

N NEW HORIZON

Measuring the Impact of RRI

Lessons learned from Pilot Action 1 of the Social Lab Nr. 15 SwafS

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1. Introduction

This report describes the activities and final results of one of the Pilot Actions implemented in the course of the Social Lab (SL) No. 15 on SWAFS, the H2020 programme line to bring science and society closer together (Science with and for Society). The Pilot Action 1 on "Measuring the impact of RRI" was developed to address an urgent need, namely the formal requirement of the H2020 projects to apply the MoRRI indicators. MoRRI stands for a study commissioned by the EC services to develop a monitoring system for RRI that is furthermore suitable to identify benefits associated with the implementation of RRI practices (MoRRI = Monitoring the evolution and benefits of RRI).

The topic of impact is high on the agenda of national and European research policy. Research funders, as well as research organizations and individual researchers, are increasingly asking themselves what contribution science can or should make to politics, society, culture and the economy. This is often discussed under the heading of the "new social contract of science," and this session intends to address the specific question whether an approach such as RRI, which specifically aims to improve the links between science and society, generates different kinds of impact or in other ways than pure curiosity-driven and peer-centered science does.

This report is structured as follows: Chapter 2 describes the context and motivation for the Pilot Action 1 and gives an overview on what the Pilot Action is concretely about. Afterwards we present the methodological approach, consisting mainly in a combination of preparatory desk research and work, face-to-face-meetings during three official SL15 events plus one further meeting in Berlin and mutual email based exchange. Chapter 4 presents the results in form of several lists of indicators developed by the PA1 team, as well as a template that shall support H2020 project leader and participants to (self)assess their past or current research and innovations activities. Chapter 5 formulates an outlook to further research and embeds the PA1 activities and results into broader debates about the impact of science.

Pilot Action 1 brought together academics and practitioners from various countries and organisations, namely: Fabio Feudo (Knowledge and Innovation, Rome, Italy), Luisa Barbosa Gomez (Universitat Pompeu Fabra, Barcelona, Spain), Andre Brasil (Leiden University), Marianne Kinnula (University of Oulu, Finland), Stefan Reichmann (Graz University of Technology, Graz, Austria), Meie van Laar (NEMO Science Museum Amsterdam, the Netherlands), Mara Balestrini (Ideas for Change, Barcelona, Spain), Shauna Stack (IHS, Vienna, Austria), Rosa Arias (partly, Fundación Ibercivis, Barcelona, Spain), Simone Rufenacht / Dorte Riemenschneider (European citizen science associations, Berlin, Germany) and finally the SL managers Susanne Bühler & Merve Yorulmaz (Fraunhofer ISI, Karlsruhe, Germany).

2. Context and motivation of the Pilot Action 1

The starting point of Pilot Action 1 was the observation that new knowledge, insights and practices resulting from many amazing RRI projects are not used beyond the project lifetime: without attention devoted to communication, exchange and monitoring, these projects' outcomes, impacts and valuable lessons learned remain unseen. We also noticed a chronic lack of monitoring and measurement of RRI project impacts, which, by nature, often extend over the end of the project's lifetime (and funding). If we want RRI to move beyond abstract discussions, working on the indicator-based monitoring of possible impacts at the project level presents a good and necessary step forward.

We set out to solve the challenge of impact monitoring for projects working with RRI by developing a template that could pay attention to the output, outcome and impact of a certain RRI project. Concretely, we wanted to achieve this by adapting the indicators of an earlier project (MoRRI) for the project level to focus on scientific impacts, economic impacts and societal respectively impacts. Together with different stakeholder and on the basis of their own field- and discipline-specific experiences and expertise, we worked on the development of a

template design. We did have to recognize that this may lead to an oversimplification of processes that are much more complex, non-linear and dynamic in nature. One needs to be wary of the danger that such a template and resulting indicators can also foreclose learning and lead to unwanted bureaucracy. Although we learned that it is rather difficult and complex to work on this topic, it is worthwhile to do it because many project coordinators need to make at least some use of (MoRRI) indicators to show the benefits and impacts of their projects.

The starting point for the indicators of the MoRRI project (see Peter et al. 2018) 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 as a result of 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 following benefits indicators have been developed by the MoRRI project (Peter et al. 2018, page 38; for further MoRRI indicators see also Annex):

- Scientific Benefits: 1) New Insights, 2) Access to previously unavailable data, 3) New skills and training activities for researchers, 4) Enlarging the pool of researchers, 5) Change of scientific culture, 6) better performance, 7) Making science known and increasing trust
- Economic Benefits: 1) Better solutions due to inclusiveness, 2) Increasing trust, 3) Increasing anticipatory skills, 4) better performance, 5) More cost-efficient data collection, 6) Changes in training, skills and culture of science, 7) New business and funding opportunities
- Societal Benefits: 1) Better alignment of research with societal needs, 2) Promotion of social justice, gender equality, solidarity, fundamental rights, 3) Society learns from science.
- Democratic Benefits: 1) empowerment of citizens, 2) better informed decision-making

This Pilot Action 1 is an example of contributing to the formalization of RRI by developing indicators for projects to measure scientific, economic and societal benefits of their output, outcomes and impacts. With the right attention to learning instead of rigidity, this may help to translate to people outside of the RRI bubble the relevance of certain RRI-oriented projects in a language that they feel comfortable with.

The results of this Pilot Action have been anchored into further ongoing discussion within the SuperMoRRI project.

The pilot actions addresses the need to measure the impacts of RRI at project level and share the findings with non-academic and academic audiences. For that purpose the pilot action attempted to create an easy-to-use template that can support a wide range of stakeholders in their evaluation of RRI activities. For this purpose, the pilot action also promoted the connection and exchange between ongoing SwafS projects and existing RRI knowledge hubs, such as NewHoRRizon or [SUPER MoRRI](#) to create closer links as well as cross-project learning and synergies.

The specific value of this PA is that it addresses very practically the need for H2020 projects to develop their impact along the MORRI indicator framework. The PA contributes to the development and emergence of good practice examples with the help of participating stakeholders who enrich the PA work and template design with their own field- and discipline-specific experiences and expertise. Working with their illustrative, contextualized practical examples and insights from their work is a meaningful way to deconstruct and concretize RRI impacts. The PA work is designed in a way that promotes cross-project synergies between SwafS projects which have been working in the past years to conceptually enrich the knowledge base. The results of this PA feed into the ongoing discussion of the SUPER MoRRI project.

Target groups of this PA are researchers, practitioners and particularly those stakeholders who are familiar with RRI, are involved in SwafS projects and who are interested in promoting cross-project synergies and measuring their project impacts with the help of MoRRI indicators.

3. (Methodological) Approach

After two very insightful meetings of the pilot group at the social lab workshops in Berlin (November 2018) and Ljubljana (April 2019), the pilot action 1 team came together for a working meeting in the Fraunhofer FORUM in Berlin. It brought together researchers, entrepreneurs and experts in the field of science education, technology, innovation and RRI who jointly worked on the creation of an easy-to-use template to share and widely communicate the benefits and impacts of RRI to academic and non-academic audiences.

By taking the existing set of RRI indicators from MORRI as starting point of the group work, we aimed at promoting exchange between existing RRI knowledge hubs and addressed the need for best practice examples in adopting and reutilizing past project results. Participants engaged in an intensive discussion on the common problem of reutilizing project results beyond the (fully financed) project scope and the resulting lack of benchmarks and impact measurements.

Another very vivid discussion revolved around the complexities of measuring impact that are related to the non-linear, context-sensitive and emergent nature of impact pathways. With a closing discussion on observable differences between progressive practices and lagging policies, participants created a common base of knowledge and understanding of the major problems, hurdles and experiences prevailing in the scientific community.

This set the ground for a fruitful teamwork on the MORRI indicators in which three groups elaborated on potential short-, mid- and long-term effects of RRI on science, economy and society that occur at project-level. The three groups presented their results by contextualizing the indicators in their respective environment and explaining the motives and thoughts that guided them in revising and reformulating the indicator descriptions. Reflecting on the group results in view of RRI as a concept that permeates sectorial and thematic borders, it became clear how smaller positive effects of RRI have the potential to aggregate to larger, interdependent and mutually reinforcing impacts across sectors and areas. In alignment with ongoing work on indicators to measure and monitor the impact of RRI in the SUPER MoRRI project, the successor of the MORRI project, further adjustments to the template are planned

The first version of the template was created in an interactive, discourse-oriented meeting in July 2019 in Berlin, during which small groups further developed pre-existing MoRRI indicators of economic, societal, democratic and scientific benefits (now further generalized to impacts) of RRI. The pilot action group is currently working on a refined version of the indicators as a basis for future use and stronger exchange across projects.

Target groups of this pilot action and potential users of the template are researchers, practitioners and particularly those stakeholders who are familiar with RRI, are involved in SwafS projects and who are interested in promoting cross-project synergies and measuring their project impacts with the help of [MoRRI indicators](#).

The specific value of this pilot actions is that it addresses very practically the need for H2020 projects to develop their impact along the MoRRI indicator framework. The pilot action contributes to the development and emergence of good practice examples with the help of participating stakeholders who enrich the pilot action work and template design with their own field- and discipline-specific experiences and expertise. Working with their illustrative, contextualized practical examples and insights from their work is a meaningful way to deconstruct and concretize RRI impacts. The pilot action work is designed in a way that promotes cross-project synergies between SwafS projects which have been working in the past years to conceptually enrich the knowledge base. Beyond ensuring a closer exchange and alignment of past and present work on (impacts of) RRI, this work uncovers the observed need

for a more nuanced and systematic approach on identifying and assessing the benefits and impacts of RRI (on project level). With an increased awareness for these needs and utilities, this pilot can also set the basis for the deepening of the work in future practical contexts

The results of this pilot action will feed into the ongoing discussion of the SUPER MoRRI project.

4. Results

As a result of the group work during the three workshop, the Pilot Action 1 developed three tables with indicators, addressing the distinction between scientific, economic and societal / democratic impacts. All tables differentiate between short-term outputs, midterm outcomes and longer term impacts and used the MoRRI indicators mentioned above as a starting point.

Based on this group work, the Social Lab managers drafted a survey instrument that operationalizes the abstract indicators using a set of yes/no-questions. This instrument offers suggestions how to measure the scientific, economic and societal output, outcome and impact of RRI projects. Although we learned that it is rather difficult and complex to work on this topic, it was worthwhile to do it because many project coordinators need to make at least some use of indicators to show the impact and benefit of their RRI project.

The survey template was re-circulated within the PA team. Based on the feedback from the PA members, the final draft version can be found below and is now ready for tests and further application.

PILOT ACTION 1: The Impact or RRI Template

<i>I. Your project</i>	
Is your project primarily:	<ul style="list-style-type: none"> ⊗ <input type="checkbox"/> Curiosity-driven ⊗ <input type="checkbox"/> Challenge-driven
Which community is the main recipient / user of your project results?	<ul style="list-style-type: none"> ⊗ Research Community ⊗ Non-Academics <ul style="list-style-type: none"> <input type="checkbox"/> From Industry <input type="checkbox"/> From Government <input type="checkbox"/> From Society ⊗ Others (please specify):

<i>II. The role of RRI</i>	
Are the following aspects systematically taken into account in your project? (Answer categories: Yes / No / don't know)	
Gender Equality	(if so, please specify): <ul style="list-style-type: none"> ⊗ I encourage gender-balanced teams in my work environment ⊗ I actively support female colleagues in their career development ⊗ I consider gender aspects in my research design ⊗ Other (please specify) _____

Ethics	<ul style="list-style-type: none"> ⊖ I submit my projects to ethical reviews ⊖ I conduct ethical reviews of projects ⊖ I consider ethical issues when designing my research ⊖ I contribute to training on ethical issues ⊖ Other (please specify): _____
Open Access	<ul style="list-style-type: none"> ⊖ I use open access publications ⊖ I publish open access ⊖ I use publicly available data ⊖ I provide publicly available data ⊖ I implement research data management plans ⊖ Other (please specify): _____
Science Education	<ul style="list-style-type: none"> ⊖ I work with school pupils (e.g. open days, joint projects) ⊖ I develop science education material (e.g. kits, websites, explanatory booklets, DVDs) ⊖ I work in partnership with schools and/or teachers ⊖ Other (please specify): _____
Public Engagement / Citizen Science	<ul style="list-style-type: none"> ⊖ I inform non-academics about my results through e.g. public lectures, writing popular science books, publishing articles in newspapers / magazines, blogs ⊖ I involve citizens in the following phase(s) of my research by: <ul style="list-style-type: none"> <input type="checkbox"/> definition of content and aims <input type="checkbox"/> conducting the research (data collection, data analysis) <input type="checkbox"/> discussing the consequences of research and / or its application <input type="checkbox"/> Communicating and disseminating the results of the project <input type="checkbox"/> Commercialisation / Exploitation of results ⊖ I actively consider how my research and innovation results will be perceived and used ⊖ I work with people who specialise in dialogue with citizens and civil society (e.g. professional mediator, communication company, science museums)
Does your research and innovation process foresee a systematic inclusion of stakeholder groups outside academia?	<ul style="list-style-type: none"> ⊖ Yes, an active involvement of previously marginalised or disenfranchised actors is foreseen <ul style="list-style-type: none"> <input type="checkbox"/> If so, which groups are involved? (please specify) _____ ⊖ Yes, the introduction of previously excluded perspectives and knowledge sources into R&I is foreseen: <ul style="list-style-type: none"> <input type="checkbox"/> If so, what are the concrete instruments to do so? (please specify) _____

In the following, we would like to ask you to assess the possible effects when practising RRI. We differentiate between scientific, economic and societal / democratic impacts on the one hand and short-, medium- and long-term impacts on the other hand. The latter are defined as follows:

- Short-term outputs = Tangible results stemming from a project activity during the project, from 6 months onwards):
- Midterm outcomes = During and directly after the project
- Long-term impacts = Broader effects beyond the beneficiaries (intended and unintended, positive and negative

III. Scientific 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	Increasing the evidential value of data by making data FAIR (Findable, Accessible, Interoperable, Reusable)	☺	☺	☺	☺
	Broaden problem framing	☺	☺	☺	☺
	Increased collaboration with other sectors (industry, public sector, civil society...)	☺	☺	☺	☺
	Increased international collaboration	☺	☺	☺	☺
Midterm outcomes	Enhancement of Knowledge through access to knowledge	☺	☺	☺	☺
	Increased reproducibility (relates back to enhancing knowledge),	☺	☺	☺	☺
	increased cooperation and interdisciplinarity through openness	☺	☺	☺	☺
	increased transdisciplinarity	☺	☺	☺	☺
Long-term impacts	Diversifying the pool of researchers (this will impact the diversity of knowledge)	☺	☺	☺	☺
	Weakening pseudoscience	☺	☺	☺	☺
	Change of scientific culture, change in institutional framework of science, change of	☺	☺	☺	☺

cts	infrastructure and practices				
	Increase the possibility of the scientific community to influence society's opinion and decision-making processes.	≈	≈	≈	≈
	Decrease in scientific misconduct	≈	≈	≈	≈

IV . Economic 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 chances of leveraging multiple perspectives from onset of project	≤	≤	≤	≤
	Relationship building between previously siloed sectors	≤	≤	≤	≤
	Exposure to new challenges with support from relevant societal actors	≤	≤	≤	≤
	Finding, testing and contrasting alternative ways of data collection that are more cost-efficient	≤	≤	≤	≤
	New promotional, reward, scholarship and grant giving processes that incorporate RRI principles into the evaluation and assessment process	≤	≤	≤	≤
	Proactive outreach and engagement activities with previously siloed actors in society	≤	≤	≤	≤
Mid-term outcomes	Synergies and superior performance through exploitation of best talent/human capital available	≤	≤	≤	≤
	Enhanced process transparency and cross-sectoral sensitization through well-established networks, intense knowledge exchange and shared agendas	≤	≤	≤	≤
	Alignment of normative standpoint on impact goals and mitigation of negative impacts	≤	≤	≤	≤
	Development and increased usage of more intelligent	≤	≤	≤	≤

	methods and instruments of data collection				
	Market rewards will favor institutions with leadership that promotes ethical and responsible relationship between science, society, and economy	≤	≤	≤	≤
	New business models and markets that reflect / align societal needs with economic possibilities/modalities.	≤	≤	≤	≤
Long-term impacts	Inclusiveness leads to superior solutions, products and services, which challenge the status quo and set new market standards. Science and economy form a mutually reinforcing network	≤	≤	≤	≤
	Shift towards an understanding of economy as an open and responsive system that acts as a catalyst for science and for societal wellbeing	≤	≤	≤	≤
	Alignment of economic incentives towards resolving tensions between actors rather than vice versa	≤	≤	≤	≤
	Traditional data collection methods are surpassed by more sustainable and cost-efficient methods	≤	≤	≤	≤
	Understanding of science and economy as mutually responsive, anticipative and intertwined systems for learning and development built around the principles of RRI	≤	≤	≤	≤
	Economy as an instrument to tackle grand societal challenges and development of sustainable mindset towards labor/resources	≤	≤	≤	≤

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)	≤	≤	≤	≤
	Broaden problem framing	≤	≤	≤	≤
	Increase science capital by increasing skills and knowledge among citizens and communities (regardless of your legal status)	≤	≤	≤	≤
	Evidence on the positive effects of science education	≤	≤	≤	≤
	Increased awareness of unconscious / personal biases	≤	≤	≤	≤
	Outreach to disadvantaged groups	≤	≤	≤	≤
Mid-term outcomes	Increased researchers' awareness of potential negative effects on citizens (precautionary principle)	≤	≤	≤	≤
	Broaden problem framing	≤	≤	≤	≤
	Increase science capital by increasing skills and knowledge among citizens and communities (regardless of your legal status)	≤	≤	≤	≤
	Evidence on the positive effects of science education	≤	≤	≤	≤
	Increased awareness of unconscious / personal biases	≤	≤	≤	≤
Long-term	Enhancement of Knowledge through access to knowledge	≤	≤	≤	≤
	Behavioural change among citizens	≤	≤	≤	≤

im pa cts	Improved scientific citizenship and trust in science	≈	≈	≈	≈
	Improved education system	≈	≈	≈	≈
	More inclusive societies	≈	≈	≈	≈
	More equitable societies	≈	≈	≈	≈

Group 1: Scientific impacts / benefits

Old version/	Short-term outputs <i>(Tangible results stemming from a project activity during the project, from 6 months onwards)</i>	Midterm outcomes <i>(During and directly after the project)</i>	Longterm impacts <i>(Broader effects beyond the beneficiaries (intended and unintended, positive and negative))</i>	
Access to previously unavailable data	Increasing the evidential value of data by making data FAIR (Findable, Accessible, Interoperable, Reusable)			
New Insights	Broaden problem framing		Enhancement of Knowledge through access to knowledge	
New skills and training activities for researchers	Increase collaboration -International -With other sectors (industry, public sector, civil society...) which could mobilise funds		No, this is a requirement for RRI having an impact, so it cannot strictly speaking be an impact of RRI (?)	
Enlarging the pool of researchers			Diversifying the pool of researchers (this will impact the diversity of knowledge) -> Problem: cumulative advantage	Weakening pseudoscience
Change of scientific culture			Change of scientific culture, change in institutional framework of science, change of infrastructure and practices; RISKS: might lead to new inequalities, might lead to "winner's reluctance"	Increase the possibility of the scientific community to influence society's opinion and decision-making processes.
Better performance			Increased reproducibility (relates back to enhancing knowledge), increased cooperation and interdisciplinarity through openness	

Foster accountability and increasing trust			Decrease in scientific misconduct
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Group 2: Economic impacts / benefits

Old version/ MoRRI basis	Short-term outputs <i>(Tangible results stemming from a project activity during the project, from 6 months onwards)</i>	Midterm outcomes <i>(During and directly after the project)</i>	Longterm impacts <i>(Broader effects beyond the beneficiaries (intended and unintended, positive and negative))</i>
Better solutions due to inclusiveness	Increased chances of leveraging multiple perspectives from onset of project	Synergies and superior performance through exploitation of best talent/human capital available	Inclusiveness leads to superior solutions, products and services, which challenge the status quo and set new market standards. Science and economy form a mutually reinforcing network
Increasing trust	Relationship building between previously siloed sectors	Enhanced process transparency and cross-sectoral sensitization through well-established networks, intense knowledge exchange and shared agendas	Shift towards an understanding of economy as an open and responsive system that acts as a catalyst for science and for societal wellbeing
Increasing anticipatory skills	Exposure to new challenges with support from relevant societal actors	Alignment of normative standpoint on impact goals and mitigation of negative impacts	Alignment of economic incentives towards resolving tensions between actors rather than vice versa
Better performance	<i>tbd</i>	<i>tbd</i>	<i>tbd</i>
More cost-efficient data collection	Finding, testing and contrasting alternative ways of data collection that are more cost-efficient	Development and increased usage of more intelligent methods and instruments of data collection	Traditional data collection methods are surpassed by more sustainable and cost-efficient methods
Changes in training, skills and culture of science	New promotional, reward, scholarship and grant giving processes that incorporate RRI principles into the evaluation and assessment process	Market rewards will favor institutions with leadership that promotes ethical and responsible relationship between science, society, and economy	Understanding of science and economy as mutually responsive, anticipative and intertwined systems for learning and development built around the principles of RRI

New business and funding opportunities	Proactive outreach and engagement activities with previously siloed actors in society	New business models and markets that reflect / align societal needs with economic possibilities/modalities.	Economy as an instrument to tackle grand societal challenges and development of sustainable mindset towards labor/resources
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Group 3: Societal & democratic impacts / benefits*

Short-term outputs (<i>Tangible results stemming from a project activity during the project, from 6 months onwards</i>)	Midterm outcomes (<i>During and directly after the project</i>)	Longterm impacts (<i>Broader effects beyond the beneficiaries (intended and unintended, positive and negative)</i>)
Example: Pilot Action 1 (our own activity)		
Output: list of indicators + template + questionnaire answering open questions	Transparency and collection of benefits among a variety of impacts	Output: list of indicators + template + questionnaire answering open questions
Further indicators		
Researchers' awareness of potential negative effects on citizens (precautionary principle)	Open knowledgeexchange	Behaviouralchangeamongcitizens
Increase science capital by increasing skills and knowledge among citizens and communities (regardless of your legal status)	Increased scientific literacy and interest in science	Improved scientific citizenship and trust in science
Evidence on the positive effects of science education	Inclusion of STEM topics in curricula	Improvededucationsystem
Increased awareness of unconscious / personal biases	Changed personal routines	More inclusive societies
Outreachtodisadvantagedgroups	Inclusion of disadvantagedgroups	More equitable societies

* The Working Group dealing with the democratic and societal benefits used the original MoRRI indicators as starting point as well but came to the conclusion that it is worthwhile to develop own indicators based on the concrete project that the team member had in mind.

5. Outlook

The challenge to develop RRI-related benefit and / or impact indicators is of growing interest among scholars and practitioners. Actually, there are several attempts to measure the impacts of RRI / de-facto RRI: The EU project RI-Paths, for example, has compiled various indicators to measure "societal impacts" of research infrastructures. These indicators show several references to the RRI concept as developed by the European Commission, focusing on different so-called RRI keys. Specifically, the RI pathway indicators mention the aspects of open access, public engagement, science communication and gender equality (Helman et al. 2020, page 16).

The EU Expert Group on Monitoring the EU Framework Programs (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 important for legitimacy, accountability and transparency of research and innovation. Further reflections on the impact assessment of research projects that aim to involve society are delivered by an Austrian working group. Their starting point is to define the goals of participation first and then deduct suitable indicators afterwards. The results are as follows (fteval Working Group on Impact Assessment, Blog Post, page 2): "Promote public understanding of science and science literacy; Increase the legitimacy of RTI policy interventions and support the co-ownership of society in science and research; Increase the relevance, responsiveness and inclusiveness of science and research, ensuring that its outcomes align with the needs, values and expectations of society; Improve transparency and society's trust in science and research".

While MoRRI indicators have largely followed the logic of the (six) RRI keys¹, the possibility of applying the four RRI principles developed in the academic literature "anticipation, reflexivity, inclusion and responsiveness" (Stilgoe et al. 2013) for the development of impact indicators has not yet been fully explored, but seems to be promising from a process perspective: while impacts as a result are often hard to grasp and, above all, an imputability of a (funding) impulse to a later event is hardly feasible in complex and dynamic systems, factors that can be reasonably assumed to contribute to the emergence of impacts can often be empirically collected relatively easily. This brings us to the concept of productive interactions (Spaapen & van Drooge 2011), impact pathways or theory-based impact evaluations (TBIE), which also take or support exactly such perspectives. A first approach in this direction was provided by the MoRRI final report (Peter et al. 2018, page 46): With reference to the concept of productive interactions and impact pathways, the following was stated: "Impact pathways are more likely to lead to societal-level benefits when the number and diversity of stakeholders that are committed to such efforts, including researchers, is relatively high". We thus suggest to follow this approach in near future.

6. References

European Commission (2018): Monitoring the Impact of EU Framework Programmes. Expert Report. Written by Peter van den Besselaar, Ramon Flecha, Alfred Radauer

fteval Working Group on Impact Assessment. Impact of RTI-Policy on the relationship between science and society. Blog Post (v 1.22, 8/2/2021)

¹ The six RRI keys are Open Access, Gender Equality, Public Engagement, Science Education, Ethics and Governance.

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Stilgoe, Jack; Owen, Richard; Macnaghten, Phil (2013): Developing a framework for responsible innovation. Research Policy 42 (2013) 1568– 1580

ANNEX: MoRRI Indicators

MoRRI Indicators used at country level and for the final report - mainly process / input Indicators (MoRRI Final Report: European Commission (editor) (2018): Monitoring the evolution and benefits of responsible research and innovation in Europe – Summarising insights from the MoRRI project. Authors: Peter, Viola; Meier, Frederic; Mejgaard, Niels; Bloch, Carter; Madsen, Emil B.; Griessler, Erich; Wuteklich, Milena; Meijer, Ingeborg; Woolley, Richard; Lindner, Ralf; Bühner, Susanne; Jäger, Angela; Tsipouri, Lena; Stilgoe, Jack Brussels)

Gender	Scientific education	Open Access	Public engagement	Ethics	Governance
Share of research-performing organisations with gender equality plans (GE1)	Importance of societal aspects of science in science curricula for 15 to 18-year-old students (SLSE1)	Open access literature (Share of open access publications, Citation scores for OA publications) (OA1)	Models of public involvement in science and technology decision-making (PE1)	Ethics at the level of research-performing organisations (composite indicator) (E1)	Use of science in policymaking (GOV1)
Share of female researchers by sector (all sectors, business enterprise sector, government sector, higher education sector) (GE2)	RRI-related training at higher education institutions (SLSE2)	Data publications and citations (OA2)	Policy-oriented engagement with science (PE2)	National ethics committees' index (E2)	RRI-related governance mechanisms within research-funding and performing organisations (GOV2)
Share of research-funding organisations (RFOs) promoting gender content in research (GE3)	Science communication culture (SLSE3)	Social media outreach/take-up of open access literature (Ratio of OA and non-OA publications used on Twitter, Ratio of OA and non-OA publications used on Wikipedia) (OA3)	Citizen preferences for active participation in science and technology decision-making (PE3)	Research-funding organisations' index (composite indicator) (E3)	RRI-related governance mechanisms within research-funding and performing organisations – composite index (GOV3)
Gender	Scientific education	Open Access	Public engagement	Ethics	Governance

Dissimilarity index (higher education sector, government sector) (GE4)	Citizen science activities in research-performing organisations (Organisational memberships in ECSA, Citizen science publications) (SLSE4)	Public perception of open access (OA4)	Active information search about controversial technologies (PE4)		
Share of research-performing organisations (RPOs) with policies to promote gender in research content (GE5)		Funder mandates (OA5)	Public engagement performance mechanisms at the level of research-performing organisations (PE5)		
Glass ceiling index (GE6)		Research-performing organisations' support structures for researchers as regards incentives and barriers for data sharing (OA6)	Dedicated resources for public engagement (PE6)		
Gender wage gap (academic professions, techians and associate professions) (GE7)			Embedment of public engagement activities in the funding structure of key public research-funding agencies (PE7)		

Gender	Scientific education	Open Access	Public engagement	Ethics	Governance
Share of female heads of research-performing organisations (GE8)			Public engagement elements as evaluative criteria in research proposal evaluations (PE8)		
Share of gender-balanced recruitment committees at research-performing organisations (GE9)			Research and innovation democratisation index (PE9)		
Share of female inventors and authors (GE 10)			National infrastructure for involvement of citizens and societal actors in research and innovation (PE10)		

RRI Impacts Matrix: Benefits (green = survey benefits) (MoRRI D9.1 Researchers Survey 2017: Bühner, Susanne; Lindner, Ralf; Berghäuser, Hendrik; Woolley, Richard; Mejlgaard, Niels, Wroblewski, Angela; Meijer, Ingeborg (2017): Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI). Report on the Researchers' Survey (Sub-task 8.1: Collection of data on RRI benefits). Karlsruhe)

No distinction according to the six RRI keys	
Societal	<ul style="list-style-type: none"> • Changed approach to risk • More competencies among locals and citizens • Outreach to disadvantaged groups • Improvement of curricula and enlarged competencies among students • Increasing interest in science
Democratic	<ul style="list-style-type: none"> • Elimination of gender bias in participation in R&D • Inclusion of citizen's knowledge • Reduction of R&I-related conflicts • Empowerment of citizens
Scientific	<ul style="list-style-type: none"> • Emergence of new research topics • Enhanced visibility in the research community • Higher relevance of scientific outputs • Higher quality of scientific outputs • Decrease in scientific misconduct • Mobilising funds
Economic	<ul style="list-style-type: none"> • Stimulation of innovation • Fast diffusion of knowledge • Improved products / services as consumer demands are addressed • Increase in relevant students and labour force • Cost reduction due to improved access to data • Effectiveness of public investment • Increased intrinsic satisfaction with science and engineering positions • Decreased costs of introducing S&T innovation

RRI Impacts Matrix: RRI Benefits based on **yearly monitoring reports** (Source: MoRRI Final Report, p. 38)

Scientific Impacts	Economic Impacts	Societal Impacts	Democratic Impacts
New Insights	Better solutions due to inclusiveness	Better alignment of research with societal needs	Empowerment of citizens
Access to previously unavailable data	Increasing trust	Promotion of social justice, gender equality, solidarity, fundamental rights	Better-informed decision making
New skills and training activities for researchers	Increasing anticipatory skills	Society learns from science	
Enlarging the pool of researchers	Better performance		
Change of scientific culture	More cost-efficient data collection		
Better performance	Changes in training, skills and culture of science		
Making science known and increasing trust	New business and funding opportunities		

* Further important impact categories are political and environmental impacts

RRI Impacts Matrix: Benefits (blue= case study benefits) (MoRRI Final Report 2018: European Commission (editor) (2018): Monitoring the evolution and benefits of responsible research and innovation in Europe – Summarising insights from the MoRRI project. Authors: Peter, Viola; Meier, Frederic; Mejgaard, Niels; Bloch, Carter; Madsen, Emil B.; Griessler, Erich; Wutekich, Milena; Meijer, Ingeborg; Woolley, Richard; Lindner, Ralf; Bühner, Susanne; Jäger, Angela; Tsipouri, Lena; Stilgoe, Jack Brussels)

	Gender	Science education	Open Access	Public engagement	Ethics / Governance
Societal	<ul style="list-style-type: none"> gender equality activities lead to research questions and findings that are better aligned with societal needs gender equality contributes to more equality and social justice 	<ul style="list-style-type: none"> science education contributes to more equality and social justice 		<ul style="list-style-type: none"> public engagement activities lead to research questions and findings that are better aligned with societal needs public engagement activities help society to participate more fully, and to learn from science 	
Democratic		<ul style="list-style-type: none"> Science education activities help better-informed decision-making 		<ul style="list-style-type: none"> empowers citizens by involving them in research that was meaningful to them and engaged them in public debates better decision-making and strengthening the democratic system 	<ul style="list-style-type: none"> positive effects on decision-making by providing reliable and trustworthy information
Scientific	<ul style="list-style-type: none"> addressing gender equality in research frames research questions that take into consideration societal needs and local knowledge leads to new insights and helped to improve research, providing researchers with access to new data shifting science, curricula and the R&I workforce towards more inclusiveness and diversity provides opportunities for previously untapped human resources and can increase the 	<ul style="list-style-type: none"> activities in science education, can increase society's knowledge about and trust in science 		<ul style="list-style-type: none"> Public engagement activities frame research questions that took into consideration societal needs and local knowledge leads to new insights and helps to improve research, providing researchers with access to new data Public engagement helps researchers to acquire new skills and to communicate and work with non-experts in research groups activities in public engagement can increase society's knowledge about and trust in science 	<ul style="list-style-type: none"> activities in ethics can increase society's knowledge about and trust in science

	<p>numbers of students/researchers from different socio-economic backgrounds</p> <ul style="list-style-type: none"> • more diverse research groups perform better than homogenous groups 				
Economic	<ul style="list-style-type: none"> • recognising gender equality leads to better organisation performance 		<ul style="list-style-type: none"> • using open access leads to better organisation performance 	<ul style="list-style-type: none"> • public engagement activities lead to more inclusiveness in research and help to create better solutions • increases trust in business • increases firms' anticipatory capacities and helps them to participate in the shaping of public discourse • public engagement helps to collect data more cost effectively 	<ul style="list-style-type: none"> • addressing issues of research ethics and integrity can help to avoid litigation costs and produce reputational gains

List of RRI Benefits Official NH Overivew (Erich Griessler, 26.11.2017)

The project [Monitoring the Evolution and Benefits of Responsible Research and Innovation \(MoRRI\)](#) looked amongst other things into the benefits of RRI. For that 21 case studies were carried out or revisited that looked for societal, democratic, scientific and economic benefits of RRI. The results have been published in two reports; first, in an extensive report providing detailed information about the case studies ([Deliverable 5.2](#)), second, in a more comparative report ([Deliverable 5.3](#)). For a publication, IHS and Joanneum further synthesized the following benefits. Detailed information can be found in the Deliverables mentioned.

Benefit	Examples of benefits
Democratic benefit	<ul style="list-style-type: none"> • Empowerment of citizens by providing access to knowledge, knowledge production, public debate and input to regulation • Decision-making processes benefit from RRI by informing, enhancing and widening public debate, providing better-informed choices as well as creating governance that safeguards scientific integrity. • Achieving more equality by funding programs that encourage women in research and providing new training methods to students
Scientific benefits	<ul style="list-style-type: none"> • Research leads to new insights because research questions take into account RRI and stakeholders' knowledge • Access to previously unavailable data • Researchers acquire new skills and create new training activities • More diverse researcher groups and greater awareness for RRI issues • Better performance • Strengthening the link to society
Societal benefit	<ul style="list-style-type: none"> • Society learns from science • Research questions and results are better aligned with societal needs • Society participates in science
Economic benefit	<ul style="list-style-type: none"> • Better solutions by involving stakeholders and addressing RRI issues • Increasing trust helps to survive economically • Increased preparedness for risks (anticipation) • Better performance • More cost-efficient data collection • Tapping into new sources of workforce • New business and funding opportunities

MoRRI Final Report 2018: Final Reflections and Outlook:

Impact pathways (see MoRRI Final Report):

cognitive transformations refer to changes in thinking and attitudes;

procedural transformations refer to changes in the ways things are done; and

competence transformations refer to systemic changes that effect all relevant actors

Pluralisation refers to the opening up of science, research and innovation to the widest range of actors possible. Democratic benefits emerge when these actors are involved in S&T decision-making and their ideas and arguments are considered in these decisions, ensuring representation of the diversity of values and expectations in society. Economic benefits emerge when connections between actors foster creativity, increase the number and diversity of contributors to, and users of, data, information and other knowledge resources, and introduce new demand-driven research topics and questions. Connections among an increased range of actors can improve mutual awareness and understanding of expectations and needs, enhancing the relevance of R&I to societal stakeholders. Pluralisation is particularly likely to be advanced and reinforced through public engagement, gender equality and open access initiatives.

Inclusion refers to the entry and active involvement of previously marginalised or disenfranchised actors, and associated elements such as local knowledge, into science, research and innovation. Democratic benefits emerge when inclusive activities lead to the introduction of previously excluded perspectives and knowledge sources into R&I, and to their engagement in R&I policymaking. The horizontal and vertical participation of women in R&I reduces bias against women, their inclusion constituting a democratic benefit in terms of representation. Inclusive educational activities or methods that benefit students with special needs also increase the representation of minority groups in science. Engagement of citizens' groups can produce economic benefits where their contributions improve the alignment of R&I with consumer demand. The inclusion of women in research design and development is a powerful example of this, which can both improve the quality of science and generate economic benefits through increased relevance of R&I outputs for women. Broad societal benefits in terms of the relevance of R&I can emerge from the inclusion of citizens' perspectives and engagement with their experience, including through citizen science and student internships, for example. Inclusion is a particularly prominent element of public engagement, science education and gender equality activities.

Legitimisation refers to the improved societal awareness, understanding and acceptance of R&I emerging from interaction, communication and critical engagement. Democratic benefits emerge when more citizens understand S&T choices and accept that the process and rationale for decision-making is legitimate. Economic benefits can extend from a reduction in the costs of market entry and consumer adoption of S&T-based products, and from increased attractiveness due to perceptions of socio-technical appropriateness. Diffused societal benefits occur when diverse stakeholder roles and contributions to R&I are understood and accepted, and young people perceive R&I as a socially and ethically attractive option for careers, including for women. Legitimisation is promoted strongly through the public engagement, science education, gender equality and ethics dimensions of RRI.

Table 1 Proposed indicators of RRI benefits

Indicator type	Indicator name (tag)	Type of benefit
Intermediate	Citizens' participation in research and innovation (PE-DEM1)	Democratic
	Reduction in bias against women's participation in research and innovation (GE-DEM1)	Democratic
	Proportion of research that includes a gender dimension (GE-DEM2)	Democratic
Modelled on pathways from RRI outputs/ outcomes to benefits	Citizens' perspectives feature in research and innovation policy-making (PE-DEM2)	Democratic
	Training of researchers in public communication (PE-SOC1)	Societal
	Citizens' awareness and understanding of science and technology choices and policy decisions (SLSE-DEM1)	Democratic
	Gender relevance of research and innovation outputs (GE-ECON1)	Economic
	Image and attractiveness of research and innovation careers (ETH-SOC1)	Societal
	Access to and utilisation of open data (OA-ECON1)	Economic
Network	Degree of diversity in research and innovation networks (GOV-DEM1)	Democratic
	Degree of coherence in research and innovation networks (GOV-SOC1)	Societal

