

THE IMPACT OF RESPONSIBLE RESEARCH AND INNOVATION (RRI) - A CO-CREATED TEMPLATE WITH A COMPILATION OF THE SCIENTIFIC, SOCIETAL AND ECONOMIC IMPACTS OF RRI

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ABSTRACT

In this paper, we show how the policy concept Responsible Research and Innovation (RRI) intends to offer added value to scientific research processes and its manifold results and how these anticipated benefits can be measured. We set out to address the recognized challenge of impact monitoring for projects working with RRI by developing a template that can pay attention to the so far hardly considered outputs, outcomes and impacts of a particular RRI project. Its usage goes beyond monitoring and evaluating purposes at the end of a project, as our proposed set of indicators can provide scholars and practitioners with guidance and inspiration in the early design or implementation phase of a project. From a policy-making point of view, this paper also highlights that developing monitoring and evaluation systems can significantly profit from stakeholder engagement and co-creation approaches, adding a bottom-up perspective to top-down suggestions of the research funders.

EMBEDDING RESPONSIBILITY IN EUROPEAN RESEARCH AND INNOVATION PROJECTS

In recent years, various societal drivers have increased the pressure on the science system to legitimize the use of public funds. Typically, it is no longer deemed sufficient to achieve goals intrinsic to research, such as contributing to the development of theory and methods or achieving knowledge gains. Instead, the contribution that research makes to solving problems matters, especially for major societal challenges. This debate is strongly linked to keywords such as Sustainable Development Goals, Societal Impacts, a “New social contract of science”, and also in particular concepts that aim to improve the relationship between science and society (Gibbons, 1999; Demeritt, 2000; Reale et al., 2015; Martin, 2011; von Schomberg, 2013).

As regards the latter, the concept of responsible research and innovation (RRI) that was initiated and promoted by the European Commission (EC), has gained particular attention. The strengthened and improved

relationship between science and society is at the core of RRI which aims to embed responsibility as a core value in research and innovation processes and cultures (European Commission, 2014; Lindner et al., 2016; Bogner et al., 2015). Generally speaking, RRI intends to create a new and improved relationship between science and society. The EC defines RRI as “a process where all societal actors (researchers, citizens, policy makers, business) work together during the whole Research and Innovation (R&I) process in order to align R&I outcomes with the values, needs and expectations of European society” (von Schomberg 2013). RRI has also been defined as “... a transparent, interactive process in which societal actors and innovators become mutually responsive to each other with a view on the ethical acceptability, sustainability and societal desirability of the innovation process and its marketable products.” (Call FP7-SiS-2012-1). Scholars like Stilgoe et al. (2013) emphasize four integrated dimensions that characterize RRI, namely anticipation, reflexivity, inclusion, and responsiveness.

The Commission has promoted the concept of RRI in a number of ways: First, through research funding under the various EU Framework Programmes. Here, the naming of the relevant programme pillars underscores the changing understanding of science-society relations that have evolved: from Science and Society (SaS, Framework Programme 6) to Science in Society (SiS, Framework Programme 7) all the way up to Science with and for Society (SwafS, Horizon 2020). While “SaS” could still be interpreted as two separate subsystems interacting with each other, “SiS” already implies close interpenetration. Finally, “SwafS” emphasizes both the normative (for) and the participatory (with) components. Horizon Europe integrates the science-society relationships, namely to engage and involve citizens and civil society organisations, in different regards, as part of the Horizon Europe Regulation and Specific Programme, as an excellence criterion and as element in the key impact pathways.

In the following, we show that normative orientation is associated with specific challenges, as it involves a cognitive bias towards benefits, without at the same time pointing out potential negative effects.

ESTABLISHING AN RRI ECOYSTEM

With the help of research funding, an RRI community of experts has emerged with numerous projects that, in addition to analytical issues such as the need for structural change in the science system (HEIRRI¹, JERRI², RRI Practice)³ and altered governance structures (Resagora⁴), has developed very practical approaches to bringing RRI into practice (RRI Tools⁵, FOTRRIS⁶, to mention just a few). On the other hand, the EU has specifically set up expert panels and commissioned services to advance the topic of RRI.

Two initiatives deserve special attention: the expert group on “Indicators for promoting and monitoring Responsible Research and Innovation”⁷ and the MoRRI project⁸. The MoRRI project aimed to monitor the evolution and benefits of RRI. In doing so, the study team developed numerous indicators for the so-called RRI keys Public Engagement, Ethics and Governance, Gender Equality, Science Education and Open Access (Peter et al., 2018). The starting point of MoRRI was an intervention logic. Accordingly, a distinction was made between inputs (“responsible practices”), outputs resulting directly from them, and longer-term outcomes or impacts. The indicators referred exclusively to the national level, even though they were often created from aggregated data at the individual or organizational level. In addition, so-called “benefit indicators” were also developed within the framework of MoRRI, which referred to the following dimensions: scientific, economic, democratic, and societal.

The EC then required in the Horizon 2020 work programmes (WP) that project applicants apply the MoRRI indicators: “Several WP18-20 topics specify indicators which applicants should work towards, notably from the Sustainable Development Goals and from the study Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI)” (European Commission, Horizon 2020 Work Programme 2018-2020, p. 8). However, due to the specific objective, approach and results of MoRRI – developing indicators that refer to the country level – it was hard to apply them at a project level.

Thus, two developments came together that posed significant challenges on the Horizon 2020 project applicants and beyond: How can researchers address the increasing demand of public research funders to demonstrate the impact of their research? How can RRI-related impacts be measured?

MEASURING THE IMPACTS OF RRI - A CHALLENGING ENDEAVOR

In recent years, there have been several attempts to measure the impacts of RRI in the context of EU projects and programmes. The EU project RI-Paths, for example, has compiled various indicators to measure societal impacts of research infrastructures. These indicators show various references to the RRI concept as developed by the EC, focusing on different so-called RRI keys (Public Engagement, Ethics and Governance, Gender Equality, Science Education and Open Access). Specifically, the RI pathway indicators mention the aspects of open access, public engagement, science communication and gender equality (Helman et al., 2020, p. 16). Moreover, the EU Expert Group on Monitoring the EU Framework Programmes (2018) has proposed “citizen engagement” as part of the Key Impact Pathways. The reason why citizen engagement is understood as a relevant impact dimension is that participatory processes are considered as important for legitimacy, accountability and transparency of research and innovation (ibid.).

However, in contrast to these practical suggestions and recommendations, there are still critical voices that warn against specifying indicators too quickly, for example the fteval Working Group on Impact Assessment: “a limited set of indicators will not do justice to the multi-dimensional character of the undertaking. The relationship between science and society must be considered in all of its dimensions, bearing in mind that this relationship is embedded in a complex system of formal and informal interactions that are open to change over time. RTI policy interventions to create and maintain such interactions are themselves important mechanisms for opening a space to shape the relationship between science and society and define collaboratively the benefits of this relationship”⁹. Nonetheless, despite these efforts, there is still need for a framework to impact monitoring for projects working with RRI that is more comprehensive and sensitive to the specificities of RRI impacts.

THE MONITORING / EVALUATION TEMPLATE

To address this challenge and need, we propose a framework of measuring the short-, medium- and long-term results of RRI that revolves around the question how the scientific, economic, societal and demo-

2 The Joining Efforts for RRI project (JERRI) aimed at fostering RRI transition in Europe by developing and testing good RRI practices in pilot cases, for a further upscaling among the RTOs in the EU28 (<https://cordis.europa.eu/project/id/709747>)

3 RRI-Practice project brought together a unique group of international experts in RRI to understand the barriers and drivers to the successful implementation of RRI both in European and global contexts (<https://cordis.europa.eu/project/id/709637>)

4 The Resagora project (Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-normative Approach) developed a normative and comprehensive governance framework for Responsible Research and Innovation (RRI) (<https://cordis.europa.eu/project/id/321427>).

5 The RRI Tools project developed a training and dissemination toolkit on RRI (<https://cordis.europa.eu/project/id/612393>).

6 Fostering a Transition towards Responsible Research and Innovation Systems (FOTRRIS) developed new governance practices to foster RRI policies and methods in research and innovation systems (<https://cordis.europa.eu/project/id/665906>).

7 The expert group was chaired by Roger Strand, professor at the Centre for the Study of the Sciences and the Humanities and the CCBIO, University of Bergen.

8 The final reports can be found here: <https://super-morri.eu/morri-2014-2018/>

9 Blog post, page 9, https://www.fteval.at/content/home/news/ag_impact_results/AG-Impact_G2-Sci-Soc_Blogpost.pdf

cratic outputs, outcomes and impacts of RRI can be defined and empirically collected at the project level. The work presented in this paper can be understood as a bottom-up based response to the top-down decision of the EC to use the MoRRI indicators as an element for project applications.

CO-CREATION IN INNOVATIVE SPACES FOR SOCIAL EXPERIMENTATION

The monitoring and evaluation template, which is presented in further detail in the following sections, is the result of a two-year bottom-up co-creation process between international R&I stakeholders from academia, education and business. It took place within a novel social experimentation format in the context of the Horizon 2020 project NewHorizon (“Excellence in science and innovation for Europe by adopting the concept of Responsible Research and Innovation”, 2017-2021)¹⁰. This project aimed to promote the integration of RRI into European, national and local R&I practice and EU funding. Methodologically, it was built around 19 social labs – “platforms for addressing complex societal challenges” (Hassan, 2014, p. 3) – each of which is dedicated to a different section of Horizon 2020, the past European Framework Programme for Research and Innovation.

The template originated from a so-called *pilot action*¹¹ under the umbrella of the social lab dedicated to the SwafS programme line. According to the understanding developed in the NewHorizon context, such pilot actions can be understood as activities that are jointly implemented by a group of stakeholders in form of social experiments that aim to tackle a specific societal challenge by systematically integrating aspects of RRI. They emerge fully bottom-up by the initiative of stakeholders interested in or affected by the identified challenges and aim at practical implementation, thus perfectly responding to the recognized deficiency and impracticability of the original set of MoRRI indicators. The specific value of this activity is thus, inter alia, that it is tailored to the aforementioned need for Horizon 2020 projects to develop their impact sections along the MoRRI indicator framework.

PROCESS, STRUCTURE AND PURPOSE OF THE TEMPLATE

From a practical point of view, the template emerged from three (physical, pre-Corona) working meetings between 12 committed R&I stakeholders who built a pilot action in order to discuss the template's overarching structure, suitable categorizations and formulation of individual indicators in an ongoing process of reflection and refinement of its objectives, practicability and overall utility. This work was done against the background of the pilot group's individual needs, experiences, and expertise. The comprehensive consideration of the interests and needs

of the pilot action members was ensured by appropriate moderation and the noteworthy group diversity in terms of disciplinary background, country of origin, age, gender, and expertise in one of the RRI keys. In fact, great stakeholder diversity is considered a key pillar of the social lab methodology and a means to ensure divergence in perspectives to stimulate creative and critical thinking (Blok, 2019) in light of the defined task's complexity and significance. In this sense, the debate in the pilot work was strongly shaped by questions around the long-term materialization of impacts (Wittmann et al., 2021), or the non-linear, context-sensitive and emergent nature of impact pathways, to name only a few methodological, conceptual or practical challenges of impact assessment.

This process resulted in the development of a multi-page template that is divided into five major sections: The first two sections cover a set of questions and criteria that are related to the project's nature and the consideration of RRI dimensions in the project's design, tailored to each of the five RRI dimensions. Figure 1 presents an exemplary overview of the statements that ask for the systematic consideration or integration of aspects tailored to the RRI key “Public Engagement / Citizen Science”.

The last three sections of the template (see Figure 2) capture the three main dimensions for impact fields, i.e., 1) scientific, 2) economic and 3) societal and/or democratic impacts of RRI. Each of these are presented in a matrix that lists the respective indicators (vertically) along a 4-point scale (horizontally). In alignment with the template's fundamental aim to better account for temporality and the multidimensionality of the effects of RRI, the indicators are subdivided into short-, medium- and longer-term impacts. The final indicator list is comprised of a modified set of existing MoRRI indicators and to a large extent of new indicators developed by the pilot group (for more details see Bühner et al., 2021). Figure 2 provides an overview of the indicators for the democratic / societal effects of RRI.

As regards the core purpose of the template, it aims to show and communicate the benefits and impacts of RRI in a systematic manner to academic and non-academic audiences by equipping them with a practical, multi-purpose template that can inspire and navigate them throughout the entire lifecycle of an RRI project. More concretely, potential users of and target groups for the template are researchers and practitioners interested in measuring their project impacts with the help of indicators that are inspired by the MoRRI indicators, but which go beyond and are jointly developed by a group of interested stakeholders, and thus more user-friendly. Its usage goes beyond monitoring and evaluating purposes at the end of a project since the lists of indicators and descriptors can provide project managers with guidance and inspiration in the early design or implementation phase of a project.¹²

10 <https://newhorizon.eu/social-labs/>

11 Requirements for pilot actions in the context of Social Labs of the NewHorizon project were that their objectives can be realistically achieved in terms of available time, money and capacities, that they are linked to the interests of the stakeholders engaged in the pilot action and that it has the potential to be of interest for other stakeholders beyond the own pilot action as well.

12 More information on the Pilot Action and the template can be found here: <https://newhorizon.eu/social-lab-15-pilot-action-1/>

Figure 1: The role of RRI in the project with the RRI key example Public Engagement

II. The role of RRI				
Are the following aspects systematically taken into account in your project? (Answer categories: Yes / No / don't know)				
		Yes	No	I don't know
Public Engagement / Citizen Science	<input type="checkbox"/> I inform non-academics about my results through e.g. public lectures, writing popular science books, publishing articles in newspapers / magazines, blogs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> I involve citizens in the following phase(s) of my research by:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> definition of content and aims	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> conducting the research (data collection, data analysis)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> discussing the consequences of research and / or its application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> Communicating and disseminating the results of the project	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> Commercialisation / Exploitation of results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> I actively consider how my research and innovation results will be perceived and used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/> I work with people who specialise in dialogue with citizens and civil society (e.g. professional mediator, communication company, science museums)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Does your research and innovation process foresee a systematic inclusion of stakeholder groups outside academia?	<input type="checkbox"/> Yes, an active involvement of previously marginalised or disenfranchised actors is foreseen <input type="checkbox"/> If so, which groups are involved? (please specify) _____			
	<input type="checkbox"/> Yes, the introduction of previously excluded perspectives and knowledge sources into R&I is foreseen: <input type="checkbox"/> If so, what are the concrete instruments to do so? (please specify) _____			

Figure 2: Template for democratic / societal benefits of RRI

V. Societal and democratic impacts / benefits of RRI					
Do / Did you expect or observe any of the impacts benefits listed below when practicing RRI?					
		I expect a respective impact / benefit	I do not expect such kind of an impact / benefit	I have already observed such an impact / benefit	I don't know / not applicable
Short-term outputs	Increased researchers' awareness of potential negative effects on citizens (precautionary principle)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Broaden problem framing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Increase science capital by increasing skills and knowledge among citizens and communities (regardless of your legal status)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Evidence on the positive effects of science education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Increased awareness of unconscious / personal biases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Outreach to disadvantaged groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Midterm outcomes	Increased researchers' awareness of potential negative effects on citizens (precautionary principle)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Broaden problem framing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Increase science capital by increasing skills and knowledge among citizens and communities (regardless of your legal status)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Evidence on the positive effects of science education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Increased awareness of unconscious / personal biases	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Long-term impacts	Enhancement of Knowledge through access to knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Behavioural change among citizens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Improved scientific citizenship and trust in science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Improved education system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	More inclusive societies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	More equitable societies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CONCLUSION

The previous sections have shown that within the framework of a social lab, it is possible to further develop existing evaluation and monitoring systems in a way such that they reflect the needs of the users well or at least better. The starting point for our work was the finding that the requirements for applicants to Horizon 2020 projects to use MoRRI indicators was impractical for a number of reasons. Together with project representatives¹³ from a wide range of fields and with a variety of scientific and institutional backgrounds, we succeeded in further developing the existing indicators and increasing their practicability. In doing so, we contributed to the recognized challenge of impact monitoring for projects working with RRI by developing a theoretically sound and practical, multi-purpose template that can pay attention to the so far hardly considered outputs, outcomes and impacts of a certain RRI project.

We are aware that our attempts to develop an easy-to-use template to capture and measure impacts is not without limitations. We recognize that this may lead to an oversimplification of processes that are much more complex, non-linear and dynamic in nature. For example, it should be noted that we still followed an ideal intervention logic. This means that we differentiate between short-, medium- and long-term results, even if it is well known that such kind of linear models do not sufficiently reflect the complexity and feedback loops of R&I activities. However, this is still the common way to operate in R&I program monitoring and evaluation activities, as can be seen in the EU Key Impact Pathways-approach as well. Another challenge that we have certainly not yet fully addressed is the vagueness of the concept of societal impacts. Here, several authors have demonstrated that there is still no consensus on what exactly is meant by this impact type (Reale et al., 2015; Bornmann, 2013; Smit and Hessels, 2021; Williams, 2020; Sivertsen and Meijer, 2020; Muhonen et al., 2020).

Furthermore, it needs to be stated that our indicators and descriptors only depict positive effects. Although the proposed indicators can always be interpreted in two directions – as the presence or absence of a benefit – the entire concept of the template is designed to show a positive contribution of science to society. This follows a policy agenda that, if one recognizes the importance of improved science and society relations in general and specific RRI activities in particular, uses such data collection specifically to demonstrate the contribution of science to generate public value and to advance RRI. This is, therefore, a normative and less “objective” approach to measuring impact.

Finally, one needs to be wary of the danger that such a template and resulting indicators can also foreclose learning and lead to unwanted bureaucracy.

However, for the ease of use and to ensure connectivity with other monitoring and evaluation systems (in particular, the Key Impact Pathways used for Horizon Europe), we believe that this approach is justified and provides new avenues for future work and the further refinement of the template. Finally, although we learned that it is rather difficult and complex to work on this topic, it is worthwhile to do it because many researchers in EU funded projects need to make at least some use of indicators to show the benefits and impacts of RRI.

A key lesson that we can draw from the work on developing an evaluation system for RRI in the context of a social lab is, in short, that despite all the effort and weaknesses, the approach is worthwhile. The participatory approach complements an expert-based top-down exercise typically used by the EC, but also by many national funders, in developing evaluation systems. In concrete terms, this means that the research funder invites a selection of high-level experts to develop a scientifically sophisticated evaluation system, but its implementation is then top-down, without adequately reflecting the realities and needs of the users of this system. As we know from current discussions about the requirements for evaluating transformative policy approaches, and as such we can in principle also understand RRI, a more intensive stakeholder involvement in all the evaluation phases including the design phase is needed (Molas-Gallart et al., 2020). The above presented results show what this could look like in practice, acknowledging that only the (generous) project funding from Horizon 2020 allowed us to start such an intense collaboration and co-creation process.

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