Science and technology have proven to be transformative forces throughout history. Today they have granted humans the capacity to alter ecosystems and the Earth’s climate and even to manipulate the building blocks of life itself. Research and innovation have changed our world and our lives, and will continue to do so. However parallel to the large positive impact on human welfare and wellbeing that science and technology have had and probably will have, they also create new risks and ethical dilemmas, do not always succeed in solving the problems they are meant to, and sometimes spur controversy.

Over the last few decades many experiments have been done that aimed at decreasing the distance between science and society. For instance, in various public engagement exercises the public has been involved in discussions and policy decisions regarding science; collaborations between scientists, ethicists and social scientists have been set up; experiments have been done with open source research data, user-driven innovation, citizen science, and much more besides.

These efforts have led to a European-wide approach in Horizon 2020 called Responsible Research and Innovation. RRI seeks to bring issues related to research and innovation into the open, to anticipate the consequences of research and innovation, and to involve society in discussing how science and technology can help create the kind of world and the kind of society we want for generations to come.

In three years’ time RRI Tools will develop a Training and Dissemination Toolkit concerning responsible research and innovation and put it to use through a Community of Practice. The toolkit will contain a set of tools intended for a variety of uses: raising awareness about RRI, and training, implementing, and disseminating RRI in Europe. A multidisciplinary consortium with 26 partners operating in 30 European countries will develop and continuously optimize the toolkit. RRI Tools will advocate policymakers, researchers, RRI-intensive industries, civil society organizations (CSOs), and science educators at national and regional levels, spreading RRI throughout society.

Following a survey of the relevant literature and consultation with experts, RRI has been provisionally defined as follows:

**Responsible Research and Innovation is a dynamic, iterative process by which all stakeholders involved in the RRI practice become mutually responsive and share responsibility regarding both the outcomes and process requirements.**

These projected outcomes and process requirements will be elaborated below, but in short we can say that:

1. RRI’s aim is to create a society in which research and innovation practices strive towards sustainable, ethically acceptable, and socially desirable outcomes; and

2. RRI does so in such a way that the responsibility for our future is shared by all people and institutions affected by and involved in research and innovation practices.
Outcomes

Based on literature about responsible research and innovation, we have developed a thematic categorization of RRI outcomes. The outcomes of RRI are divided in three categories:

1. Learning outcomes
RRI should lead to empowered, responsible actors across the whole range of our socio-technical systems (scientists, policymakers, CSOs, businesses and innovators, educators). Structures and organisations where these actors function should create opportunities for and provide support to actors to be responsible, ensuring that RRI becomes -and remains- a solid and continuous reality.

2. R&I outcomes
RRI practices should strive for ethically acceptable, sustainable and socially desirable outcomes. Solutions are found in opening up science through continuous, meaningful deliberation with societal actors. In the end, the incorporation of societal voices in R&I will lead to relevant applications of science.

3. Solutions to societal challenges
Today’s societies face several challenges. The European Commission has formulated seven ‘Grand Challenges’ as one of the three main pillars of the Horizon 2020 programme. In order to support European policy, R&I endeavours should contribute to finding solutions for these societal challenges, which are:

- Health, demographic change, and wellbeing;
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Climate action, environment, resource efficiency, and raw materials;
- Europe in a changing world – inclusive, innovative and reflective societies;
- Secure societies – protecting freedom and security of Europe and its citizens.

Process requirements

In order to achieve the outcomes as described above, the R&I process has to accord with certain process requirements. We have identified eight requirements and divided them in four clusters.

1. Diversity & inclusion
Diverse and inclusive RRI processes should call for the involvement of a wide range of stakeholders in the early development of science and technology, both for normative democratic reasons and to broaden and diversify the sources of expertise and perspectives. In this respect, inclusive practices should lead to diverse practices. In reverse, diverse practices are more likely to be inclusive.

2. Anticipation & reflection
Anticipation both concerns understanding how the present dynamics of research and innovation practices shape the future, and envisioning the future. Therefore, one enables oneself to act on future challenges. In order to act adequately and be open to changes in direction, also reflection is required. This reflection concerns both definitions of the problem(s) at issue, commitments, practices, and individual and institutional values, assumptions and routines.

3. Openness & transparency
Openness and transparency are conditions for accountability, liability and thus responsibility. This is an important aspect for publics to establish trust in science and politics. However, more openness does not automatically lead to more trust. The information has to be tailored to the needs of stakeholders in order to make sense to them.

4. Responsiveness & adaptive change
Responsiveness means responding to emerging knowledge, perspectives, views, and norms. Responsiveness is a condition for adaptive change. RRI requires a capacity to change or shape existing routines of thought and behaviour but also the overarching organizational structures and systems in response to changing circumstances, new insights and stakeholder and public values.

RRI is all about anticipating how decisions regarding research and innovation might shape our future (i.e., how they impact on both the environment and the society we live in). RRI requires that we reflect on our actions, that we are open and transparent about the decisions we make, the actions we take and the impacts these might have. It builds on the belief that science and innovation not merely take place in society, but that they take place for society with society.
RRI means experimenting further and improving upon existing practice. It means paying close attention to current developments, be they positive efforts by scientists to take responsibility for emerging technologies, or institutional and cultural barriers that are stopping progress. RRI also encompasses research ethics, gender and other forms of inclusion, open access to scientific data and publications, and scientific education. Scientists and innovators should be encouraged to take responsibility for the futures they help shape. But the responsibility is not individual, nor is it theirs alone. The challenge is to find collective ways to take care of the future.

To make the translation from such theoretical notions of RRI to practical RRI standards and tools, the Consortium will investigate ‘real world’ experiences with RRI by looking at existing practices that might already exert one or more elements featuring in the RRI working definition. Such experiments can inspire others and should be encouraged. Future RRI practices can learn from steps that have already been made. The RRI Tools project thus collects promising RRI practices to analyse them and to draw lessons from them.

Promising RRI practices are defined in the project as practices that excel in one or more of the key features of our definition, are connected both to research and innovation, and promote stakeholder involvement. The nature of these ventures, however, can diverge widely. For example, promising RRI practices can be (1) instruments, (2) projects, (3) programmes, or (4) organisations. For each of these types of RRI practice, an example is given.

**1. Instrument: PlayDecide**

PlayDecide is an online discussion game that stimulates dialogue about controversial issues in a simple and effective way. There are several reasons to engage in dialogue: from providing a direct input to a policy decision, to raising awareness for an issue. This game is developed to strengthen communication between science, policymakers, and society in Europe. This game can be viewed as a promising practice for RRI because it is playful and creative and can be used as co-creation and inclusive tool for subjects that need multi stakeholder perspective.
2. Project: ‘Seeking Sociable Swine’

‘Seeking Sociable Swine’ is a project conducted by Wageningen University, VU Amsterdam, and the Institute for Pig Genetics. Researchers from different disciplines worked together to create a shared solution for the improvement of animal welfare in pig production. In parallel to laboratory research after pig welfare, all stakeholders were involved in a multistakeholder dialogue, facilitating the process of reflecting on one's own perspective in relation to the total diversity of perspectives at stake.

3. Programme: MVI

MVI (Responsible Innovation) is a funding programme by the Dutch Organisation for Scientific Research (NWO), directed at emerging technological developments that presumably have large (both positive and negative) impacts on individuals and societies. The program contributes to socially responsible innovation by broadening and deepening the study of ethical and societal aspects of technological trajectories in both national and international contexts.

Where are we going?

The RRI tools project will develop tools for disseminating, training, implementing and practicing RRI in Europe. The tools will be used by policymakers (with a special focus on them), science educators, RRI-intensive industries, CSOs, and researchers and, therefore, need to be tailored to their motivations and needs. The project is organizing stakeholder workshops throughout Europe to give representatives of these groups the opportunity to express their ideas and needs in promoting and realizing RRI.

Furthermore, these workshops give stakeholders the opportunity to reflect on and contribute to the working definition presented in this Policy Brief. This definition will be evaluated throughout the project and it might change in response to contributions from consortium members or stakeholders in research and innovation practices. Aside from the working definition and the stakeholders’ needs, the workshops focus on collecting promising practices of RRI throughout Europe. These RRI practices will be compiled in an extensive database that is being analysed to (1) formulate good practice standards, (2) select the most promising ones, and (3) make a distinctive set of showcases to present on the RRI Tools website.

Both the good practice standards and the showcases are meant to guide stakeholders in accomplishing good practice in RRI. The good practice standards, in turn, will contribute to an evaluation methodology of RRI and will be used to build tools for the RRI Toolkit.

Many steps have been taken in realising RRI, but more are necessary. RRI Tools is not the only project active in establishing RRI in Europe. More in-depth information about the path towards RRI so far and a historical perspective on the development of the concept, we refer to the About RRI section on our website; for further information on some of the European projects working on RRI, see below.

OTHER RRI PROJECTS FROM THE EC

ENGAGE2020
The goal of Engage2020 is to increase the use of engagement methods and policies by mapping what is practiced and spreading awareness of the opportunities amongst researchers, policymakers and other interested parties.

GREAT
The GREAT project aims to develop an empirically based and theoretically sound model of the role of responsible research and innovation governance and investigate the characteristics of responsible practices.

PERARES
The PERARES project aims to strengthen public engagement in research by involving researchers and Civil Society Organisations in the formulation of research agendas and the research process.

PROGRESS
The ProGRess project aims to advocate a European normative model for RRI globally, using constitutional values as a driver to inform societal desirability.

RESAGORA
The ResAGorA project aims at doing extensive research about existing RRI governance across different scientific and technological areas, continuous monitoring of RRI trends and developments in selected countries, and constructive negotiations and deliberation between key stakeholders.

RESPONSIBILITY
The goal of the Responsibility project is to develop a virtual observatory for enhancing the interaction among research outcomes and policy making, incorporating the full potential of scientific achievements in the policy development and implementation.

What about ‘fundamental’ research?

Fundamental research is not aimed exclusively at meeting the immediate, material needs of society. The deep insights into the world where we live – from subatomic to universal scales, from the microbiotic to the global environment – are a vital part of human culture. RRI applies to all stages and aspects of research, including fundamental research.