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Innovation and Education

A new Horizon for Society?

Analysing the integration of Responsible Research and Innovation in Horizon Europe

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Executive Summary

How can we bridge the gap between science and society? The concept of **Responsible Research and Innovation (RRI)** implies that different societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society. This report analyses **to what extent and how RRI will be integrated into the forthcoming European Framework Programme (FP) for Research and Innovation (R&I), Horizon Europe (HEU) (2021-2027)**. First, the concept of RRI and its promotion in European R&I policy so far is explored. A particular focus lies on the current Framework Programme for R&I of the European Union (EU), Horizon 2020 (H2020) which makes RRI a cross-cutting issue and includes specific RRI actions under the 'Science with and for Society' (SwafS) programme part. In the following, the prospective implementation of RRI in HEU is analysed based on the legislative sources that already exist at the time of writing and personal interviews with experts. This report finds that the **EU's conceptualisation of RRI as comprising six so-called 'keys'** (gender equality, research ethics, science education, open access, public engagement and governance) is itself **dissolved**, with the RRI keys being promoted **separately** and the science and society nexus being for the most part integrated into the **new Open Science narrative**. This **new understanding of Open Science** as not only covering access to scientific publications and research data but also openness towards society is further reflected in a reorganisation of the Directorate-General for Research and Innovation (DG RTD). The report presents how different HEU elements take up the RRI agenda, such as the **'Reforming and Enhancing the European R&I system'** intervention area in the horizontal Pillar IV, the **cross-cutting issue of Open Science** and the **new monitoring and evaluation system**. It continues with an analysis of the role of RRI in the new European Research (ERA), finding that different parts of the RRI agenda are spread across the new ERA priorities and objectives. Stakeholders and RRI experts all underline the importance of RRI, but do not always agree on whether it is best promoted in a top-down approach (e.g. through including it in evaluation criteria) or via institutional bottom-up initiatives. The report concludes with policy recommendations to strengthen RRI integration at different levels, such as building on existing RRI resources and expertise and promoting trans- and interdisciplinary research.

1 What is RRI?

Research and Innovation not only answer scientific questions and solve problems, but must also be in line with the needs and ethical values of society. Societal actors have to be included in the R&I discussion in a transparent and open way in order to ensure the consideration of a diverse set of voices and to be flexible to changing and emerging demands. It is exactly at this point were Responsible Research and Innovation (RRI) comes into play. RRI policies aim to support R&I system transformation to **better align research and innovation processes and outcomes with societal values, needs and concerns** by **encouraging societal actors** (such as researchers, citizens, policy makers, businesses or third sector organisations) **to work together during the whole R&I cycle.** RRI is seen as a dynamic, iterative process in which all stakeholders involved in the R&I practice become mutually responsive and share responsibility regarding both the outcomes and process requirements. According to the literature, RRI policy intends to **make R&I impacts socially beneficial** through responsible innovators **actively constructing their 'responsibility'** and **reflecting on communication and discussion** of their results in order to achieve societal support and to allow for social guidance of their research endeavours. Besides positive **social impacts** such as raised awareness and more socially and environmentally sustainable products, RRI has also **economic benefits**: The early consideration of societal needs and ethical considerations is more likely to bring up economically successful innovation by reducing the risk of innovations failing after market introduction. Consequently, RRI entails more efficiency in public and private research funding. Increased stakeholder participation and free data flow also incentivise innovation. As the economic significance of R&I for European citizens is increasing, the 'science and society nexus' becomes more and more important in supporting the provision of relevant and effective R&I. RRI provides an **opportunity to build greater trust and societal support in the R&I system** by bringing "more democracy into science and more science into democracy."

1.1 RRI in European Research and Innovation Policy

RRI is a multidimensional concept with no clear definition, but has become more and more enshrined in the R&I policy agenda of the EU. The European Commission (EC) defines RRI as an approach that "anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation". This implies that in bringing science and society closer together, R&I have a significant potential to **contribute to the tackling of the "grand societal challenges"**[1], to the **achievement of Sustainable Development Goals (SDGs)** and to the **overturning of increasing scepticism** in science and suspicion towards evidence-based policymaking. RRI is in line with several other EU Declarations, Communications and Initiatives, in and outside R&I policy[2], and it is an **inherent part of the European R&I philosophy** – at least at the declaratory level. The EU has been a significant player in the process of conceptual development and institutionalisation of RRI. Besides, RRI is also on the national research policy agenda of individual countries[3]. The term RRI first emerged at EU level during the **2000s,** with a common strategy launched in 2001 to bridge the gap between the scientific community and society with the €80 million **'Science and Society' (SaS)** Action Plan within the Sixth Framework Programme for Research and Technological Development (FP6) (2002-2006).

[1] According to some, RRI emerged in EU R&I policy because of concerns about unchanged general welfare levels despite increasing R&I expenditures. As a consequence, the EU's RRI agenda would concentrate on reducing negative effects in R&I areas holding "potentially adverse societal effects" while actively promoting R&I with high societal benefits, such as solving societal challenges.
[2] RRI is reflected in the Europe 2020 Strategy for Growth or the Council conclusions on the Social Dimension of the European Research Area (both 2010). RRI also follows the 2009 Lund Declaration (updated in 2015), which demands European and national institutions to let the "Grand Challenges of our times" drive European research, and underlines the need to address societal needs and ethical questions in R&I. The topic is also discussed in the 'LAB-FAB-APP' Lamy Report (2017) which acknowledges the decreasing consensus and support from the public given the complexity of global challenges and technologies.
[3] Examples are the UK Engineering and Physical Sciences Research Council or the Dutch Maatschappelijk Verantwoord Innoveren.

In the 7th Framework Programme for Research and Technological Development (FP7) (2007-2013), the €330 million **'Science in Society' (SiS)** programme was introduced with the similar aim of fostering public engagement and a sustained two-way dialogue between civil society and science, including initiatives relating to gender or science communication. The number of call topics mentioning RRI increased continuously in the course of FP7. Under **Horizon 2020 (H2020)**, the current EU R&I Framework Programme (2014-2020), RRI is described and implemented as an **umbrella approach covering different aspects of the R&I and society linkage** (see section 2).

A major step towards a definition of RRI was reached in 2014 at the Sciences, Innovation and Society Conference in Rome where under the Italian Council Presidency the **Rome Declaration on Responsible Research and Innovation** was adopted. The Rome Declaration enshrined the following **six RRI dimensions, the so-called 'RRI keys'** (icons and descriptions developed by the RRI Tools project, see page 26): gender equality, research ethics, science education, open access, public engagement and governance.

Gender equality as RRI key is about promoting and ensuring gender balance in research teams and decision-making bodies, and considering the gender dimension in the R&I process and content itself in order to improve the quality and social relevance of scientific results.

Research ethics focuses (1) on research integrity, thus the prevention of intolerable R&I practices, and (2) on science and society, meaning ethical acceptability for society. It covers compliance with fundamental ethical principles and legislation to scientific research in all its branches.

Science education activities aim to provide citizens with a deeper understanding of science and develop their abilities to contribute to science and science-related policymaking. It covers formal and informal science education, communication and co-production of knowledge, making science careers more attractive and improving science and technology literacy.

Open access relates to issues of accessibility to and ownership of scientific information. Free and early access has the potential to improve the quality of future research, facilitate fast innovation and foster constructive collaborations and dialogue with society. It mainly covers access to peer-reviewed scientific publications and digital research data.

Public engagement means the creation of participatory multi-actor exchanges and dialogues with the potential to foster mutual understanding, co-create R&I outcomes and to provide inputs to R&I policy agendas. It is characterised by distinct role for science and societal actors.

Governance, both a RRI key itself and a 'horizontal bottom line' underpinning the other five keys is about promoting effective and sustainable changes towards RRI through changes in R&I institutional structures and governance systems. The objective is to make R&I governance more inclusive, accountable and transparent via RRI keys.

The implemented RRI package aims to foster institutional change through the uptake of RRI procedures by stakeholders, research performing organisations (RPOs) and research funding organisations (RFOs). The EU's promotion of **RRI within H2020** is **based on this RRI understanding as comprising six keys**. The Rome Declaration with the six RRI keys can be given credits for making the RRI concept easier to understand and measure, but it is not unchallenged by R&I actors (see section 7). In today's scientific and academic culture, several barriers and challenges to RRI implementation exist. Some scientists may see and oppose RRI as being too abstract, jeopardising academic freedom or preventing the scientific community from conducting blue-sky research. In reply to such arguments, RRI proponents argue that RRI is "not about leaving responsibility to the general public" to decide on the subjects of research, but about "having the capacity to listen to them if necessary." While some RRI aspects such as public

engagement would be more suited to be applied in some specific disciplines, other keys such as research ethics or gender equality could be implemented "across the board".

2 RRI in Horizon 2020

The EU's 8th Framework Programme (FP) for Research and Innovation H2020 (2014-2020) represents RRI's biggest momentum in European R&I Policy so far. RRI is not only **explicitly mentioned** in the H2020 legal basis (for the first time in a European FP), but also implemented by a two-fold approach including 1) establishing a dedicated **RRI-related programme part** (SwafS) and 2) making **"responsible research and innovation including gender"** under Article 14 a 'cross-cutting issue'. This means that RRI is promoted throughout all Horizon 2020 objectives.[4]

2.1 Science with and for Society (SwafS)

RRI is a key action of 'Science with and for Society' (SwafS), which is established as a horizontal programme part with a **€462.2 mn budget underpinning H2020's three main pillars**. RRI-dedicated funding opportunities are set out in multiannual SwafS Work Programmes (WP) containing different calls for proposals. SwafS' objectives are to "build effective co-cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility." The programme covers **eight lines of activities** which also include the Rome Declaration's six RRI key areas: science careers, gender equality, public engagement, science education, open access/open data, governance and ethics, due and proportionate precaution as well as science communication. It is mainly in the SwafS programme where the knowledge basis for RRI has been developing. The objective is to give these topics enough leverage within the SwafS programme to promote RRI in European R&I in general and to engender **institutional changes in RFOs and RPOs**. SwafS proposes an "increasingly transdisciplinary and multi-stakeholder approach, involving citizens and end-users, the public sector and industry, in order to link and take advantage of unique perspectives and knowledge." Through enabling institutional changes in RFOs and RPOs, so the EC, SwafS results contribute to the implementation of the European Research Area (ERA) priorities (see section 5), a greater stakeholders involvement in R&I as well as more effective societal engagement. Welcoming the SwafS programme as a "bright spot in the EC's efforts" to advance RRI in Horizon 2020, RRI supporters acknowledge the **ability of SwafS to "advance conceptual development around, awareness of, and capacities to support embedding of RRI in a variety of settings"**, despite a **very small budget** relative to other H2020 lines.

2.2 RRI promotion as a cross-cutting issue

Art. 14 of the H2020 Regulation makes RRI a cross-cutting issue, meaning that e.g. also projects focusing exclusively on technology development or natural sciences are required to consider RRI keys such as public engagement or ethical acceptability. This means RRI would theoretically have to be applied across all H2020 funding instruments and at various project stages, using dedicated targets and evaluation criteria. To that end, €0.5 bn of the budget for the 'Societal Challenges' and 'Industrial Leadership' pillars are earmarked for RRI actions. Concretely speaking, applicants interested in RRI-relevant calls from non-SwafS programmes are required to specify in their proposals how RRI (societal actors working together during the whole R&I process to align processes and outcomes with values, needs and expectations of society) will be addressed. **Within the specific objectives of respective thematic programmes, such as Societal Challenges in Pillar II, actions can focus on thematic elements of RRI [e.g. RRI keys], as well as on more integrated approaches to promote RRI uptake.** While some topics demand applicants to appropriately consider interdisciplinarity or gender dimensions in R&I content, others require applicants

[4] Other articles of the H2020 Regulation also explicitly refer to RRI keys such as gender equality (Art. 16, also for the first time in a European FP), open access (Art. 18) and ethical principles (Art. 19).

to include participation from non-scientific stakeholders (transdisciplinarity), with non-complying researchers asked to justify their reasons. As of WPs 2016-17, the RRI definition was made coherent (reflecting the Rome Declaration) across all concerned calls for proposals and short narratives were developed to link H2020 activities with RRI and society and to make RRI presentation consistent across H2020. With the same WP generation, RRI inclusion also increased with 16 out of 22 thematic WPs explicitly addressing RRI (versus 6 out of 22 in WP 2014-15). The **responsibility for RRI as a cross-cutting issue lies within the subunit Science and Society (G4.001) of DG RTD**. For mainstreaming, **"flagging"** is a common method to draw the attention of applicants to RRI-relevant topics. For the identification of RRI relevant projects, project officers from the EC and executive agencies responsible for the management of different H2020 parts attribute a "flag" to RRI-relevant funded projects, which can then be identified in the Common Research and Development Information Service (CORDIS). However, the flagging system does not reveal why projects were attributed a flag. Many of the RRI-related calls **foster inter- and transdisciplinary approaches**, which may also be used to strengthen RRI within Research Policies.[5] Experience with RRI as a cross-cutting issue has shown that although applicants need to consider RRI and/or its aspects in their proposals, and evaluators for non-SwafS topics have been briefed by RRI experts, it is n**ot always clear to both applicants and evaluators what RRI means in relation to the call text**.[6] There is also no adequate post-evaluation monitoring and "enforcement" of RRI during project implementation.

2.3 Evaluation of RRI promotion in H2020

To monitor and evaluate the impact of H2020, the EC identified Key Performance Indicators (KPIs) for each programme part and cross-cutting issue of the FP. To assess the effectiveness of RRI promotion within H2020, it makes sense to look at two concrete KPIs summarised in the two boxes below:

KPI of the SwafS programme: Number of **institutional change actions** promoted by the programme, comprising both the percentage of funded research organisations implementing actions to promote RRI, and the number of adopted institutional change measures

Institutional changes within beneficiaries' institutions must be **sustainable**, such as the creation of an ethics committee or a competence cell of gender expertise, as opposed to for instance the organisation of a conference. Data on the SwafS KPI will thus only become available when the last SwafS projects end. In February 2020, there were around **400** institutional change actions towards RRI recorded for the SwafS programme, a figure clearly exceeding the set target of 100. However, the ultimate figure will probably be lower since one-off activities not lasting beyond funding time are currently included.

KPI of the cross-cutting issue 'Responsible Research and Innovation' Percentage of projects where citizens, Civil Society Organisations (CSOs) and other societal actors contribute to the co-creation of scientific agendas and scientific contents

[5] According to the Expert Group on the State of the Art in Europe on RRI (see Annex), **trans-, interdisciplinarity and RRI are closely linked**. Both nurture greater creativity, increase the likelihood that R&I actions are directly targeted at societal challenges and entail second order impacts of more trust in R&I and changed mind-sets. The same expert group says that while mainstreaming assures that the **administrative burden** for applying researchers and evaluators **remains low**, the **capacities** for achieving major progress in aligning R&I policy with societal needs and harmonisation in EU R&I policy and across Member States **remain limited**.
[6] Conceptual uncertainty about what RRI exactly means has been a recurrent theme in the SwafS/RRI Expert Advisory Group (EAG) which advices the EC on drafting the WPs. The former chair of the SwafS EAG suggested in the light of this "curious situation" that "RRI may be an emperor without clothes, or that there may not even be an emperor at all, only a **fashionable label.**"

Given definition with "other societal actors", RRI as a cross-cutting issue captures a wide range of activities and participants, thus a quadruple helix approach (university, industry, government plus civil society and media), but not necessarily all parts thereof. The following two figures indicate for every H2020 programme part the number and percentage of projects flagged by respective project officers during the grant preparation stage as entailing engagement with citizens, CSOs and other societal actors contributing to scientific agendas and contents (thus an RRI approach) from 2014 to January 2020:

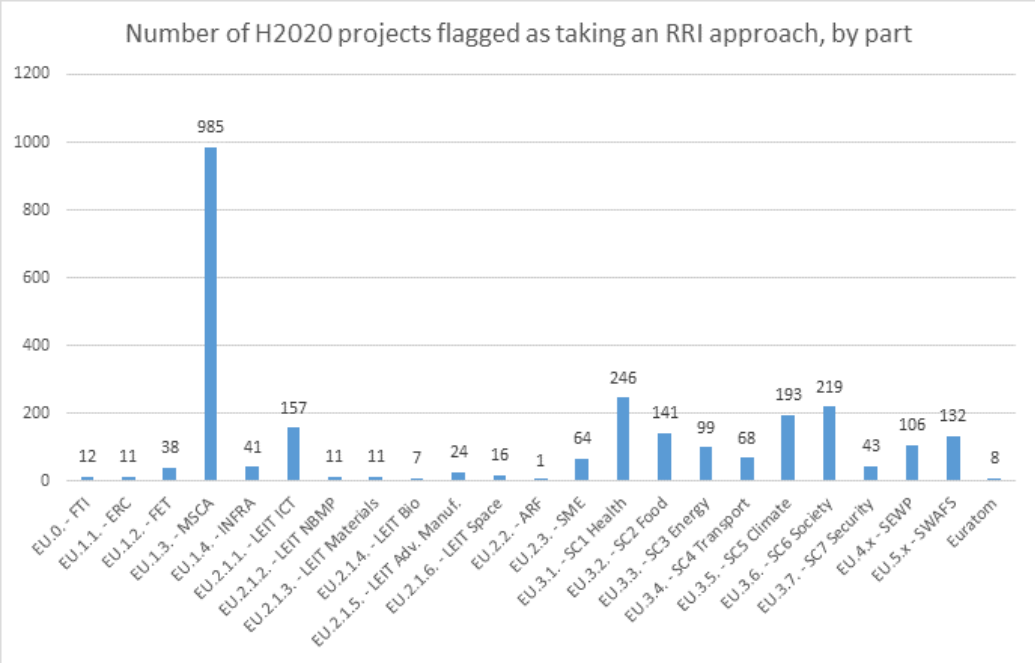

Figure 1: Number of H2020 RRI-flagged projects (Source: Open Science Unit, DG RTD)

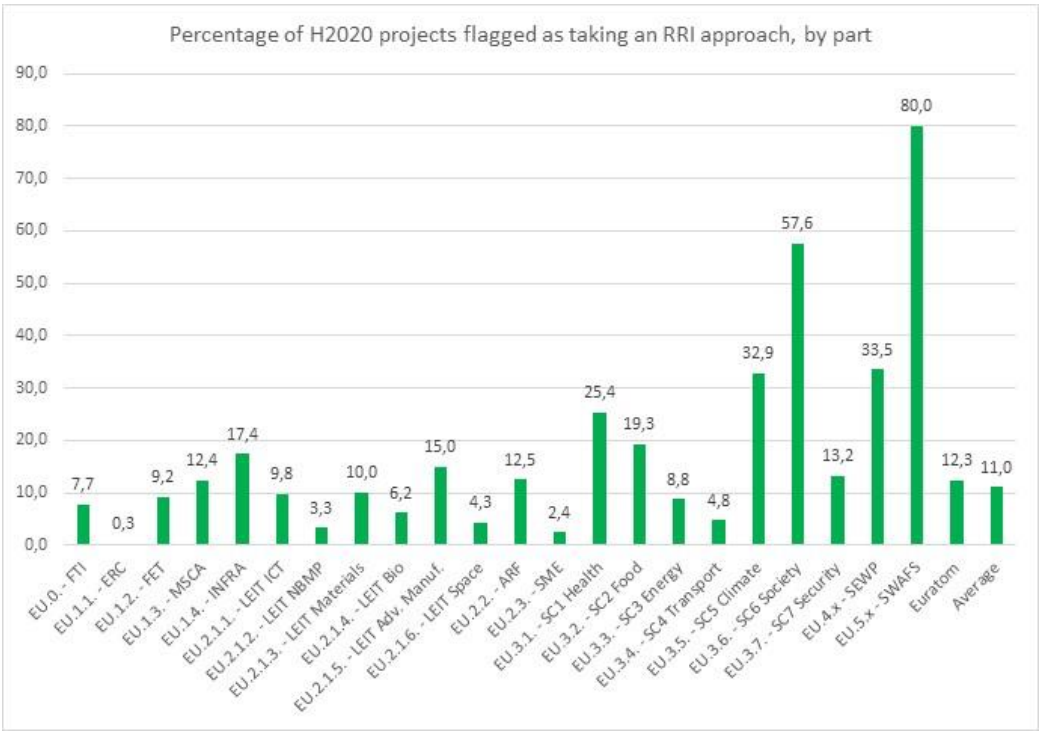

Figure 2: Percentage of H2020 RRI-flagged projects (Source: Open Science Unit, DG RTD)

As Figure 1 and 2 show, RRI has been dispersed across all parts of H2020, but unevenly with an average of 11% of projects adopting an RRI approach. By the end of H2020, this number will be higher given the steady increase of RRI-flagged projects in recent years. With four out of five projects having an RRI approach[7], **RRI seems to be strongly encapsulated within the SwafS programme as the main promoter for RRI, followed by Societal Challenge 6** (Inclusive Societies, SC6) which also promotes citizen-centred governance and citizen-driven innovation through a general integration of Social Science and Humanities (SSH). Also worth mentioning is the very low percentage of RRI-flagged projects among ERC funded projects (0.3%) and projects in the SME instrument (2.4%). However, the figures must be considered with caution since RRI keys can also be identified in non-RRI projects. Gender for instance is also a cross-cutting issue according to the H2020 legislation, but gender-related projects do not always entail the involvement of citizens, CSOs and other societal actors.

The figures above are also reflected in the 2017 H2020 Interim Evaluation, which found that "**results are encouraging in terms of the embedding of SSH and RRI in H2020, even if highly uneven across the programme.**" Consultation results identified the **SwafS** programme as "**highly relevant** to the overarching challenges Europe is facing in transversal areas of H2020, in particular the **need for greater support for citizen science and user-led innovation**." The Interim Evaluation also found that **civil society and CSOs are in general not involved at a satisfactory level in R&I governance** (even in SC6), compared to traditional R&I actors such as academia and industry.[8] The European Economic and Social Committee "questioned whether the programme sufficiently involved real 'societal' stakeholders and requested clarification as to whether all societal groups can and should participate in SwafS."[9] The Interim Evaluation further emphasised the "**need for more outreach to civil society** to **better explain results** and the **contribution** research and innovation can make to the **resolution of societal challenges**." Civil society should be better included in the H2020 programme **co-design** (agenda-setting) and its implementation (**co-creation**) to maximise socio-economic impact. Other EU institutions arrived at the same conclusion.[10] As showed in the results of the public H2020 Stakeholder Consultation in the Interim Evaluation, 70% of the respondents agreed fully or to a large extent that H2020 helps to support science with and for society, with the **SwafS programme part being "a key way in which H2020 responds to citizen's needs"**. The RRI community argues in a similar way (see section 7) but also identifies "lack of awareness, limited motivation or incentives, or mismatches in skills and expertise as challenges to the implementation of RRI at project and policy (national and EC) levels."

[7] The 20% of the SwafS projects without an RRI approach can englobe activities related to gender equality (without public engagement aspects), science communication or science careers.
[8] The Interim Evaluation further finds that CSO participation in FP6, FP7 and Horizon 2020 was and is still marginal, despite a low-level increase during H2020 from 1.4% in FP7 to 2.3% in H2020. Participating CSOs generally take on non-core roles in project consortia. Similarly, SSH integration is not evenly represented across disciplines, with the low participation of humanities remaining a challenge, and SSH inclusion in WP design, calls description and project evaluation is insufficient.
[9] Despite the support for involvement of civil society in Horizon 2020, 83% of the CSOs surveyed by the European Economic and Social Committee either agree or strongly agree on a lack of knowledge exchange between the scientific community and civil society.
[10] The European Parliament recognised in its Resolution 2016/2147(INI) "the needs for the involvement of public and private stakeholders and civil society, and the importance of citizen science in ensuring that society plays a more active part in defining and addressing the problems and in jointly putting forward the solutions." The Council Conclusions of 1 December 2017 referred to "the need for a greater outreach to the general public and to better reflect the views and needs of stakeholders, users and citizens in the R&I agendas", and it suggested to the EC "to launch a pilot to involve citizens in the agenda-setting process."

3 Change in narrative: From SwafS to Open Science

The way in which RRI was institutionally anchored within DG RTD changed during the course of H2020. In the beginning, 'SwafS'-Unit B7 was responsible for Science with and for Society (supported by Unit B5 of the Research Executive Agency), with two respective sub-units for Gender and RRI. Ethics and Open Access were both addressed in separate units. During a big reorganisation of DG RTD in June 2019 aimed at strengthening the institutional uptake of the SDGs, **the Open Access and the SwafS Units were merged**, reflecting a new conceptual understanding of what Open Science means. The **new Unit G.4 'Open Science'** covers **traditional aspects of Open Science**, thus access to scientific publications and research data (openness between researchers and disciplines) as well as the **openness of science towards society** within **sub-unit G.4.001 'Science in Society'** (covering citizen science and research ethics, amongst others).[11] This restructuring is in line with the 2016 'Three O Strategy' of former EU Commissioner for Research and Innovation, Carlos Moedas which identifies **Open Innovation, Open Science** and **Open to the World** as three goals for EU R&I policy. The 'Three Os' are mutually supportive with RRI principles, since they contribute to putting citizens at the centre of attention of R&I organisations and policies. For example, Moedas underlines under 'Open Innovation' that an "invention becomes an innovation only if users become a part of the value creation process. Notions such as 'user innovation' […] emphasise the role of citizens and users in the innovation process as 'distributed' sources of knowledge. **This kind of public engagement is one of the aims of the Responsible Research and Innovation programme in H2020**." 'Open' in this context is understood as a synonym to user-centric. Under 'Open Science', the Moedas' strategy covers openness of scientific publications, research data as well as endeavours to promote a 'more Open Science environment (Citizen Science), and it is using **Open Science as a means to make science "more responsive to societal and economic expectations, in particular by addressing major challenges faced by society."** This is in line with the definition of RRI. The Open Science Policy Platform, an Expert Group set up in 2016 to advise the EC on how to develop Open Science, identified meanwhile eight Open Science policy priorities, which are summarised in the table below:

Use and management of research results	Alignment of research partners
1. FAIR[12] data	5. Rewards and incentives
2. European Open Science Cloud (EOSC)	6. Research Integrity
3. Research Indicators & Next-Generation Metrics	7. Skills and education
4. Future of scholarly communication	8. Citizen science

Table 1: Priorities of the Open Science Policy Platform (Source: Open Science Policy Platform website)

As shown above, research integrity, open science education skills and citizen science are also considered components of Open Science. In fact, the sub-unit G.4.001 'Science in Society' also covers exactly those topics. This makes sense since both the Open Science agenda and RRI are conceptualised with an emphasis on sustainable democratisation changes to the R&I processes – changes that enable RPOs and RFOs to "systematically open up research". Citizen Science for instance is seen as an example of and a tool towards RRI despite only a light institutional embedding and not yet being widely recognised as a valid knowledge producer. Insights in how this new Open Science rationale affects the next European R&I Framework Programme Horizon Europe (HEU) (2021-2027) can be found in the HEU Impact Assessment, which was published in June 2018 together with the EC proposal and announced a "reinforced

[11] Gender equality (in terms of gender balance and gender content in R&I) and science education are both dealt with in separate unites. In addition, there is a 'Citizen advisor' covering the whole DG RTD.
[12] FAIR is an acronym composed from 'Findable, Accessible, Interoperable and Reusable'. Recommendations and specific actions for stakeholder groups to support implementation of FAIR can e.g. be found in the 2018 report of the EC Expert Group on FAIR data.

Open Science policy". The same source also said that **HEU would "continue to support RRI"** within human capital development. In another document accompanying the HEU proposal, the EC enumerated specific R&I challenges the new FP would have to address. Amongst them are "sub-optimal creation of high-quality knowledge and **lack of diffusion of knowledge**" and "**insufficient Open Science**", which should both be addressed in Pillar I of the upcoming FP. It is interesting to note that the initial name for Pillar I in the HEU proposal was 'Open Science', but was later changed to 'Excellent Science' during the interinstitutional negotiations (trilogues). Another identified R&I challenge for the new FP was the **"low awareness of innovative solutions and insufficient end-user/citizen involvement in the R&I process"**, and this conclusion fed into the sharpening of future Pillar II.

4 RRI in Horizon Europe

After the EC published a proposal for HEU in June 2018, the European Parliament and the Council reached a partial political agreement (PGA) in March 2019. At the time of writing, some issues including budget and association of third countries are still open. HEU's legal basis consists of the two main documents: (1) A proposal for a Regulation of the European Parliament establishing HEU, laying down the rules for participation and dissemination, and its annexes, as well as (2) a Proposal for a Decision of the European Parliament and of the Council on stablishing the Specific Programme implementing HEU, and its annexes. HEU is divided into three pillars 'Excellent Science' (with a proposed budget of €25.8 bn), 'Global Challenges and European Industrial Competitiveness' (€52.7 bn) and 'Innovative Europe' (€13.5 bn). They are underpinned by a cross-cutting part called 'Widening participation and strengthening the European Research Area (ERA)'. This 'Pillar IV' consists of two so-called 'Intervention Areas': 'Widening Participation and Spreading Excellence' (at least a 3.3% budget share) as well as 'Reforming and Enhancing the European R&I System' (€0.4 bn).

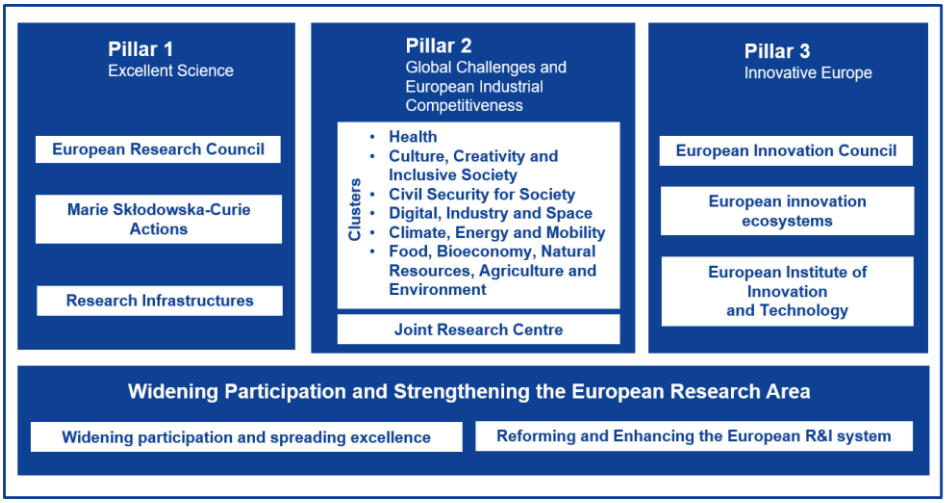

Figure 3: Structure of HEU (Source: EC website on HEU)

At first sight, there is no SwafS-like programme part dedicated to RRI or its keys as under H2020. This led to a **concerned reaction from the RRI community** about the absence of a specific programme line and what was considered an insufficient budget dedicated to Science, Society and Citizens' activities (see for instance a SwafS National Contact Point (NCP) petition with 1'4000 signatories or the Pathways Declaration "Future of Responsible Research and Innovation (RRI) in HEU"). Signatories warned that now, when institutional change actions initiated under H2020 start to gain momentum, a RRI agenda dilution would counteract the reaping of SwafS investments'

benefits. Contrary to H2020 with its Article 14, **HEU's legislative basis mentions the term of Responsible Research and Innovation only marginally**. **Recital 26** states that the Programme "should engage and involve citizens and CSOs in co-designing and co-creating responsible research and innovation (RRI) agendas and contents that meet citizens' and civil society's concern, needs and expectations", and that it should do so "across the Programme and through dedicated activities in the part 'Widening participation and strengthening the European Research Area'." Recitals are however legally non-binding and only give an indication on how the dispositions of HEU shall be interpreted. The only legally binding disposition mentioning RRI is **Art. 2(2)c of the Specific Programme**, which describes "promoting responsible research and innovation, taking into account the precautionary principle" as one of the **operational objectives of the Specific Programme**. RRI keys such as gender, ethics, open science and the need to strengthen the links between science and society are however mentioned in other dispositions. This is in line with another publication accompanying the HEU proposal where the EC states that it would **continue to promote RRI as a cross-cutting issue** (by providing incentives for institutional changes and developing skills and capacities towards RRI and gender equality').

Based on a Strategic Planning Process, a multiannual **Strategic Plan** (2021-2024) will help defining the strategy for the first years of HEU and serve for preparing the content of the first WPs. Here, the EC is according to Art. 4a of the Specific Programme required to "**ensure early involvement and extended exchanges**" with **Member States, the Parliament and a consultation with stakeholders** and the **public at large"**, aiming for a **stronger engagement with citizens and civil society at large.** The Strategic Planning Process **focusses in particular on Pillar II** and covers **"relevant activities in other pillars and the Widening Participation and Strengthening the European Research Area part"** as well as **cross-cutting issues**. The first version of the Orientations towards the Strategic Plan from May 2019 only limitedly referred to RRI[13]. After two major sets of co-design activities (an open web consultation as well as direct EC-stakeholders interactions at the R&I Days), the report on their outcomes showed the **concern of some respondents over the lack of references to RRI, a future SwafS programme** and in particular with respect to the promotion of **gender equality**. Concerning citizen science, the EC noted the "**significant number of responses"** emphasising the **importance of a high level of citizen participation in co-design and co-creation** in order to meet the SDGs. Those responses also stressed that R&I "must take into account the needs, values and expectations of citizens, in line with RRI and seek to go beyond technological solutions to those that encompass social, economic and governance issues". Other respondents highlighted the **importance of leveraging and valorising the existing large amount of knowledge and networks having developed from Science and Society (FP6), Science in Society (FP7) and SwafS (H2020).** Stakeholders also strongly called for a strengthening of gender as a cross-cutting priority. As a result, the second Orientations published in October 2019 included a **stronger consideration of gender**. The RRI community welcomed the updated document as a "big win", "considering the fact that there was no mentioning of SwafS and RRI before the public consultations". After a last consultation among major umbrella organisations, the third Orientations from December 2019 only modified some minor technical aspects, none in regards to RRI. This last version will serve as a basis for the final Strategic Plan (expected to be adopted at the end of 2020), which will eventually define the final desired impacts and funding priorities. Nevertheless, the existing Orientations indicate already most of the final Strategic Plan's direction, including the results from above-mentioned co-creation activities.

[13] In the first version of the first Orientations towards the Strategic Plan, RRI is mentioned in the description of the priorities of the 'Widening and Enhancing the ERA' intervention area and in relation with some proposed cross-cutting issues such as Open Science.

SwafS and Widening, two separate objectives in H2020, will now be covered in the same programme, 'Pillar IV. Despite the uncertainty about RRI's future role, **the legislative basis of HEU provides for the possibility to continue the two-fold approach of H2020 with a) having a RRI-related programme part (see section 4.1.) and b) mainstreaming RRI-related keys as cross-cutting issues (see section 4.2)**. The following paragraphs will elaborate on those two channels, keeping in mind that at the time of writing, many preparations for HEU are still ongoing, meaning that the details about mechanisms and programmes are still to be decided upon.

4.1 Reforming and Enhancing the European Research Area

Looking at Pillar IV, the first intervention area **'Widening participation and spreading excellence'** aims to share excellence and enhance FP participation of countries performing lower in R&I. The intervention area acts as a successor to the 'Spreading excellence and Widening participation' programme line of H2020. It will continue the main instruments thereof (Teaming, Twinning and ERA Chairs as well as the next generation of the Policy Support Facility PSF) and especially focus on fostering brain circulation across the ERA. The second intervention area, **'Reforming and enhancing the EU Research and Innovation System'** is of relevance for the promotion of RRI and its keys. The Annex of the Specific Programme specifies 14 lines of actions thereof, which are summarised in the box below:

1) Strengthening evidence base for R&I policy
2) Foresight activities to anticipate emerging needs and trends (amongst others in **co-design** with citizens)
3) Support for policy makers, RFOs and RPOs involved in ERA (related) policies or coordination and support measures
4) Accelerating transition towards **Open Science**
5) Support to national R&I policy reforms (strengthened PSF services or synergies with Structural Funds)
6) **Attractive career environments, skills and competences**, including incentives promoting the adoption of **open science practices**, **responsible R&I**, entrepreneurship, trans-disciplinarity, citizen engagement, gender equality plans, diversity and inclusion strategies and comprehensive approaches to institutional changes (hereby providing support to the R&I dimensions of the European Universities' R&I dimensions)
7) **Citizen science**, supporting all types of formal, non-formal and informal science education and citizen engagement in the **co-design of R&I agenda and co-creation** of R&I content through transdisciplinarity
8) Support and monitoring of **gender equality** and other forms of diversity in scientific careers and decision making and as well as gender integration in R&I content
9) **Ethics and Integrity**, e.g. by further developing a coherent EU framework
10) International cooperation
11) Scientific input to other EU policy-making
12) EU R&I programme implementation, including monitoring, evaluation, design and impact assessment
13) Strengthened support for NCPs through regular meetings, training, coaching and strengthened support structures, including development of minimum standards for their operation (e.g. conflict of interest avoidance)
14) **Dissemination and exploitation of R&I results**, data and knowledge, synergies with other EU programmes, science **communication**.

In conclusion, **7 or 8 of these 14 lines take up former SwafS/RRI topics.** The importance of Open Science is evident in different lines, e.g. in finding new indicators and approaches to evaluate and reward research careers. However, it is not clear yet how the proposed budget of **€400 mn** will be allocated across the 14 action lines of this intervention area. According to the EC, the main purpose of 'Strengthening and Enhancing the ERA' is to establish a **leverage effect across the programme** that **builds on the results and toolkits of the SwafS programme**. It will especially be here where RPOs focusing on RRI keys and adopting RRI procedures can find relevant calls. It is also likely that most of these lines of action will be designed as Coordination and Support Actions (CSA), aimed to support institutional changes, while leaving the possibility for occasional Research and Innovation actions (RIA), with a limited amount of funding. The reason for this, so the EC, is that **the SwafS programme has been successful in promoting institutional changes within RPOs and RFOs, and a continuation of the SwafS programme would thus not be effective, since it has already served as a catalyst for change**.[14] Examples for future

[14] For instance, there are already six times as many citizen science projects in H2020 across the whole FP than within the SwafS programme itself.

'Strengthening and Enhancing the ERA' actions could be best practice and experience exchange, brokerage events or calls for projects which pull together Citizen Science activities in and beyond the EU. Moving away from a dedicated policy support of RRI through the SwafS programme, the objective of HEU is to **raise learning profiles, increase awareness and use the toolkits and resources created under H2020** across all of HEU, with the same objective of **attaining institutional change**.[15] This intervention area focuses on very diverse facets in view of realising the ERA (see section 5). The allocated budget is with €400 mn however smaller than for SwafS (€0.462 mn).

4.2 Cross-cutting issues

In accordance with Art. 5 of the HEU Specific Programme, cross-cutting issues are identified in the HEU Strategic Planning. As the final Orientations towards the Strategic Plan show, **RRI disappears as a cross-cutting issue** (compared to Art. 14 of H2020), but most if not all of the proposed cross-cutting issues **are intrinsically linked** to RRI or even represent H2020 RRI keys on their own:

- **Gender equality** (eliminating gender inequality in R&I systems, gender balance in research and decision making integration of gender dimension in R&I content across the whole programme, including health, artificial intelligence (AI) or climate change)[16]
- **Interdisciplinarity and SSH inclusion** (SSH can help to understand how to best engage with citizens in tackling societal concerns and how to exploit new technologies in a way that focuses on citizens' needs and concerns, and is a key element in fostering necessary behavioural change)
- **Open Science** (mainstreaming of Open Science practices as new modus operandi, see section 4.3)
- **Ethics and research integrity** (continue developing a coherent framework based on the European Code of Conduct for Research Integrity, actions addressing ethical dimensions of new technologies, notably AI and environment protection, cooperation between regional and national ethics actors)
- **Dissemination and exploitation of results** (integration in education and training, emphasis on third party uptake with private investments, dedicated activities for visibility, use and valorisation of R&I results, including mission outputs, proposition of framework for feeding R&I outcomes into policy and decision-making)
- **Knowledge circulation between research, industry, education and training** (integrate R&I activities with education and training, support activities for knowledge exchange and cross-sector transfer, e.g. MSCA)
- **Key enabling technologies (KETs)** (Clusters will develop and apply KETs to promote EU's industrial and social leadership, with Pillar I contributing to scientific breakthroughs and Pillar III to KET-based innovations)

Despite the absence of a dedicated programme part to fund RIA and CSA projects on traditional RRI key areas and RRI not being officially a cross-cutting issue anymore, the **HEU legislation provides for several "hooks" on which actions for strengthening RRI and its keys can be based**. Especially interesting with regards to RRI is the Open Science. First, since the former SwafS/RRI unit now is an institutional part of the Open Science Unit (see section 3). Second, since **Open Science**, according to its conceptualisation reflected in the Orientations also comprises the **engagement and involvement of citizens, Civil Society Organisations and end-users**, the **promotion of "responsible research hand innovation**", which "will improve trust between science and society, as well as the uptake of **scientific evidence-based public policie**s and innovative solutions." Consequently, the following section is dedicated to Open Science as a cross-cutting issue.

[15] This approach can be compared to the strategy of strengthening SSH inclusion in EU R&I FPs. A dedicated programme part of FP7 to promote SSH participation was dissoluted in H2020 where SSH were 'mainstreamed' as a cross-cutting issue through e.g. flagging SSH-relevant proposals. One can argue whether SSH mainstreaming has been successful in H2020 (see Interim Evaluation mentioning the limited success). Often, topics flagged for SSH participation did not involve participants from a SSH background.
[16] According to the EC, HEU will go beyond H2020 "by advancing an inclusive concept of gender equality and diversity in open and democratic R&I institutions." With this 'intersectional approach considering interlocking systems between gender and other social categories and minorities (including ethnicity, race, social class and wealth, gender identity and sexual orientation [LGBTI+] and disability), it is expected to better approach the diverse inequality factors increased by R&I actors.

4.3 Open Science Policy in HEU

Open Science gradually evolved throughout the FPs: While under FP7 only a pilot on **Open Access to scientific publications** was conducted, it became **mandatory** in all H2020 with a contractual obligation to ensure open access to every peer-reviewed scientific publications relating to results produced within the programme. However, beneficiaries can freely choose between self-archiving (so-called 'green' open access with an embargo period of 6 months or 12 months for publications in the SSH) and publishing in full open access journals (so-called 'gold' open access). In addition, the EC has launched a flexible pilot for Open Access to research data (**ORD pilot**) aimed at improving and maximising access to and re-use of research data generated by H2020 projects. Projects participating in the ORD are also required to develop a **Data Management Plan (DMP)** in which they specify what data is generated, whether and how it will be exploited or made accessible for verification and re-use and how it will be curated and preserved. However, an 'opt-out' is possible, with a recognised possibility to close own research data, either before or after the signature of the grant agreement for specific reasons such as Intellectual Property Rights (IPR) or the protection of scientific information. While the **ORD pilot was limited** to some areas of H2020, it was **extended** to cover all thematic areas as of the WP of 2017.[17]

The **new approach to Open Science** including openness towards society (see section 3) is also reflected in HEU: The EC considerably steps up its Open Science Policy, with **Open Science practices being mainstreamed as the new "modus operandi"**. The EC expects the new Open Science policy to increase 1) R&I **quality and efficiency** through the sharing of reusable and reproducible results, 2) R&I **creativity** through collective intelligence and cross-disciplinary research without data struggling as well as 3) **trust** in the science system through the engagement of researchers and citizens. HEU also contains entirely new definitions of Open Science, compared to previous Framework Programmes, which are enshrined in Art. 2 and 10 of the Regulation and supported by Art. 6a.

Regulation Art. 2 – Definitions

- **'Open Science'** means an approach to the scientific process based on open co-operative work, tools and diffusing knowledge, including the elements of Art. 10.
- **'Open Access'** means the practice of providing online access to research outputs resulting from actions funded under the Programme, free of charge to the end-user, in accordance with Article 10 and 35(3) of this Regulation

Regulation Art. 6a – Principles of the Programme

- The programme shall promote co-creation and co-design through **engagement of citizens and civil society**.

Taken together, these new definitions go beyond the current understanding of Open Science as just comprising access to scientific publications and research data, by defining it as an approach consistent with the institutional embedding and the mandate of the Open Science Unit within DG RTD. Open Access now not only covers access to scientific publications but also to "research outputs" in general. These rather vague dispositions leave room for interpretation. Art. 10 is specifically dedicated to Open Science and thus most relevant here:

Regulation Art. 10 – Open Science

- **Open Science as an approach** to the scientific process based on cooperative work and diffusing knowledge to be encouraged, including open access to scientific publications resulting from HE funded research and to research data, including those underlying scientific publications and in line with principle 'as open as possible as closed as necessary'
- **Principle of reciprocity** to be promoted and encouraged in all association and cooperation agreements with third countries
- Responsible **research data management** to be ensured in line with FAIR principles; attention to long-term data preservation
- **Other Open Science practices** to be promoted and encouraged, including for benefit of SMEs

[17] In 2017, after the scope extension of the ORD pilot, 62% of all projects across H2020 participated.

Based on dispositions above and in accordance with the HEU Impact Assessment, HEU's new Open Science policy consists of the following main features:

4.3.1 Open Access to scientific publications and research data

Open Access to scientific publications is widely considered as an example for successful mainstreaming in H2020. Open Access to all peer-reviewed scientific publications will **continue to be mandatory** for HEU beneficiaries. In addition, requirements will be introduced to ensure that beneficiaries or the authors **retain sufficient IPR**s to achieve compliance with Open Access requirements. While under H2020 the embargo period can be 0, 6 or 12 months, HEU will require immediate Open Access, thus an **embargo period of 0** (to be confirmed whether or not to be included in the Model Grand Agreement (MGA)). Related Article Processing Charges will continue to be eligible, but **newly not anymore for 'hybrid' journals** with both an Open Access and a subscription-based part. Taken together, the mentioned-above HEU obligations are in line with Plan S. Another change is that under HEU, **Open Research Data must be provided by default**, covering all research data newly generated or modified on the basis of existing data within a HEU action. According to the principle of 'as open as possible, as closed as necessary', exceptions are possible for duly justified reasons including commercial exploitation, data protection rules, privacy, confidentiality, trade secrets, Union competitive interests, security rules and IPRs. Whether or not opting out is possible will be evaluated during the review process, where beneficiaries will have to provide justifying reasons before a panel. In the following, the EC approves the opt-out request. As a consequence, **DMPs will also become mandatory** for all HEU projects that generate, collect and re-use research data in order to make Data Management an integral part of the research process. DMPs must be provided in line with FAIR principles, meaning that identifiers, trusted repositories and machine-readable licenses are required. According to **Art. 32 of the HEU Regulation, "costs related to open access including data management plans shall be eligible for reimbursement** as further stipulated by the grant agreement."

4.3.2 Open Science Practices

Most important with regards to RRI promotion is that according to Art. 10 of the Regulation, **HEU will embed 'Open Science Practices'**. These practices are defined in a footnote in Annex I of the HEU Specific Programme: **"The policies and practices to be addressed range from sharing research outputs as early and widely as possible through commonly agreed formats and a shared infrastructure (e.g. the European Open Science Cloud), citizen science, and developing and using new, broader approaches and indicators for evaluating research and rewarding researchers."** This indicates another extension of 'Open Science', which now also includes opening other research outputs than data such as methodologies, workflows, models, software and algorithms. Another feature is that citizen science as well as new evaluation and reward indicators (aimed at encouraging and incentivising researchers to practice Open Science focusing both on RFOs and RPOs) are now also consolidated under the 'Open Science Practices' umbrella. Art. 35(3) of the HEU Regulation further states that **WPs may provide for additional financial incentives or obligations to adhere to Open Science Practices** as incentives. However, requirements for "recognised good Open Science Practices for the entire research cycle" contained in HEU WPs will depend on the scientific discipline and the WP's particular focus. Compliance with Open Science practices will also cover training and development for researchers aiming to "acquire and improve their skills in Open Science." **WPs can also oblige to use the EOSC** for storing and giving access to research data. However, the extent to which Open Access to other research outputs than data will be required is still up to discussion. In addition, the HEU Impact Assessment mentions three related HEU initiatives:

- **Mandatory technical standards** will be crafted to assure that scientific information, publications, data and other research outputs including the metadata thereof can be located for re-use in the long term (including the use of persistent and unique identifiers and certified repositories compliant with EOSC and FAIR principles)
- An **Open Science label** will be introduced to reward universities embodying modern, collaborative practices.
- The adaption of the **European Code of Conduct** will be further promoted by the EC with research integrity being "fully incorporated in guidance documents."

Open Science is further mentioned as an **operational objective** of HEU in the Specific Programme, **together with "promoting responsible research and innovation"** and "**improving the relationship and interaction between science and society**, including the visibility of science in society and science communication, and promoting the involvement of citizens and end-users in co-design and co-creation or processes. This underlines the **cross-cutting nature of Open Science across the programme as well as its link to RRI**. Open Science is further taken up in the HEU Regulation's **Recitals** 4 and 5, with Recital 26 focusing on Open Science Practices and mentioning RRI in that context. Additionally, the 'Reforming and Enhancing the European R&I system' intervention area foresees a spare budget for **policy support** for the mainstreaming of Open Science, attractive research careers and citizen science and responsible research and innovation, e.g. in the structure and governance of RPOs and universities.

However, the **success of the promotion of Open Science Practices will depend on the extent to which they will become a legal obligation**, meaning in which WPs it will be mandatory to adopt Open Science Practices that involve the 'involvement of citizens and end-users in co-design and co-creation processes'. The issue is that proper citizen involvement and citizen science is challenging to achieve in practice. In response, the EC indicates the use of **cascade funding** as a remedy in the HEU Clusters of Pillar II, thus financial support for third parties (FSTP) to make participation faster and more attractive for local communities. Another question is the appropriate consideration of Open Science Practices in the **evaluation procedure**, especially in the light of the experience with the mainstreaming of RRI in HEU (section 2.3). The Implementation Strategy sets out how HEU will be managed in practice and establishes rules and procedures for the WP design, proposal submission, the evaluation procedure and monitoring. The first Orientations towards the Implementation Strategy of HEU, which were also created by co-design activities during Summer and Fall 2019, indicate that even more than for previous framework programmes, achieving impacts is at the centre. At the time of writing, the Implementation Strategy is still under discussion, but most of its aspects, including important elements of the MGA and the three maintained evaluation criteria **'excellence', 'impact** and **'quality and efficiency of the implementation'** are already fixed in the HEU legal basis. What is still under discussion are the **'aspects to be taken into account'** for each of the three evaluation criteria, which must be answered by the evaluators for all proposals. Under H2020, the only Open Science-related question for applicants relates to the DMP, which evaluators evaluate according to its quality under 'impact'. Already confirmed for HEU is the **obligation for applicants to indicate in their proposal whether their research data is open or closed**. At the time of writing, there is an ongoing discussion on the integration of 'Open Science Practices' in the evaluation criteria, on **whether Open Science practices and co-design with citizens and end-users should be included in 'aspects to take into account'** under the **excellence criteria**, or eventually under the **impact** criteria. This means in practice that applicants would be required to properly consider and apply appropriate Open Science Practices (according to their definition in the HEU Specific Programme), which would then be evaluated by the experts. If this happens, the promotion of RRI and Open Science Practices will receive a considerable boost since evaluation criteria are the starting point for applicants. The question of how to nudge, promote and foster good Open Science Practices and especially to evaluate and reward proposals in a transparent way is complex. It also **requires** the inclusion of

relevant expertise in the evaluation panel and adequate briefing of panel members. If Open Science Practices are to be included in WPs and in the evaluation criteria, it would mainly concern **Cluster activities** in Pillar II but potentially **not the European Research Council (ERC)**, which has its independent evaluation criteria[18].

4.4 Key Impact Pathways related to RRI and Open Science

The HEU legislation includes an obligation to monitor the effectiveness of measures to improve citizen and civil society involvement. This is where the new **Key Impact Pathways (KIPs)** come in: In the HEU Impact Assessment, the EC identified nine KIPs for the future FP, which are subsumed in three categories – scientific, societal and economic impacts. KIPs will replace the H2020 Key Performance Indicators (KPI). KIPs and related KIP indicators will **structure the monitoring of the FP's progress towards its objectives**. The KIPs, so the EC, stem from a need to better communicate this progress and to better demonstrate why EU R&I investments matter. Representing the "backbone of the HEU monitoring and evaluation", the corresponding KIP indicators will unite both qualitative and quantitative information and will be reported on an annual basis. According to the EC, KIPs are a "novel, ambitious yet pragmatic approach for indicator frameworks when facing complexity", aimed at "using a set of key storylines and allowing for data disaggregation and data linking and meeting data needs." Compared to H2020 with 23 KPIs for the programme parts and 14 KPIs for crosscutting issues, this represents considerable concentration of monitoring criteria. The nine KIPs consist of a **story line** as well as of **three indicators** each (one for the short-, medium- and long-term each).[19] Out of the nine KIPs, Number 3 and Number 6 are of relevance to the 'Science in Society' sub-unit:

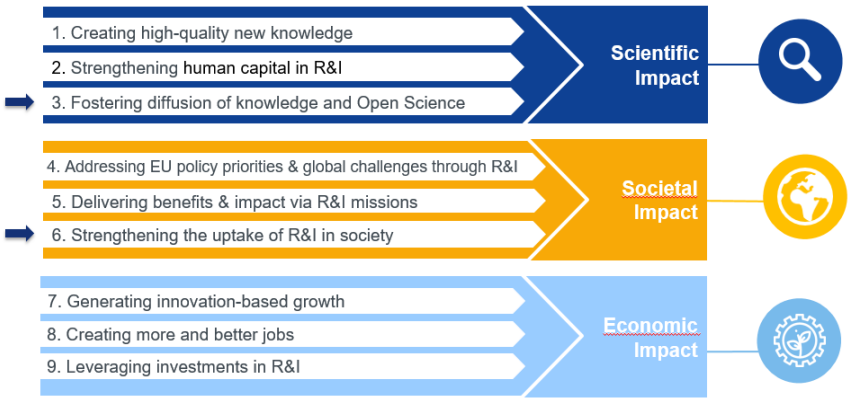

Figure 4: Key Impact Pathway Indicators for HEU to track progress (Source: EC)

The Annex of the HEU Regulation gives an overlook about the rationale the KIPs as well as about the different indicators it is composed of. For KIP 3 and 6, this information is summarised in the table below:

Key Impact Pathway	Short-term (as of year 1+)	Medium-term (as of year 3+)	Long-term (as of year 5+)
KIP 3: Fostering diffusion of knowledge and Open Science	Shared knowledge: Share of FP research outputs (open data/publication/software etc.) shared through open knowledge infrastructures[20]	Knowledge diffusion: Share of open access FP research outputs actively used/cited	New collaborations: Share of FP beneficiaries having developed new **transdisciplinary/transsectoral collaborations** with users of their open FP R&I outputs

[18] The evaluation criteria of the ERC differ from the rest of HEU, with the ERC focusing only on 'scientific excellence' but defining it differently than DG RTD for other H2020 programmes. The ERC is unique in terms of autonomy and bottom-up funding of curiosity-driven research. According to the RRI experts, the ERC has been "basically immune" to RRI integration, with a need for change perceived especially in terms of public engagement, societal impact and interdisciplinarity.
[19] Critics argue that the KIP indicators match the targeted scientific, economic and social impacts only to a limited extent, and that the criteria are "not seen from the actionable perspective of the actors of each domain".
[20] It is interesting to note here that this indicator originates from the MoRRI project (see section 7).

	Message: HEU opens up science, as shown by research outputs shared openly, re-used and at the origin of new transdisciplinary/transdisciplinary/trans-sectoral collaborations. Data needs: Identification of research outputs (in particular publications and research data) co-funded by the FP through the insertion of a specific DOI for the FP when publishing or sharing openly (e.g. OA journals/platforms (publications) and open FAIR repositories (data)), allowing follow-up tracking of open access performance in terms of active use/citations and collaborations.		
KIP6: Strengthening the uptake of research and innovation in society	Co-creation: Number and share of FP projects where EU citizens and end-users contribute to the **co-creation** of R&I contents	Engagement: Number and share of FP beneficiary entities with citizen and end-users engagement mechanisms after FP project	Societal R&I uptake: Uptake and outreach of FP co-created scientific results and innovative solutions
	Message: HEU creates value for European citizen, as shown by engagement of citizen in the projects and beyond the projects by improved uptake of scientific results and innovative solutions. Data needs: Collection of data at proposal stage on the roles of partners (incl. citizen) in the projects, structured survey of beneficiary entities and tracking of uptake and outreach trough patents and trademarks and media analysis.		

Table 2: Open Science-related KIPs and corresponding indicators (source: HEU Regulation, adapted)

KIP 3 measures the scientific impact of the Open Science agenda and takes it further to "new transdisciplinary/trans-sectoral collaborations." KIP 6 aims to encourage RPOs to build institutional support structures to systematically engage with non-scientific actors, thus effectively taking the SwafS programme KPI for Horizon Europe as a whole. The EC indeed also proposed in the HEU Impact Assessment to **go beyond the H2020 RRI KPI** "to assess the effects of the co-creation on the development of citizen engagement mechanisms in beneficiary entities (such as citizen fora, participatory research, co-creation facilities etc.), and then assess the extent to which this affects the uptake and outreach of the scientific results (e.g. changing behaviours) and innovative solutions from the programme."

The KIP monitoring applies to the whole framework programme, with the different time indicators building on each other to attain the long-term indicators. To track HEU's progress towards its objectives, **applicants will likely be required to describe their contribution to the different KIPs**. KPI monitoring and reporting by applicants will consequently **continue beyond the end of funded projects**, in order to measure e.g. to what extent projects lead to new collaborations and to what extent citizen and end-user engagement continues after a HEU project ends. The HEU Regulation also states that in addition, data on **profiles** of both beneficiaries and evaluators (including the **type of organisation (such as Civil Society Organisations, SMEs and private sector), gender, role in project[21], scientific discipline/sector, including SSH**) will be collected. HEU applicants and beneficiaries will have to submit this information on involved individuals in projects during the course of funding.[22] The tracking towards RRI and some of its keys thus continues. On the practical side, the Expert Group on the HEU MGA ensured that the KIP approach will be implemented "without increasing the burden on beneficiaries as much as possible." In addition, **further incentives for continued reporting** on Dissemination and Exploitation after the project's end will be provided (e.g. HEU Impact Award), in order to lead "beneficiaries from obligation towards opportunities of exploitations."

[21] According to the EC, this can be e.g. be Research performer; Technology development; Testing / validation; Demonstration (proof of viability); Scale-up; Private buyer of solutions to be developed; Public procurer of innovative solutions; Finance provider; of the technology basis; Provision of the technology infrastructure; **Representative of civil society interests/needs** and others.
[22] Moreover, so the EC, data shall also be monitored on the **climate-related financial contribution** of HEU, communication and dissemination of R&I results or on exploitation and deployment of R&I results.

4.5 RRI in novel parts of HEU

The next section elaborates on new HEU programme parts with a potential RRI integration through public outreach.

4.5.1 Missions

Among the most important novelties of HEU are the Missions, by which the EU wants to address global challenges through a portfolio-based approach beyond individual R&I actions. The EC stated that the whole way **missions are implemented is aligned with RRI guiding principles**, since citizens "will be involved in setting the priorities for the missions" and co-creation with stakeholders will be very intense. The importance of citizen engagement and public involvement have also been outlined in the Lamy High Level Group Report, the final RISE group report or in the two Mariana Mazzucato reports, which provide the basis for the Missions. At the time of writing, the Mission Boards and Assemblies for the five broad Mission areas[23] defined in the Annex of the HEU regulation are coming up with proposal for first concrete missions, which will be integrated into the Strategic Plan. Both, the identification and preparation of first missions throughout 2020 are **continuously accompanied by public outreach activities**, consisting of awareness raising events and dedicated stakeholder and citizen engagement workshops. In fact, every Mission board had to provide a **Citizen Engagement and Communication Strategy as a first deliverable.** The EC announced to further ramp up citizen engagement during the course of 2020.[24] Missions provide an important **opportunity for political outreach,** given their high public presence. However, the current engagement with citizens through dedicated co-creation events is rather low compared to other stakeholder involvement. It remains to be seen whether citizen involvement goes beyond the first stage of missions, thus from co-design through implementation (involving e.g. citizen science or user-led innovation) and oversight to final evaluation. Another question is how to ensure that citizen engagement is diverse and inclusive. It must however be kept in mind that the budget allocated to missions is rather limited. The coming months will show how the Missions unfold and to what extent the existing Open Science Practice networks and methodologies will be included. Missions have the potential to serve as a testbed for public engagement and for inter- and transdisciplinarity.

4.5.2 European Innovation Ecosystems

The ambition of the European Innovation Ecosystems is to contribute to the development of an effective innovation ecosystem at EU level through connecting national innovation actors, programmes and policies to overcome the fragmentation of the European innovation landscape.[25] The provisionally allocated budget to this part of Pillar III amounts to €0.5 bn, which includes also co-funding joint innovation programmes, such as EUREKA Eurostars. The European Innovation Ecosystem unit is part of the Task Force of the European Innovation Council (EIC). The mandate of the EIC relates to breakthrough and disruptive innovation, targeting especially market-creating and/or deep tech innovation in view to scale-up companies. In contrast, the **mandate of the European Innovation Ecosystem is broader with the Specific Programme mentioning also other forms innovation, including non-technical, public and inclusive social innovation, e.g. relating to public procurement.** Interesting in relation to RRI is **social innovation**, which is the "development and implementation of new ideas (products, services and models) to meet social needs and create new social relationships or collaboration." In order to foster dialogue on the final design of the European Innovation Ecosystem, a so-called EIC Forum will be set up to define the direction of the European

[23] The five Mission areas are (1) cancer, (2) adaptation to climate change including societal transformation, (3) healthy oceans, seas, coastal and inland waters, (4) climate-neutral and smart-cities and (5) soil health and food.
[24] Besides the EC also plans to set up a new website to gather inputs from stakeholders as well as a survey open to the public. It is however the MS which are called upon to disseminate the Missions approach and to identify appropriate citizen outreach events.
[25] In this context, the EIEs are also about creating appropriate regulatory frameworks to access new markets.

Innovation Ecosystems.[26] At the occasion of co-design activities (R&I days, **public web-based survey** and workshops for different stakeholder groups), the challenges, needs and different roles of future European Innovation Ecosystems are currently discussed. It is **still premature** to say to what role RRI will play. **Regional authorities and civil actors** (such as foundations) will play a role in the European Innovation Ecosystems, building thereby on H2020. There are discussions on how to best align top-down instruments to support the mainstreaming of the cross-cutting issues of Open Science or Gender with the bottom-up nature of the EIC. It is sure is that those topics will play a role, but it remains unclear through which actions and to what extent.[27]

4.5.3 European Institute of Innovation and Technology (EIT)

The European Institute of Innovation and Technology (EIT) is the last component of Pillar III and has a bigger budget (€3 billion) than the EIEs. According to its mandate, the EIT promotes "innovation with a people-centred approach", by integrating the knowledge triangle (companies, research institutions and universities) alongside the thematic Knowledge and Innovation Communities (KICs)[28]. Therefore, Open Innovation and Open Science seem to be deeply integrated in the EIT. **However, KICs are free to include or not include other participants in their consortia[29].** The EIT wants to abstain from interfering through a "the Community knows best" approach. The structure of the EIT can be characterised as **very bottom-up and decentralised,** with the EIT Governing Board only exercising a limited control over the KICs. Submitted proposals from consortia within the KICs are evaluated against the criteria of a market need for the proposed product, its innovative degree and a solid business model. According to the HEU Regulation, the EIT will "facilitate, empower and award entrepreneurs, innovators, researchers, educators, students and other innovation actors to work together in **cross-disciplinary teams**", "while **ensuring gender mainstreaming**". The EIT has made an increased representation of women in entrepreneurship, economic leadership and the technology sector a **strategic priority**.[30] Gender and diversity are also criteria in its annual funding award for all EIT KICs, which have to give account about their internal gender equality at before the EIT board. The HEU Regulation further states that EIT activities will be characterised by an **"open innovation approach"**.[31] Given its **decentralised, market-oriented and bottom-up structure**, the EIT only has a **limited influence on how the RRI agendas is implemented** in the KICs, with financial incentives and Strategic Recommendations being the main instruments. The EC proposal for a new EIT regulation and the EIT Strategic Innovation Agenda 2027-2027 (SIA) from July 2019 reflects the key role of the EIT as part of the Open Innovation Pillar and aims to enhance the transparency

[26] The EIC Forum on EIES consists of public authorities and bodies responsible for national innovation policies and programmes of EU MS and associated countries.

[27] In line with the priorities of Commission President Ursula von der Leyen, the 2020 WP for the EIC pilot will be updated. Additional opportunities for companies with women CEOs (or equivalent positions) is also expected, to ensure 25% of all finalists in the EIC Accelerator Pilot are women-led companies. If, following the first-round remote evaluation, a minimum of 25% of companies selected for the final-stage interviews are not led by women, additional interviews will be scheduled.

[28] The EIT is not a research centre and does not contribute to finance individual projects, but supports the translation of existing research results into successful innovation for the market by providing KICs with grants. Each of the current eight KICS consists of several Collocation Centres spread all over Europe. KICs are launched with the EC defining broad societal challenges (SCs) oriented to achieve the SDGs. **The only minimum requirement is that the KIC has to consist of at least one university, one RPO and one business partner.**

[29] The EIT climate KIC has a strong partner base among regional and local authorities, since they matter for delivering on the objectives of the climate SC. The same applies to the EIT Foods KIC, where consumer organisations are involved.

[30] Besides dedicated Women leadership and entrepreneurship activities, the EIT Board e.g. introduced a specific EIT Woman Award for female entrepreneurs or adopted an Internal Gender Mainstreaming Overarching Action Plan both for EIT and its KICs covering gender representation and a gender-responsive portfolio. The EIT has further implemented gender mainstreaming at different levels, with e.g. **eight of the 12 EIT Governing Board seats being currently held by women** and 55% of experts participating in business plan evaluation and grant reporting being women (compared to 11% in 2013).

[31] Intellectual Property Rights patterns and technologies are decided upon at the individual KIC level. The ETI currently works on a strategy for dissemination, replication and codification of results. So far, results from EIT-supported activities are mostly available free of charge and have to be widely disseminated. Those efforts are to be stepped up and strengthened under HEU.

and inclusiveness of consortia's business plans as well as monitoring, supervision and steering of KICs by the EIT Governing Board. According to the SIA, the EIT will enhance its regional impact by increasing its openness towards potential partners and stakeholders, including links with relevant smart specialisation strategies.

5 RRI in the new European Research Area

The European Research Area (ERA) launched in 2000 aims to build an effective Research Area in Europe, open to the world and based on the internal market through integrating scientific resources. To work towards this overarching objective, a range of ERA-related initiatives and reforms has been implemented during the last two decades. While the EC plays mostly a monitoring and supporting role, the national dimension of the ERA has been increasing in the last years. Despite its rather intergovernmental character, the **ERA can also be seen as a vector to promote the uptake of RRI and/or its keys** on its territory.[32] To give the ERA a new impetus and react to its slowing implementation, the European Research Area and Innovation Committee (ERAC) adopted an Opinion on the Future of ERA in December 2019. Although the document does not explicitly mention RRI, several references to its keys can be found in both the three **new ERA objectives** and **four new ERA priorities**. The first new ERA objective ('Be wholly inclusive and collaborative, and increase research quality throughout Europe') covers **open research processes and outputs, gender equality, integrity and involvement of society** to achieve "responsible European R&I ecosystems". The third, ('Be inspiring and open, and contribute to wider European policy objectives') calls upon ERA policies and actions to be "**more relevant to wider society**", amongst others also by making research-based knowledge more visible through "new opportunities offered by the **Open Science and Open Innovation principles**." The Opinion further outlines potential intervention areas for each of the four new **ERA priorities** – although they are illustrative only, they are interesting in the light of RRI promotion within the ERA, especially Priority 3:

ERA priorities	Potential intervention areas that relate to RRI
(1) Framework conditions for the production, circulation and use of knowledge, including research career issues	• Developing a European **framework for career evaluation and career progression** for researchers, including inter-sectoral mobility and **gender-related issues** under the **Open Science and Open Innovation principles** • Further developing **Open Science and Open Innovation policy approaches**
(2) R&I-driven joint action with other policy areas in a global context	• Embedding R&I and promoting capacities for absorption of new knowledge and technologies in other **sectoral policies**, including towards the SDGs and within missions
(3) Relevance and visibility of R&I for society	• **Co-designing, implementing and assessing R&I policies** with stakeholders and society, namely by finding more effective ways of **involving citizens** in setting and implementing R&I policy priorities • Promoting the valorisation and recognition of R&I achievements by society, by designing and implementing **better communication** of R&I impact, benefits and relevance • Within the context of supporting Open Science and Open Innovation approaches, developing **participatory approaches** such as citizen science as well as socio-innovation, social entrepreneurship and the protection of cultural heritage
(4) Broad inclusiveness (mostly on Widening)	• Ensuring **gender equality** throughout research careers and research content

Table 3: New ERA priorities related to RRI/Open Science (Source: ERAC Opinion on the Future of the ERA)

The new ERA paradigm outlined in the ERAC opinion aims for a **more cohesive ERA that "reassesses the role of science for society"** and mentions the need for a "**better demonstration of its societal relevance and its responsiveness to societal needs"** as one of its five requirements. Different elements from HEU's 'Enhancing and

[32] For instance, 'Gender equality and mainstreaming in research' and 'Optimal circulation, access to and transfer of scientific knowledge, including Knowledge circulation and Open Access' have been two of the six previous ERA priorities.

Strengthening the ERA' part (see section 4.1) are taken up, such as Open Science practices including citizen science, gender equality, attractive career environments and scientific input to other policies. The Opinion also describes a **shift "from involvement of stakeholders in research-based knowledge policy design and implementation** to **broader societal engagement and responsiveness".** However, many of the aspects of the new ERA, including potential legislative measures in the domain of Open Science are still up to discussion. The Opinion document has to be considered with caution, but it nevertheless gives insights in where the discussion is going.

6 Stakeholder opinions

Some R&I stakeholders have given their opinion on RRI and its promotion in European R&I policy:

The **European University Association (EUA)** does not have a position on RRI as an umbrella concept in its totality, but **rather focuses on the individual RRI components at various degrees without directly opposing one of its keys**. Representing over 800 culturally and geographically diverse universities and national rectors' conferences in 48 countries, the EUA is of the opinion that **transition towards RRI must primarily be directed and supported at the institutional level**, with only a limited supportive role for the EU and FPs. Acknowledging that the SwafS programme has been effective in raising awareness and building capacity, the EUA also thinks that the eight programme lines have been too broad and too diverse to be bundled under one umbrella approach. Therefore, the EUA is pleased to see the EC's focus switch from individual projects to institutional changes in RPOs and universities as a whole, e.g. through new pilot calls in the last SwafS WP 2018-2020 aiming to promote institutional transformation through synergies between research and education of European Universities. A **strong focus of the EUA** lies on Open Science, gender equality as well as on **public engagement** to a more limited degree. **Interinstitutional and interdisciplinary collaboration are key to assure leadership support for RRI and to promote institutional change** according the EUA. The association does not support the idea of introducing RRI evaluation criteria in all HEU programme parts, but suggests to **include them in WPs where it is necessary**, especially in delicate research areas (such as facial recognition) requiring societal backing and ethical consideration. The EUA is opposed to the introduction of gender quota for high-level positions in member organisations.

The **Conference of European Schools for Advanced Engineering, Education and Research (CESAER)** welcomes the **increasingly interdisciplinary and institutional character of the RRI discussion**. However, it voices critique on the EU's **limited progress in RRI promotion and in the development of appropriate and realistic indicators,** which should capture the very essence of responsibility and societal outreach itself rather than focusing on jobs and economic growth. For CESAER, the issue of responsibility has already been in the focus for a long time, especially in view of the fact that technical universities touch upon **key technologies (KET)** (AI, biotech, quantum technologies), which require a lot of societal backing and ethical considerations. CESAER is of the opinion that **SSH incorporation in both Science, Technology, Engineering and Mathematics (STEM) education and research** is key to foster the societal uptake of new technology and behavioural change, for instance through integrating research ethics in STEM curricula. The mandate of STEM universities is also increasingly discussed in the debate about environmental, social and economic sustainability, where STEM universities have to reconsider their mandate. To that end, an internal CESAER Working Group on sustainability has been set up. However, the debate on research ethics and integrity must not be one-sided, meaning that **society and politics also have to provide for sound political, judicial and economic framework conditions** for universities to act upon the resolution of the grand societal challenges. CESAER consequently welcomes the **definition of the ERA as a value-based community**.

Recently, a declaration on equality, diversity and inclusion was adopted within CESAER **with the objective of increasing gender balance at all decision-making levels and in advisory boards to at least 30% by 2023**. CESAER mainly focuses on STEM relevant and challenging Open Science aspects such as RDM or developing new career assessment indicators. While supporting **transdisciplinarity and public engagement** activities, CESAER also stresses the need for appropriateness and utility of the latter. It emphasises its support for **the integration of RRI-related evaluation criteria in HEU,** with however pointing out that an excellence-only oriented programme like Pillar I is needed in order **to not impede basic blue-sky research**.

The Guild of Research-Intensive Universities (The Guild) is supportive of the RRI spirit, with several working groups active in institutional capacity building and best-practice exchange in relation to RRI key areas, such as gender equality or Open Science. It argues that **FP9 should continue to develop the citizens-science relationship by building on the legacy of the SwafS actions in H2020**. A bottom-up approach is however considered more suitable to achieve concrete results than a one-size-fits-all strategy, taking into account institutional cultures, procedures and autonomy and fostering a diversity of approaches. In this context, The Guild supports the **European Universities Initiative** as a good opportunity to directly support institutional change towards RRI and achieve transformation in universities, including Open Science and citizen engagement as key elements thereof. This especially applies to the **Open Science Agenda's ambitious timeline**. To **incentivise citizen engagement** for mainstreaming purposes, **The Guild proposes dedicated top-up funding for successful HEU projects,** since wider public engagement is not always possible in the light of the resources, expertise and timeframe of concerned projects. Here, the **Excellence initiative** is seen as an opportunity to support universities not only in becoming more competitive, but also in advancing in areas such as Open Science, interdisciplinarity, science communication or gender equality. Last, The Guild strongly advocates for a genuine embedding of SSH in all implementation stages and appropriate co-creation, in order to increase meaning of the EU for citizens.

7 RRI in practice

The following chapter comprises interesting RRI-related projects as well as the view of RRI experts on RRI promotion in European R&I policy. According to all of the interviewed people from below-mentioned projects, the success of RRI mainstreaming in H2020 has been limited since RRI has neither been **consistently and appropriately considered in the evaluation criteria** nor effectively **monitored** after proposal submission. RRI researchers and practitioners notice the **presence of an RRI framework at the declaratory level (i.e. introductory text)**, but a weak representation at the topic level leading to inefficient mainstreaming in other programme parts than SwafS. While some programme lines strongly encourage RRI (besides SwafS and SC6 also MSCA with its focus on public engagement and training activities), others included RRI in the first Work Programmes of H2020 but then omitted it.[33] Noting the absence of direct RRI references in the HEU proposal, there is the fear that **without a SwafS-like programme, the conceptual and methodological development of RRI will suffer** and not move forward. This is however strongly needed, also because conceptual unclarity about what RRI exactly means has been a recurrent issue under H2020. Some say that the **different RRI approaches adopted by the EC create "further conceptual confusion about what RRI actually is"**, with the RRI keys being a prominent example, which **has 'more to do with the bureaucracy of maintaining [RRI] as a cross-cutting theme** [in the H2020 programme] than with the conceptual

[33] Moreover, the Joint Research Centre (JRC), ERA-Net Co-funds or the ERC with its individual evaluation criteria almost exclusively consider scientific excellence in the evaluation without any RRI reference, meaning publications in high impact factor journals.

foundations of RRI'."[34] Consequently, experts call for a **dual approach** with **more dedicated funding** than what is currently foreseen for the corresponding intervention area of Pillar IV. Similarly, it is argued that RRI has reached a **'deadlock at the strategic level'.** Although it is **often referred to in high-level declarations** (making it a "fashion"), the RRI concept is **not adequately implemented at the operational level** given the strong focus of European R&I programmes on **scientific excellence** (e.g. in the ERC) as the exclusive evaluation criteria. If the RRI philosophy is to succeed, RRI jargon is to be avoided as much as possible, since it is not about ticking boxes or applying a rigid conceptual framework, but rather about **embedding the "RRI way of thinking" across HEU**. Even if the RRI "fashion" might be over, its components will survive and there might be a potential reuse despite the administrative burden, that makes R&I actors sometimes hesitate. The RRI spirit remains relevant, especially since public and private bodies need an ethical and social "licence to operate", which is more important today than ever before.

The **'Monitoring the Evolution and Benefits of Responsible Research and Innovation' (MoRRI)** project was based on a EC service contract and ran from 2014 to 2018 with the objective to "provide scientific evidence, analysis and policy intelligence to support DG RTD research funding activities and policy-making activities in relation with RRI." Eventually, it established a **monitoring system to measure to what extent, how and where RRI has become integrated within European Research**, based on the EC's conceptualisation of RRI with its six keys. MoRRI identified **36 indicators for the six RRI keys** (see Annex). The resulting framework was applied to the national R&I systems in all EU MS, which were then clustered according to their RRI scores pattern. Results revealed a **significant diversity across RRI dimensions and key area implementation for EU MS**, and monitored different types of RRI benefits (democratic, societal, and economic). The MoRRI indicators then served as a basis for EU research policy and further study: **As of the WPs 2018-20 in H2020, some SwafS topics specify not only SDGs but also MoRRI indicators which applicants should address, leaving them the option to take up other objectives or indicators than the suggested ones.** This is taken into consideration in the proposal evaluation under the 'impact' criterion. After the conceptualisation and implementation of the first RRI monitoring system in Europe, **SUPER MoRRI** runs as a successor programme to MoRRI from 2019 to 2023 and aims to further assess and refine the indicators and ensure sustained data collection and curation. To that end, an RRI indicator hub drawing in data streams from a national correspondents network will be created. Another objective is to develop a proper scientific understanding of the complex and diverse relationships between RRI policies and practices and their societal, democratic, economic and scientific benefits. In view of HEU, there seems to be no direct opportunity for the future use of (Super)MoRRI indicators as such, but SUPER MoRRI's ambition is to contribute with the revised indicators to the direct integration of RRI practices in RFOs and RPOs, through advocacy and awareness raising. RRI experts involved in both MoRRI and Super MoRRI give the EU's RRI conceptualisation with its 6 keys credits for making RRI easy to understand and operationalise, and for continuing existing funding line traditions from previous FPs. However, researchers involved in (SUPER)MoRRI argue that the keys and corresponding indicators are also rigid and not always suitable to be applied at the micro level of individual scientists.

The question of **how RRI can be further integrated into international and national R&I practice and funding** is addressed by **NewHoRRIzon**, the biggest SwafS project funded under H2020 running from 2017 to 2022. **Social**

[34] One can argue that while the Rome Declaration might have made sense for the EC, the different keys have already a longstanding, separately evolving tradition within RFOs and RPOs, with the relevance of the difference keys varying according to the discipline. Stating that the EC's conceptualisation is simply a "merging of existing policies under one umbrella", one can also consider RRI more as a **reflexivity** about the decisions, values and norms scientific work is based on, and on the implications of objectives, procedures and outcomes of R&I activities. It includes society involvement from the beginning on.

Labs are run **on different H2020 programme parts** to assess current RRI practices within H2020 and to reflect on how to embed RRI into R&I policies and funding programmes in the future. Results of these Social Labs so far have shown that RRI seems to be included only pro forma as a set of practices instead of "meeting the spirit" of RRI key areas, which in turn limits the impact on SDG achievement and R&I's alignment with societal expectations and needs. To better integrate RRI, New HoRRIzon demands a shift from considering RRI a "general cross-cutting-issue" to an "**explicit policy goal, materialized in clear guidelines for action."** The EC should develop and actively disseminate information on RRI policy implementation tools that (1) explain the rationale and benefit of RRI uptake, (2) train and support change agents to secure organisational acceptance and (3) offer institutional incentives supporting RRI-oriented change.

The **la Caixa Foundation (LCF)** is a private foundation in Spain that funds scientific research mainly in Biomedicine and Health through open calls, and by collaborating with universities, research institutes and hospitals; and that runs an extensive 'Science in Society' programme. The objective of the 'Science in Society' programme is to foster scientific culture among all people, promote scientific professions and show the importance of scientific research as a tool to social change. Since the inception of RRI within EU R&I policy, LCF has devoted increasing efforts to support this R&I paradigm shift through for example participating in several SwafS/RRI related projects such as the flagship project RRI Tools, where LCF acted as project coordinator. Under RRI Tools, a digital platform (the RRI Toolkit) with a remarkable set of resources to advocate, train, disseminate and implement RRI under H2020 was developed. The **RRI Toolkit offers tailored guidance for researchers, policy makers, the education community, business and industry as well as Civil Society Organisations who want to integrate RRI in their projects**. According to LCF, the RRI Toolkit has a considerable and loyal user community, making RRI Tools 'the most followed project in the RRI field." LCF also incorporates RRI criteria in its funding calls, fellowship and training building activities for health researchers, innovators and entrepreneurs, coupled with calls promoting transdisciplinary R&I[35].

8 Conclusions and policy recommendations

RRI is a multidimensional and dynamic concept that has been taken up in European R&I policy in different ways, with notably being mainstreamed in H2020 as a cross-cutting issue and specifically promoted via the SwafS programme. Throughout H2020, an RRI understanding as comprising six keys – gender equality, ethics, science education, open access, public engagement and governance – has been prevalent. In HEU, **RRI will move forward with the new Open Science agenda,** which now not only covers an early and wide sharing of knowledge and tools, but also the alignment of research partners including **open collaboration between science and society** under the so-called 'Open Science Practices' umbrella. The RRI **keys will be promoted separately** and the **'RRI spirit' will live on** in the upcoming FP, its monitoring system as well as in the new ERA. Although the SwafS are gone in name, their content persists in the HEU Pillar IV intervention area "Reforming and Enhancing the European R&I system". However, **some RRI keys (such as Open Access or gender equality) might receive more attention than others**. Although RRI is at the declaratory level an inherent part of European R&I policy, there are several issues where spirits divide: Should RRI or aspects thereof be included in HEU evaluation criteria? If yes, in which programme parts? And to what extent is it necessary to have sufficient dedicated funding for RRI activities in a specific SwafS-like programme

[35] Example for such RRI-related funding criteria are scientific impact and **social relevance** (positive, relevant and innovative difference to the scientific field and/or the society), **responsible research** (detailed analysis of ethical, legal, social and environmental implication of project execution and its potential results) and **dissemination and transfer** (suitable description of the mechanisms, actions and activities of dissemination, communication, social implication, valorisation and results transfer).

part, similar to a safe "homebase" for RRI and its conceptual development?[36] And is a top-down political approach through European FPs operationalised in criteria for funding really the best approach to see the value of the RRI unfold best, or is a bottom-up strategy (e.g. through the European Universities) more efficient to foster institutional changes?

RRI mainstreaming and a RRI "homebase" are both needed. Institutional change is slow and requires dedication and nurturing, along with continued funding. Active support of institutional change supports RRI dissemination, and surveys show that the institutional environment can positively influence the degree of RRI activities and the attitude towards them, e.g. via funding incentives or dedicated staff in charge of RRI parts. Analyses of the efficiency of RRI integration in H2020 show that **progress has been made, but there is still a long way to go**. The HEU legislation provides for a continued two-fold approach to promote RRI, but it remains to be seen how much of the already limited budget will eventually be devoted to RRI activities. The new Open Science narrative seems promising, but uniting **the RRI and the Open Access community under one umbrella will not be easy**. **Making results public and including societal actors as data providers is not yet responsibility.** Citizens and societal actors must be included in the R&I process from the beginning in a transparent and inclusive way, in setting scientific agendas, co-designing and conducting research. Of course, thinking that this can be done throughout all scientific disciplines is utopian, but basic reflections on ethical values and societal acceptance must take place not only in social sciences or in medicine. The HEU legislation suggests a **strong emphasis on impact communication and citizen outreach, supported by a mission-oriented approach and a strengthened Open Science policy**.[37] If Open Science Practices are to be successfully mainstreamed, **key entries are their inclusion in WPs, proposal submission and especially in the evaluation criteria through the 'aspects to be taken into account'**. The next years will show to what extent RRI will effectively be "mainstreamed" across the whole FP, or whether RRI risks to remain isolated in society-oriented HEU programme parts such as Pillar IV or Cluster 2 (Inclusive Societies).

In general, the different interviewees (see Annex) mentioned the following measures to strengthen RRI:

- **Trans- and interdisciplinary research** should be promoted via dedicated funding and calls, thereby encouraging R&I taking into account societal needs and perspectives from other academic disciplines (e.g. SSH).
- **Act at the national level**: There are already efforts in some EU MS to develop RRI frameworks. National level RRI programmes should be strengthened, also since they are "relatively explicit and specific" and "closer to actual research and innovation where RRI can be implemented." A coordination of those activities is needed to share experience, avoid duplication and harmonise national RRI standards.
- **Develop useful indicators to monitor and evaluate RRI Implementation** (e.g. by building on SuperMoRRI) since the H2020 KPIs for SwafS and RRI are difficult to evaluate due to their complexity.
- **Build on knowledge and resources generated in SaS, SiS and SwafS**. The necessary RRI expertise and toolkits (e.g. RRI Toolkit) already exists in view to foster good collaborative Open Science practices, draft WPs and evaluate proposals. **RRI and transdisciplinary competences should be included in evaluation panels and advisory boards**, especially in relation to science and technologies and Missions.
- To avoid that RRI stays a mere lip service, it has to be **consistently promoted** throughout the whole project cycle, meaning appropriate RRI inclusion in proposal submission, evaluation and review. This can for example

[36] Some suggest that it is exactly this "lack of conceptual clarity" of the RRI framework to the intended users that impedes RRI's effective implementation in research practice.
[37] To that end, the conducted co-creation activities for the Strategic Plan are already a good starting point and can be considered as a form of RRI implementation itself, but the public consultation was on the other hand de facto limited to Pillar II.

be achieved through an attachment addressing RRI related questions and reflections, an obligation to incorporate RRI-specific actions in projects' tasks, deliverables, milestones and budgets and RRI-informed criteria in proposal evaluation and RRI expertise in evaluation panels.

- A 'RRI hub', a **RRI policy advocacy and expertise centre** should be created (e.g. as part of the EC's Research Executive Agency) to support RRI mainstreaming in European R&I policy (in- and outside of HEU) and its supervision.
- Today's scientific and academic culture is not very conducive to RRI and Open Science. Most RFOs and RPOs exclusively use bibliometric parameters as proxies for excellence in career assessments of researchers, which does not facilitate Open Science. To increase Open Science practices, researchers as key agents of change must be encouraged and incentivised by employers, RPOs and RFOs. The latter have to better **recognise and reward Open Science in recruitment criteria, career progression and grant assessment procedures** instead of exclusively using bibliometric parameters as proxies for scientific excellence. The EC Working Group on Rewards under Open Science proposed to this end for instance an Open Science Career Assessment Matrix that takes into account the full spectrum of Open Science activities, including research integrity, citizen science and stakeholder engagement. Similar actions that have been announced for the HEU 'Enhancing and strengthening the European R&I system' intervention area, the new ERA as well as within R&I stakeholder organisations are thus welcomed.

More than previous FPs, **HEU plays a crucial role for the EU in shaping, supporting and delivering on European policy priorities**. The **'RRI spirit' is key to build societal support** not only for European R&I policy, but for EU policies in general, regardless of how it is labelled. Alignment of R&I processes and outcomes is also crucial in view to demonstrate the impact R&I can have to achieve the SDGs and solve today's global challenges such as the climate and digital transformation. The costs of non-action, thus inadequate RRI consideration would not only jeopardise the efficient and effective use of public funding in research and development of innovative technologies, but also limit European scientists and innovators in tackling the challenges of today and tomorrow.

9 Annex

9.1 Options to strengthen RRI at the institutional level

In a 2013 report in the run-up to H2020, the Expert Group on the State of the Art in Europe on Responsible Research and Innovation proposed different options for strengthening RRI in European research policy:

1. No particular action (continue FP7)
2. 'Improved Business as usual' with specific funding for RRI, with several actions possible
    a. Mainstreaming of RRI in existing Funding Programmes, no new funding opportunities: RRI criteria would have to be applied across all EU funding programmes.
    b. Increased share of funding for inter- and transdisciplinary research
    c. Specific funding line for research on RRI to study interactions of science, innovation and society to develop conceptual basis and successful application in practice
3. Improved coordination with the EU MS without a legally binding initiative (directly addresses MS, businesses, private RPOs and RFOs)
    a. Improved coordination of RRI activities in the MS (regular reports of MS to the EC, funding activities for RRI within existing MS funding programmes, Incentives through Public Procurement and others)
    b. Codes of Conduct for RRI activities
    c. Voluntary RRI standards
4. Improved coordination with the MS with a legally binding initiative

After identifying and balancing each policy option's consequences with respect to costs, impacted actors and harmonisation capacity, the expert group concluded that policy option 3 was to prefer, given the range of impacted actors and the larger amount of research funding while assuring enough flexibility to particular contexts. Actions under policy 2, so the expert group, should also be considered as a complementary option on the European level.

9.2 MoRRI Indicators

The following table 4 provides an overview of the 36 RRI indicators from the MoRRI project, or more precisely of the 36+ indicators, since some consist of several measurements. As of the SwafS WP 18-20, they served as a voluntary reference for applicants, who could specify in their proposals to which extent they contribute to their enhancement, leaving them the choice to adopt other standards.

RRI dimension	Indicator code	Indicator Title	Source
Gender Equality (GE)	**GE1**	**Share of research-performing organisations (RPOs) with gender equality plans**	HEI, RPO surveys
	GE2	**Share of female researchers by sector**	Eurostat
	- GE2.1	Share of female researchers – all sectors	Eurostat
	- GE2.2	Share of female researchers – business enterprise sector	Eurostat
	- GE2.3	Share of female researchers – government sector	Eurostat
	- GE2.4	Share of female researchers – higher sector	Eurostat
	GE3	**Share of research-funding organisations (RFOs) promoting gender content in research**	RFO survey
	GE4	**Dissimilarity index**	SHE Figures

	- GE4.1	Dissimilarity index: higher education sector	SHE Figures
	- GE4.2	Dissimilarity index: government sector	SHE Figures
	GE5	**Share of RPOs with policies to promote gender in research content**	HEI, RPO surveys
	GE6	**Glass ceiling index**	SHE Figures
	GE7	**Gender wage gap**	Eurostat
	- GE7.1	Gender wage gap – academic professions	Eurostat
	- GE7.2	Gender wage gap – technicians and associate professionals	Eurostat
	GE8	**Share of female heads of RPOs**	HEI, RPO surveys
	GE9	**Share of gender-balanced recruitment committees at RPOs**	HEI, RPO surveys
	GE10	**Share of female inventors and authors**	Patstat, Scopus
	- GE10.1	Share of female authors	Scopus
	- GE10.2	Share of female investors	Patstat
Science literacy and science education (SLSE)	**SLSE1**	**Importance of societal aspects of science in science curricula for 15 to 18-year old students**	HEI survey
	SLSE2	**RRI-related training at higher education institutions**	HEI survey
	SLSE3	**Science communication culture**	MASIS
	SLSE4	**Citizen science activities in RPOs**	ECSA, Scopus
	- SLSE4.1	Organisational memberships in ECSA was ist das?	ESCA
	- SLSE4.2	Citizen science publications	Scopus
Public engagement (PE)	PE1	Models of public involvement in science and technology decision-making	MASIS
	PE2	Policy-oriented engagement with science	Eurobarometer
	PE3	Citizen preferences for active participation in science and technology decision-making	Eurobarometer
	PE4	Active information search about controversial technologies	Eurobarometer
	PE5	Public engagement performance mechanisms at the level of RPOs	HEI, RPO survey
	PE6	Dedicated resources for public engagement	Indicator dropped – results from HEI and RPOs surveys on PE resources are inconsistent.
	PE7	Embedment of PE activities in the funding structure of key public RFOs	RFO survey
	PE8	PE elements as evaluative criteria in research proposal evaluations	RFO survey
	PE9	Research and innovation democratisation index	SiS survey
	PE10	National infrastructure for involvement of citizens and societal actors in research and innovation	SiS survey
Open Access (OA)	**OA1**	**Open access literature**	DOAJ list, PMC, the ROAD list, CrossRef, and OpenAIRE
	- OA1.1	**Share of open access publications**	DOAJ list, PMC, the ROAD list, CrossRef, and OpenAIRE
	- OA1.2	**Citation scores for OA publications**	DOAJ list, PMC, the ROAD list, CrossRef, and OpenAIRE
	OA2	**Data publications and citations**	Indicator dropped – inconsistent and erratic underlying data
	OA3	**Social media outreach/take-up of open access literature**	WoS and Altmetric.com
	- OA3.1	Ratio of OA and non-OA publications used on Twitter	WoS and Altmetric.com Limited to publications
	- OA3.2	Ratio of OA and non-OA publications used on Wikipedia	WoS and Altmetric.com Limited to publications

	OA4	**Public perception of OA**	Eurobarometer
	OA5	**Funder mandates**	DG RTD
	OA6	**RPOs' support structures for researchers as regards incentives and barriers for data sharing**	HEI, RPO surveys
Ethics (E)	**E1a**	**Ethics the level of RPOs**	HEI, RPO surveys
	E1b	Ethics at the level of RPOs (composite indicator)	HEI, RPO surveys
	E2	**National ethics committees' index**	EPOCH
	E3a	**RFOs' index**	RFO survey
	E3b	RFOs' index (composite indicator)	RFO survey
Governance (GOV)	**GOV1**	**Use of science in policymaking**	MASIS
	GOV2	**RRI-related governance mechanisms within RFOs and RPOs**	RFO, HEI, RPO surveys
	GOV3	**RRI-related governance mechanisms within RFOs and RPOs – composite index**	RFO, HEI, RPO surveys

Table 4: MoRRI indicators (source: MoRRI final report, adapted)

9.3 Interviewees

Name and Function	Organisation	Specific topic of the interview
Michael Arentoft and Linden Farrer, Policy Officers	DG RTD, Sub-Unit G.4.001 (Science and Society)	Integration of RRI/Open Science in DG RTD, H2020 and HEU
Alan Cross, Deputy Head of Unit	DG RTD, Unit B.3. (Common Service for Business Processes)	Inclusion of RRI in FP's Implementation Strategy and Evaluation
Deirdre Furlong, Head of Sector	Research Executive Agency (ERA), Spreading Excellence, Widening Participation, Science with and for Society, Project Management	Project management of SwafS project under H2020, inclusion of RRI as a cross-cutting issue
Veronica Vaccari, Deputy Head of Unit	DG RTD, EIC Task Force 2 – Innovation Ecosystems	RRI in European Innovation Ecosystems
Matthea Fammels, Head of Office	EIT, Brussels Liaison Office	RRI in the EIT
David Bohmert, Secretary General	CESAER	CESAER position on the EU's RRI agenda and own RRI-related activities
Thomas Jørgensen, Senior Policy Coordinator	EUA	EUA's position on the EU's RRI agenda and own RRI-related activities
Sarika Wilson, Head of Policy	The Guild	The Guild's position on the EU's RRI agenda and own RRI-related activities
Ralf Lindner	MoRRI / SuperMoRRI	MoRRI and SuperMoRRI, indicators for measuring RRI, RRI promotion in European R&I policy
Erich Griessler	NewHoRRIzon	NewHoRRIzon, explorative talk about RRI in general and in EU R&I policy
Eva Zuazua Schucker, Belén Perat Rodríguez	'la Caixa' Foundation / RRI Tools	Inclusion of RRI in RFOs, experience with RRI projects under H2020 and the EU's RRI policy

Table 5: List of interviewed people as sources of the report