landscape of Responsible Research and Innovation. Nanotechnologies 6: 167-184, 10.1007/s11569-012-0157 • MASIS: https://morri.res-agora.eu/masis • SATORI: http://satoriproject.eu/work_packages/comparative-analysis-of-ethics-assessment-practices/
Date	EPOCH: 2011 MASIS: 2011 SATORI: 2014
Time-series	Yes, time series would be possible but would only make sense in large intervals because institutional changes are suspected to happen slowly.
Potential time series data	Yes; there is data available to start, additional data would have to be collected by primary data collection (desktop research, expert interviews)
Measurement level	Will depend on the final composition of this indicator
Unit of analysis	National level. In most cases one NEC per country.
Coverage	The index covers national ethics committees (NEC) in 32 countries.
Attributes	
Assessment of RRI indicators	
Analytical level	This will depend on the final tailoring of the indicator
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	In most cases there is no need for aggregation because there is only one NEC per country. In few countries aggregation is necessary because there are two or three organisations.
Sub-categorisation from dimension typology (functional vocabulary)	-
Interlinkages with other RRI dimensions	PE, SLSE, GOV
Data collection specifications	
Data collection methods	Data is available from the EPOCH project and the MASIS reports. Information on output in terms of opinions is also available at the NEC Forum website (http://europa.eu/sinapse/directaccess/NEC/Public-Library/) If primary data collection is necessary, a questionnaire can be send out to

	NECs. For a list see: http://apps.who.int/ethics/nationalcommittees/. Membership of the organization in the NEC Forum is also an indicator for selecting the right organisation (https://www.bka.gv.at/site/3461/default.aspx#a1).
Representation issues	NEC are easy to identify because in most countries there is one organization, in few countries two to three organizations.
Feasibility issues	There is ample information to cover NECs: • EPOCH • MASIS, • SATORI NEC Forum
Additional points to pay attention to	
Comments/caveats	It must be clarified how to weigh the different indicators to arrive at one index.

Information item	**E3**
Indicator characteristics	
Name of indicator	**Research Funding Organisations Index**
Primary/secondary data	Primary Data
Need for supplementary data collection	Primary data collection
Description	The index is composed of several indicators that capture the input, output and context of mechanisms dealing with ethics and societal implication or research in public and private research funding organisations (RFO). It covers the following indicators: 1. Do RFO integrate ethics assessment in their funding decisions? 2. What is the formal and actual scope of ethics review? What criteria does ethics assessment cover? 3. Do applications which are monitored for ethics cover all disciplines or do they miss in certain research areas? 4. Do mechanisms exist for multi-stakeholder and/or transdisciplinary processes of appraisal of societal relevance and ethical acceptability (presence/frequency)? 5. Are their documented changes in R&I priorities in R&I priorities (research or research funding) attributable to multi-stakeholder and/or transdisciplinary processes of appraisal of societal relevance and ethical acceptability (presence/frequency)? 6. Are there ELSI[7]/ELSA project components in research projects and/or transdisciplinary components that address societal relevance and ethical acceptability (presence/frequency)? 7. Documented change in R&I priorities attributed to appraisal of ethical acceptability. 8. % of funding with ethics review per total funding. % of research proposals for which ethics review/IRB clearance process requires substantive changes in grant application or second ethics assessment.
Qual / Quant	Quantitative
Source of data	Primary data collection from a sample of public and private research funding organisations (RFO)

[7] ELSI/ELSA stands for „ethical, legal and societal/societal implications/issues/aspects" of a given field or research or innovation (Expert Group on Policy Indicators for Responsible Research and Innovation" (January 2015)

Date	2015
Time-series	Yes
Potential time series data	Yes
Measurement level	Will depend on the final composition of the indicator
Unit of analysis	Institution aggregated to country
Coverage	EU Member States
Attributes	The index measures existence, output and quality of mechanisms integrating ethics into research funding.
Assessment of RRI indicators	
Analytical level	This will depend on the final tailoring of the indicator
Analytical level (aggregation)	Institutional data will be aggregated to national data
Is indicator based on aggregation/disaggregation	Aggregation of data from different organisations
Sub-categorisation from dimension typology (functional vocabulary)	-
Interlinkages with other RRI dimensions	PE, GOV
Data collection specifications	
Data collection methods	MoRRI correspondents will identify relevant RFOs in their countries and contact persons.
Representation issues	Data collection recognizes the variation of research funding organizations across Europe. Therefore a functional approach is applied. The term "research funding agencies" is applied, which also includes research ministries. The survey should cover the largest and most influential public and private research funding agency in terms of money spent. They could cover both basic and applied research.
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without huge costs.
Additional points to pay attention to	
Comments/caveats	Weighing of factors has to be considered in the index

4.2.5 Open access

Information item	OA1
Indicator characteristics	
Name of indicator	**Open Access Literature (OAL)**
Primary/secondary data	Primary
Need for supplementary data collection	For Gold OA. OA journals directories will be used (DOAJ, Crossref, WoS indication of OA journal, etc.). For Green OA we will use a harvesting approach to obtain 'evidence of freely accessible' papers: PubMed Central papers, papers with a version in Arxiv (or other repositories). We will use an approach comparable to Archambault's.
Description	The indicator will calculate the number and share of publications that have some 'free' online accessibility (both in Gold and Green OA). The proposed approach: For Gold OA we can use CWTS available data on OA journals. For the Green OA indicator 'harvesting' would be necessary. Essentially, searching for free available copies of publications.
Qual / Quant	Quantitative
Source of data	CWTS counts with the following databases: Web of Science. Mendeley. Open Access databases (based on Crossref, DAOJ and ROAD).
Date	n/a
Time-series	Yes it is possible for future replications of the indicator. Retrospectively, we can go back to 1980 for the Web of Science, but preferably not earlier than 2005.
Potential time series data	Yes
Measurement level	Raw counts and shares
Unit of analysis	Countries, regions, disciplines, institutions and authors.
Coverage	All countries, disciplines, institutions, authors with publications in the Web of Science.
Attributes	Counts and shares.
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	Global, national, disciplinary, regional, institutional, project/programme and individual.
Is indicator based on aggregation/disaggregation	The indicator(s) is(are) based on raw and aggregated data.
Sub-categorisation from dimension typology (functional vocabulary)	Open Access
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection	For the Gold OA, CWTS already counts with methods and databases, so they can be easily implemented. For the Green OA there we will adapt

methods	Archambault's harvesting method. This requires a substantial amount of resources. See data proposal below.
Representation issues	Similar representation (and biases) as regarding the use of the Web of Science/Scopus database
Feasibility issues	For data collection, depending on the choices can go from high feasibility (e.g. only Gold OA), to medium/low (for Green OA) as the harvester technology would need to be developed (although the validity of the indicator would be much higher). Validation of the results could be regarded as a necessary step.
Additional points to pay attention to	
Comments/caveats	Caveats related with bibliometric indicators also apply here (coverage of databases, bibliographic metadata limitations, etc.). This indicator requires both standardised procedures and data collection and also more exploratory approaches.

Information item	**OA2**
Indicator characteristics	
Name of indicator	**Data publications and citations per country.**
Primary/secondary data	Primary data obtained from the Data Citation Index to be acquired and used. This is the preferred option as citations are already calculated in this source.
Need for supplementary data collection	Information on author-institutions needs to be processed. If the DCI is used, the country information can easily be extracted from the records.
Description	Caveats related with bibliometric and altmetric indicators also apply here. This indicator requires both standardised procedures and data collection and also more exploratory approaches..
Qual / Quant	Quantitative
Source of data	The Data Citation Index (DCI) on the Web of Science.
Date	N/A
Time-series	Possible in as much the publication date is recorded by DCI
Potential time series data	Yes
Measurement level	Raw counts and possible some relative measures at the country level.
Unit of analysis	Countries.
Coverage	All European countries.
Attributes	Counts and ratios.
Assessment of RRI indicators	
Analytical level	Output
Analytical level (aggregation)	Country, institutional, venue and author levels.
Is indicator based on aggregation/disaggregation	The indicator is based on data publication data (disaggregated). It needs to be aggregated at the unit of analysis (e.g. countries, institutions, publication venues, authors, etc.)
Sub-categorisation from dimension typology (functional	Open Research Data

vocabulary)	
Interlinkages with other RRI dimensions	-
Data collection specifications	
Data collection methods	Data extraction from DCI. The data will be organised in a relational model. Probably, country, institutional and author data will need to be harmonised
Representation issues	Potential limitations based on the coverage by DCI.
Feasibility issues	Medium feasibility if the Data Citation Index is used
Additional points to pay attention to	
Comments/caveats	Caveats related with the Data Citation Index apply here. These indicators require still exploratory approaches. Data publication is still a developing area, this means that unforeseen problems may pop up during the development of the indicator

Information item	**OA3**
Indicator characteristics	
Name of indicator	**Social media outreach/take up of Open Access Literature and open research data**
Primary/secondary data	Primary data (i.e. Web of Science or Scopus data - and data collected in OA1 and OA2) + other secondary data (i.e. Mendeley and Altmetric.com)
Need for supplementary data collection	Need of data collection as decided in OA1 and OA2.
Description	This indicator will inform how OA European publications and data publications are being disseminated across social media tools.
Qual / Quant	Quantitative
Source of data	CWTS counts with the following databases: Web of Science. Mendeley. Altmetric.com. Open Access databases (based on Crossref, DAOJ and ROAD), and potentially all the information collected in OA2.
Date	From 2012 onwards.
Time-series	Yes, from 2012 onwards.
Potential time series data	Yes
Measurement level	Raw counts, shares and ratios.
Unit of analysis	Countries, regions, institutions and authors.
Coverage	All countries, institutions, authors with OA publications in the Web of Science (and with a DOI or other identifiers) and Open research data publications in the DCI
Attributes	Counts, ratios and shares.
Assessment of RRI indicators	
Analytical level	Outcome
Analytical level	Global, national, regional, institutional, project/programme and individual.

(aggregation)	
Is indicator based on aggregation/disaggregation	The indicator(s) is(are) based on raw and aggregated data.
Sub-categorisation from dimension typology (functional vocabulary)	Open Access
Interlinkages with other RRI dimensions	Public Engagement (PE)
Data collection specifications	
Data collection methods	Bibliometric and altmetric data collection. CWTS has already developed methodologies to implement this. It would be necessary to experiment with the altmetric approaches.
Representation issues	Similar representation (and biases) as regarding the use of the Web of Science and altmetric databases.
Feasibility issues	Medium feasibility. In so far as OA1 and OA2 is done, data collection will be easy
Additional points to pay attention to	
Comments/caveats	Caveats related with bibliometric and altmetric indicators also apply here. This indicator requires both standardized procedures and data collection and also more exploratory approaches.

Information item	**OA4**
Indicator characteristics	
Name of indicator	**Public perception of Open Access - PPOA**
Primary/secondary data	Secondary: EU, national, NUTS II level
Need for supplementary data collection	The data that are currently available are based on one ad-hoc collection. In order for this indicator to be rich in data and robust enough this Eurobarometer would need to be published on a more regular basis.
Description	The indicator showcases public perception of online free availability of the results of the publicly funded research in the EU Member States. Data are collected on the EU-level, but can be disaggregated by individual Member States or by various socioeconomic profile (gender, age, level of education, attitude to science).
Qual / Quant	Quantitative.
Source of data	Indicator presented at European Commission. Special Eurobarometer 401. Responsible Research and Innovation (RRI), Science and Technology. Available at: http://ec.europa.eu/public_opinion/archives/ebs/ebs_401_en.pdf, p. 147-151.
Date	Data collected at April - May 2013.
Time-series	No. The data have been collected ad-hoc, especially for this issue of Eurobarometer.
Potential time series data	Yes, if the European Commission launches a new issue of this Eurobarometer.
Measurement level	Ordinal

Unit of analysis	EU, national, gender, age, level of education, interest in science
Coverage	EU27 countries + Croatia (Croatia was not a Member State during the field work for this survey).
Attributes	Shares.
Assessment of RRI indicators	
Analytical level	Output / Context
Analytical level (aggregation)	EU, national, gender, age, level of education, interest in science
Is indicator based on aggregation/disaggregation	The indicator is based on aggregated data.
Sub-categorisation from dimension typology (functional vocabulary)	Open Access
Interlinkages with other RRI dimensions	Governance Dimension, Public Engagement Dimension
Data collection specifications	
Data collection methods	The data covers the population of the respective nationalities of the European Union Member States, resident in each of the Member States and aged 15 years and over. The basic sample design applied in all states is a multi-stage, random (probability) one. In each country, a number of sampling points was drawn with probability proportional to population size (for a total coverage of the country) and to population density. The sampling points were drawn systematically from each of the "administrative regional units", after stratification by individual unit and type of area. They thus represent the whole territory of the countries surveyed according to the EUROSTAT NUTS II (or equivalent) and according to the distribution of the resident population of the respective nationalities in terms of metropolitan, urban and rural areas. Total number of interviewees for the EU28 is 27,563.
Representation issues	The ad-hoc character of the indicator is a limitation.
Feasibility issues	High feasibility provided the European Commission can use the collected data for further analysis.
Additional points to pay attention to	
Comments/caveats	The indicator covers the public perception of online free availability of the results of the publicly funded research. If this is to be collected more regularly, the European Commission might consider extend it to cover more also other dimensions of RRI (for example public engagement).

Information item	**OA5**
Indicator characteristics	
Name of indicator	**Funder Mandates**
Primary/secondary data	Secondary
Need for supplementary data	The data covered the whole EU (as of 2012). It does not cover Croatia. It is an ad-hoc collection of data used for writing up the Commission Staff Working

collection	Document.
Description	The indicator presents if and how many funder mandates for open access publishing there are in the EU Member States. Funder/institutional mandates relate to the policy and practice of funding institutions giving research grants or of academic institutions to request the research output to be made openly accessible.
Qual / Quant	Quantitative.
Source of data	The indicator is presented in the Commission Staff Working Document: Impact Assessment Accompanying the document Commission Recommendation on access to and preservation of scientific information in the digital age {C(2012} 4890 final} {SWD(2012) 221 final} based on openaire.eu., available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0222:FIN:EN:PDF, p. 88.
Date	Data collected in 2011.
Time-series	The data has been collected only on the ad-hoc basis for the staff working document. However, more up-to-date (but apparently partial) data can be found in the Melibea/Dulcinea and Sherpa/Juliet repositories. Further information can be retrieved from Funding Acknowledgements in OA publications (see OA1).
Potential time series data	Not probable.
Measurement level	Nominal
Unit of analysis	National
Coverage	27 EU Member States (excl. Croatia).
Attributes	The number of funder mandates (count).
Assessment of RRI indicators	
Analytical level	Output/ Context
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	The indicator is based on aggregated data.
Sub-categorisation from dimension typology (functional vocabulary)	Open Access
Interlinkages with other RRI dimensions	Governance Dimension
Data collection specifications	
Data collection methods	The overview of how many funder/institutional mandates there are across EU Member States was carried out by the European Commission as background input information for the Commission Staff Working Document. The number of mandates per country was based on the information available at www.openaire.eu (OpenAire aimed to support the implementation of Open Access in Europe. It provides the means to promote and realise the widespread adoption of the Open Access Policy, as set out by the ERC Scientific Council Guidelines for Open Access and the Open Access pilot launched by the

	European Commission).
Representation issues	The indicator is available only for 2011-2012. However, a closer cooperation with the OpenAire project might help to obtain more recent data.
Feasibility issues	Medium/Low feasibility. Data is not accessible through the public website of OpenAire.
Additional points to pay attention to	
Comments/caveats	As this indicator is based on the data provided by the European Commission, there might be a scope to make the dataset richer and up-to-date.

Information item	**OA6**
Indicator characteristics	
Name of indicator	**RPO support structures for researchers as regards incentives and barriers for data sharing**
Primary/secondary data	Primary
Need for supplementary data collection	-
Description	This indicator will capture practices and perceptions of the incentives and barriers for and against data sharing in RPOs. It relates to OA as well as governance. Specific operationalisation remains to be done in Task 4.
Qual / Quant	Quantitative
Source of data	The indicator is based on indicator proposals with regard to open access and open science presented in the report 'Indicators for promoting and monitoring Responsible Research and Innovation. Report from the Expert Group on Policy Indicators for Responsible Research and Innovation' (EU Commission, June 2015, pages 6, 32-33).
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Will depend on the final composition of this indicator
Unit of analysis	RPOs / Countries
Coverage	Research performing organisations in 28 EU countries .
Attributes	Incentives and barriers for and against data sharing practices for instance include: • Mechanisms for implementing and monitoring data sharing (website uploads, blogposts (social media in general), upload of datasets, upload of scientific articles etc.) • Management of scientific data (openness with regard to the scientific process, 'dialogue among professional and non-professional participants' etc.) • Number of projects with a continually updated 'virtual environment'. • Funding specifically allocated for data sharing Implementation of specific policies with regard to open access/open science

Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National on the basis of information about RPOs
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	-
Interlinkages with other RRI dimensions	GOV
Data collection specifications	
Data collection methods	Data will be collected as a (module of a) survey aimed at universities and major public research institutions. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. In case of low response rates, the respective RPOs can be contacted again via phone, relevant experts can be identified and be guided through the survey via phone.
Representation issues	The rates and quality of responses will vary among countries and institutions
Feasibility issues	The indicator is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without large costs.
Additional points to pay attention to	
Comments/caveats	**-**

4.2.6 Governance

Information item	GOV1
Indicator characteristics	
Name of indicator	**Composite indicator of RRI governance**
Primary/secondary data	Secondary data
Need for supplementary data collection	-
Description	This indicator will bring together indicators on gender, public engagement, open access, and ethics (GE1, GE3, GE9 , PE1, PE2, PE3, PE7, PE8, PE9, PE10, OA4, OA5, OA6, E1, E2, E3) to provide an evaluation of member state governance systems against a qualitative typology of governance approaches. The typology will depend on the empirical clustering of the above-mentioned metrics.
Qual / Quant	Quantitative
Source of data	The indicators described above. Typology-development may be inspired by the typology of governance described in Hagendijk and Irwin 2006, but will depend on the empirical material.
Date	2016
Time-series	No
Potential time series data	The indicator could potentially be reproduced in future data collection, if the constitutent indicators were also to be sustained.
Measurement level	-
Unit of analysis	-
Coverage	EU28
Attributes	-
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	N/A
Interlinkages with other RRI dimensions	Directly interlinked with several other dimensions. Is based on an understanding of Governance as an overreaching dimension.
Data collection specifications	
Data collection	The indicator will be developed based on analyses of data collected through other dimensions of the project. The intention is to derive RRI factors from

methods	these, and describe countries based on their position with regard to these factors. Cluster analysis of countries is envisaged.
Representation issues	**-**
Feasibility issues	Depends upon collection of other indicators
Additional points to pay attention to	
Comments/caveats	**-**

Information item	**GOV2**
Indicator characteristics	
Name of indicator	**Existence of formal governance structures for RRI within research funding and performing organisations**
Primary/secondary data	Primary
Need for supplementary data collection	-
Description	This indicator will determine whether RRI is seen as a priority issue for organisations and is supported by a formalised governance structure. The data for this indicator will be gathered through RPO and RFO surveys and will be presented at the aggregated national level as the share of organisations having a formalized governance structure. The exact operationalisation (in terms of questionnaire items) remains to be done in Task 4.
Qual / Quant	Quantitative
Source of data	Data collected through RPO and RFO surveys
Date	-
Time-series	No
Potential time series data	Yes
Measurement level	Interval, share of organisations with formalized governance structure
Unit of analysis	Countries (basic units RPOs and RFOs)
Coverage	EU28
Attributes	
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National on the basis of information about RPOs
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension	-

typology (functional vocabulary)	
Interlinkages with other RRI dimensions	
Data collection specifications	
Data collection methods	Data will be collected as (modules of) surveys aimed at universities and major public research institutions and major research funding organisations. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) as well as the main national research funding agencies in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. In case of low response rates, the respective RPOs and RFOs can be contacted again via phone, relevant experts can be identified and be guided through the survey via phone. Specific items will be developed targeting the existence of formalized RRI governance structures.
Representation issues	The rates and quality of responses will vary among countries and institutions
Feasibility issues	
Additional points to pay attention to	The quality and value of this indicator will depend on matters of definition. Organisations may have in place governance processes and structures that relate to RRI but they may not refer to them by that name. Surveying of organisations will therefore have to be done with care in order to pick up on the varied activity that might count as RRI.
Comments/caveats	**-**

Information item	**GOV3**
Indicator characteristics	
Name of indicator	**Share of research funding and performing organisations promoting RRI**
Primary/secondary data	Primary
Need for supplementary data collection	-
Description	This indicator will assess how widespread the RRI framework is through national research and innovation systems by determining the share of research funding and research performing organisations promoting the RRI framework.
Qual / Quant	Quantitative
Source of data	
Date	-
Time-series	No
Potential time series	Yes

data	
Measurement level	Interval, share of organisations
Unit of analysis	Countries, however basic units are RFOs and RPOs
Coverage	EU28
Attributes	
Assessment of RRI indicators	
Analytical level	Input
Analytical level (aggregation)	National on the basis of information about RPOs
Is indicator based on aggregation/disaggregation	Aggregation
Sub-categorisation from dimension typology (functional vocabulary)	-
Interlinkages with other RRI dimensions	
Data collection specifications	
Data collection methods	Data will be collected as (modules of) surveys aimed at universities and major public research institutions and major research funding organisations. A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a representative sample (see below) of universities or major research institutions (should be defined in guideline to correspondents) as well as the main national research funding agencies in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. In case of low response rates, the respective RPOs and RFOs can be contacted again via phone, relevant experts can be identified and be guided through the survey via phone. Specific items will be developed targeting the organisations' use of the RRI framework.
Representation issues	The rates and quality of responses will vary among countries and institutions
Feasibility issues	
Additional points to pay attention to	
Comments/caveats	**-**

5 Compilation of data collection methods

Chapter 5 compiles and specifies the empirical programme for harvesting primary data across the six RRI dimensions. The specific data collection methods and research approaches will be outlined and issues of feasibility and data administration will be considered. Moreover, the chapter delineates the need for assembling secondary data.

5.1 Data collection: Primary data

Table 5.1 provides an overview of the altogether 23 indicators relying on primary data collection methods and the proposed methods involved. In the following, each of these methods will be described and discussed in detail.

Table 5.1 RRI indicators relying on primary data collection methods

Primary data	Indicators
Science in Society actor survey	PE9, PE10
RPO-survey	GE1, GE5, GE8, GE9, SLSE2, SLSE 4, PE5, PE6, OA6, E1, GOV2, GOV3
RFO-survey	GE3, PE7, PE8, E3, GOV2, GOV3
Register data (database)	GE10, OA1, OA2, OA3
Qualitative, desk-research	SLSE1

5.1.1 Science in Society actor survey

The primary data collection for the indicators PE9 and PE10 will be based on a stakeholder survey among organisations centrally located in the broader 'science in society' field. Data will be collected using a web-based survey. The respondents will be identified based on the national MASIS reports. Each national MASIS report contains a listing of main national stakeholders around 'ethics in S&T', 'equality, diversity and inclusiveness in scientific institutions', 'science communication', and 'technology assessment'. Around 20-30 stakeholders for each country, approximately 1,000 across the 37 MASIS country reports, including web-links to all institutions, are available. A contact person, preferably the Head, and contact details (i.e. email address), should be collected for each of these app. 1,000 stakeholder organisations. In turn, a web-based survey will be administered to the identified respondent population. Some efforts will be needed to establish the contact details for the stakeholder organisation, but it should not be a complicated task, and it can be handled centrally. The web-based survey can likewise be administered centrally and is not demanding in terms of resources.

5.1.2 Research Performing Organisation (RPO) survey

The primary data for the indicators GE1, GE5, GE8, GE9, SLSE2, SLSE 4, PE5, PE6, OA6, E1, GOV2, and GOV3, will be collected as modules in a survey aimed at universities and major public research institutions (GOV2 and GOV3 will also rely on RFO survey, see below). A two-step procedure will be applied. First, the national correspondents to MoRRI will be invited to identify the full population or a

representative sample[8] of universities or major research institutions (should be defined in guideline to correspondents) in their respective countries, and to provide contact details including email addresses for relevant institutional representatives. Second, a web-based survey will be centrally administered to the identified population. Online-survey response rates are hardly predictable and telephone interviews could be used to improve coverage. However, this strategy is resource demanding, and it is questionable whether additional resources are available for such response rate optimization tasks. All in all, this data collection strategy is considered moderately resource demanding. The effort of the correspondents is limited and the survey can be centrally administered without huge costs.

5.1.3 Research Funding Organisation (RFO) survey

The indicators GE3, PE7, PE8, E3, GOV2, and GOV3 rely on primary data collected through a web-survey directed at public and private research funding agencies in the EU member states. The data collection process includes the following main procedural elements: First, each national correspondent will identify the main national research funding agencies and private research funding organisations. The sample should ideally cover the full population, or at least the key public funding agencies/organisations for competitive funding in terms of annual amounts of resources allocated. Second, a web-based survey will be centrally administered to the identified population. Online-survey response rates are hardly predictable and telephone interviews could potentially be used to address non-respondents. However, this strategy is resource demanding, and it is questionable whether additional resources are available for such response rate optimization tasks. The overall resource demands related to this data collection strategy are moderate - the effort of the correspondents is limited and the survey can be centrally administered without huge costs.

5.1.4 Register data

The primary data constituting the basis of the indicators GE10, OA1, OA2 and OA3, will be retrieved from bibliographic databases such as Scopus, Web of Science and Google Scholar. Time series are possible, including a retrospective analysis of the past years and depending on the database used, several disciplines might be slightly underrepresented (e.g. social science and humanities within the Web of Science). The actual harvesting of peer-reviewed publication can be done relatively easily. The feasibility-issues related to the register-based approaches are, in other words, more a question of how data will be validated, coded and queried against other data sources.

[8] For countries in which the number of universities and major public research institutions does not exceed 20, the national correspondents will provide contact details for the full population. In countries in which the number exceeds 20, correspondents will provide a contact details for a sample of 20 institutions, representative in terms of size (turnover), university/research institution distribution, and geographical location (finer details to be specified in the guidelines to correspondents).

5.1.5 Desk research and qualitative interviews

The indicator SLSE1 consists of primary data collected through desk research and validation interviews with experts at education ministries and other responsible actors. The national correspondents will be provided with a set of questions to be answered, either by desk research or by a combination of desk research and phone interviews with central stakeholders. In countries where education policy is not decided at the national but at the regional level, representation issues can arise if not all regions are covered by the desk research. In such cases, a small number of selected regions could be identified for which the data collection is conducted. The regions will be selected in cooperation with the project team. The indicator is only based on the formal/written curriculum and not on the implemented or attained curriculum. However, accounting for resource constraints, this is considered to be an informative and feasible first step.

5.2 Data collection: Secondary data

Table 5.2 delineates final set of indicators based on the following already existing data sources: Eurostat (GE2), She Figures (GE4 and GE6), MORE2 (GE7), MASIS (SLSE3, PE1, and E2), Eurobarometers (PE2, PE3, PE4 and OA4), EPOCH (E2), SATORI (E2) and Openaire.eu (OA5). GOV1 is a composite indicator based on secondary analysis of data collected throughout other dimensions.

Table 5.2 Overview indicators from secondary sources

Secondary data	Indicators
	GE2, GE4, GE6, GE7, SLSE3, PE1, PE2, PE3, PE4, E2, OA4, OA5, GOV1

6. References

Brom, F.W.A.; Chaturvedi, S., Ladikas, M., Zhang, W. (2015). Institutionalizing Ethical Debates in Science, Technology, and Innovation Policy: A Comparison of Europe, India and China. In: Ladikas, M.; S. Chaturvedi; Zhao, Y.; Stemerding, D. (Eds.) Science and Technology Governance and Ethics. Springer, Cham, Heidelberg New York, Dordrecht, London, 9-23.

Caprile, M., Addis, E., Castano, C., Linge, I., Larios, M., Moulders, D. & Vazquez-Cuperio, S. (2012). Meta-analysis of gender and science research – Synthesis report. Luxembourg: European Union, Directorate-General for Research and Innovation.

European Commission (2014). European Research Area: Progress Report 2014.

European Commission (2015a): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Dimension of Citizen Engagement and Participation of Societal Actors in Research and Innovation. Sub-task 2.5, deliverable D.2.1.

European Commission (2015b): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Gender Equality Dimension. Sub-task 2.5, deliverable D.2.3.

European Commission (2015c): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Dimension of Science Literacy and Scientific Education. Sub-task 2.5, deliverable D.2.2.

European Commission (2015d): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Dimension of Open Access. Sub-task 2.5, deliverable D.2.4.

European Commission (2015e): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Dimension of Research and Innovation Ethics. Sub-task 2.5, deliverable D.2.4.1.

European Commission (2015f): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI): Analytical Report on the Dimensions of Research and Innovation Governance. Sub-task 2.5, deliverable D2.4.2.

European Commission (2015g): Indicators for promoting and monitoring responsible research and innovation: Report from the expert group on policy indicators for responsible research. DG Research and Innovation: Brussels.

European Union (2012): Responsible Research and Innovation. Europe's ability to respond to societal challenges. Available at: http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf

Hagendijk, R., & Irwin, A. (2006). Public deliberation and governance: engaging with science and technology in contemporary Europe. Minerva, 44(2), 167-184.

Hertog, den P., Jager, C.-J., te Velde, R., Veldkamp, J., Aksnes, D.W., Sivertsen, G., et al. (2012). Science, Technology & Innovation Indicators 2014. Dialogic. Utrecht. Retrieved April 18 2015: http://dialogic.nl/documents/other/sti2_themepaper1.pdf

MORRI Proposal (2014). Monitoring the evolution and benefits of Responsible Research and Innovation. Technical Proposal following Call for Tenders Nr. RTD-B6-PP-00964-2013.

The Cornell Lab of Ornithology. (2015). Defining Citizen Science. Retrieved March 3, 2015, from http://www.birds.cornell.edu/citscitoolkit/about/definition