# RiEcoLab

eit Manufacturing

Co-funded by the European Union

## RESPONSIBLE INNOVATION-LED ENTREPRENEURIAL UNIVERSITY
(Ecosystem Integration Labs)

The overall joint vision of RiEcoLab for 2030 is to develop a novel way of performing research and development in universities to ensure immediate commercialisation (spin-offs) and involvement of a large number of internal stakeholders.

## PROJECT DESCRIPTION

The EILs and the IVAP will build on capacity developed around the following toolkits:

- Toolkit 1: participatory engagement strategy for facilitating the entrepreneurial discovery process;
- Toolkit 2: setting up, institutionalising and operationalising the EILs;
- Toolkit 3: embedding responsible research and innovation in the innovation spin-off strategy of HEIs;

- Toolkit 4: bridging public and private impact investors to support spin-offs;
- Toolkit 5: implementing an inclusive performance measurement system (operationally, environmentally and socially) to monitor the impact of the spin-offs;
- Toolkit 6: effective collaboration, innovation, entrepreneurship, participatory engagement, and co-creation in a digital environment. (DigComp and EntreComp).

## PARTICIPATING PARTNERS

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# T3: Embedding Responsible Research Innovation (RRI) in the innovation spin-offs/start-ups/scale-ups strategy of HEIs

## WP1 – IVAP FRAMEWORK AND TRAINING MATERIAL DEVELOPMENT

### Task 1.1. –Integrated IVAP toolkits development

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# 1. EXECUTIVE SUMMARY

## 1.1. Overview

RiEcoLab Toolkit 3 (T.3) aims to introduce the concept of **Responsible Research Innovation (RRI)** and embed RRI in the innovation spin-offs/startups/ scale-ups strategy of HEIs. The goal is to raise awareness for all stakeholders, especially university administrators, and help them understand why RRI is necessary the benefits, and how it can be embedded in the HEIs strategy. RiEcoLab envisions its Ecosystem Integration Labs (EILs) to be developed as a living-lab (LL) structure where responsible innovation can be co-produced with quadruple helix stakeholders (scientists working in HEI's and societal actors, such as businesses, governments, end-users/citizens), to lead the path to impactful spin-offs/ startups/scale-ups and successful innovation which its envisioned users value. To deliver on its aims, the RiEcoLab Toolkit3 will answer the question: why LLs and RRI are not always linked and how should we proceed to link them?

The policy keys and actors of Responsible Research Innovation will be defined, together with RRI's principles and core values and the RRI process requirements. Furthermore, different approaches for measuring RRI outcomes and relevant KPIs will be presented. Starting with defining LLs, a discussion about how LLs can have an RRI perspective will follow. The goal of raising awareness on RRI principles for all stakeholders and a step-by-step plan for setting up LLs under RRI principles, will be discussed. Valuable tools and methods for RRI-proof LLs, supporting the above-mentioned step-by-step approach, will be then identified. Existing self-evaluation tools for RRI will be presented, and the need for customizing them according to the needs of different stakeholders will be examined. Last but not least, for capitalizing on experience, several best practices on RRI and LLs are briefly presented and referenced for further exploration.

## 1.2. Learning Outcomes

Upon the completion of the Toolkit 3 training, learners will be able to:

- define the policy keys, actors, key principles and process requirements of Responsible Research Innovation
- recognize the relevant KPIs and different approaches for measuring RRI outcomes
- identify the tools and methods for creating LLs under an RRI perspective
- apply a step-by-step plan for setting up LLs under RRI principles
- identify existing self-evaluation tools and best practices for RRI and LLs.

## 1.3. Target audience

Toolkit 3 can be used by:

- Upper Management of HEIs (Board of Trustees, Rectors, Vice-Rectors, Deans)
- Policy Makers and Top Administrators who support Research & Development in other Institutions, such as; R&D Business/Industry Departments; Technology Parks; Technology Transfer Offices; local management offices of Governmental

Organizations/Ministries engaged in Research, Technology & Innovation; Development Agencies; Chambers of Industry and Commerce; NGOs and Associations of Business/Industry people (ex. Young Entrepreneurs, Export associations, etc) and identified EILs Associated Partners.

- Graduate students and researchers who are engaging in research and innovation wishing to exploit the commercial impact of their research

### 1.4. Impact

Toolkit 3 aims to create an impact by raising awareness in all quadruple-helix stakeholders on RRI principles and connecting RRI and the LLs philosophy. It will develop a shared understanding and better equip them with valuable tools and a step-by-step methodology to guide them on how to embed RRI in their innovation strategy and decision making. Therefore, it should contribute to improved internal processes in the universities and other stakeholder institutions by encouraging administration to facilitate, support, and promote RRI Ecosystem Labs.

## 2. GLOSSARY OF TERMS/ ABBREVIATIONS

EIL: Ecosystem Integration Labs

EU: European Union

ENoLL: European Network of Living Labs

GEP-LL: Living Labs that adopt a purely means-goal effectiveness perspective

HEI: Higher Education Institutions

KPI: Key Performance Indicator

LL: Living Lab

MGA: Means-Goal Effectiveness

RoRI: Responsible online Research and Innovation

R&I: Research and Innovation

RRI: Responsible Research and Innovation

RRI-LL: Living Labs that adopt an RRI perspective

TRREE: Training and Resources in Research Ethics Evaluation

T: Toolkit

## T3.1. INTRODUCTION

Innovation does not always translate easily into products that are valued and widely used in society. Sometimes a lot of money and effort is put into inventing and making a technology, which never succeeds to enter the market or leads to a market failure. RiEcoLab aims to address this problem by fostering closer collaboration between researchers and innovators working at HEIs and societal actors, such as businesses, governments and end-users/citizens. It aims to do this in a way that fits a Responsible Innovation approach.

Responsible Research and Innovation (RRI) is a concept that gained particular visibility over the last decade in the European Union (EU) and refers to a process of research and development that considers scientific inquiry in a broader societal context (Owen, 2013; von Schomberg 2013). RRI fosters an open, multi-stakeholder collaboration including researchers, citizens, policy makers, businesses, third sector organizations, etc. to discuss the question of how science and technology should be shaped in the best possible way to not only contribute to solving today's problems, but also create a world that will be desirable for future generations. More specifically, von Schomberg (2013) defines RRI as "a transparent, interactive process by 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, in order to allow a proper embedding of scientific and technological advances in our society" (von Schomberg 2013: 9).

What is taken as a starting point for RRI is that there is not an immediate and easy 'match' between society and technological innovation. Society can also resist technological innovation, which may hinder its use as initially intended in some contexts. Further, society may use technological innovations differently than initially intended, which may substantially alter the societal purposes that the technology eventually serves. Considering complex (wicked) societal problems such as the burden of the current food production and consumption system on the environment, new technologies alone cannot reduce that burden. The technologies also need to become integrated into the (inter-) actions and habits of people. Society needs to change alongside technology. Therefore, science and society need to work together to bring about change and make innovation a success.

This is the purpose of RiEcolab. RiEcoLab envisions its Ecosystem Integration Labs (EILs) to be developed as a living-lab structure where responsible innovation can be co-produced with quadruple helix stakeholders in order to lead the path to impactful spin-offs/ startups/scale-ups.

Living Labs (LL) typically bring experimentation out of its usual contexts in science laboratories at universities or R&D departments and into real-life environments where stakeholders can interact with it. The European Network of Living Labs (ENoLL), a platform established in 2006 to foster ICT-based innovations around the world, defines LL as: "user-centred open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings" (openlivinglabs.eu/aboutus).

RiEcolab's EILs are living labs, which aim to bring about closer collaboration between scientists working in HEI's and societal actors, such as businesses, governments, end-users/citizens. The purpose of this is to bring about more successful innovation, which is valued by its envisioned users. But also, innovation that actually helps to realize important societal goals, as Europe faces grand challenges to which innovation must help bring solutions. Hence, RiEcolab's living labs work according to an RRI perspective: it is not only innovation they help to bring about, but Responsible Innovation.

HEIs still often sit in their ivory towers, despite the critique of the past decades: more interaction with societal actors is needed. This often leads to hindered innovation: innovation that scientists produce often fails on the market because it is not accepted and used by the public. RRI delivers an approach that seeks closer collaboration between actors to realize innovation that is valued and used. In order to achieve this, RiEcoLab, builds upon designing and co-creating responsible innovation living labs based on responsible research and innovation (RRI).

This leads to questions; since LL have been around for some time as well as RRI, why these two are not always linked? And furthermore, how should we proceed in order to link RRI and LL?

## T3.2. RESPONSIBLE RESEARCH INNOVATION (RRI)

Over the last decades, many efforts have tried to reduce the distance between science and society, leading 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, anticipate their consequences, and involve society in discussing how science and technology can help create the kind of world and society we want for generations to come.

### T3.2.1. Policy Keys and Actors of Responsible Research Innovation

The European Commission (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/public-engagement-responsible-research-and-innovation)has provided more concrete normative orientations in the form of six policy keys that RRI should foster: ethics, gender equality, governance, open access, public engagement and science education.

- Ethics: focuses on one hand, on research integrity (the prevention of unacceptable research and research practices) and on the other hand, on science and society (the ethical acceptability of scientific and technological developments).
- Gender Equality: is about promoting gender-balanced teams, ensuring gender balance in decision-making bodies, and always considering the gender dimension in Research and Innovation (R&I) to improve the quality and social relevance of the results.
- Governance: arrangements that lead to acceptable and desirable futures have to be robust and adaptable to the unpredictable development of R&I (de facto governance); be

familiar enough to align with existing practices in R&I; share responsibility and accountability among all actors; and provide governance instruments actually to foster this shared responsibility.

- Open access: addresses issues of accessibility to and ownership of scientific information. Free and early access to scientific work might improve the quality of scientific research and facilitate fast innovation, constructive collaborations among peers, and productive dialogue with civil society.
- Public engagement: fosters R&I processes that are collaborative and multi-actor: all societal actors work together during the whole process to align its outcomes to society's values, needs, and expectations.
- Science Education: focuses on enhancing the current education process to better equip citizens with the necessary knowledge and skills so they can participate in R&I debates; and in-creasing the number of researchers.

RRI entails engaging all actors, from individual researchers to policymakers, educators, business and industry innovators, civil society organisations and governments, through inclusive, participatory methodologies in all stages of R&I processes and in all levels of R&I governance (from agenda-setting to design, implementation, and evaluation).

- For researchers: RRI will fortify research projects by underlining openness, straightforwardness, variety, comprehensiveness and adaption to changes. RRI assists with reclassifying analysts' jobs in the public eye and the cooperation between science and society. Connecting all entertainers in research as indicated by RRI can yield results more qualified to cultural requirements.
- For Policy Makers: RRI gives a chance to produce more prominent confidence in the science and advancement framework. RRI can enhance competitiveness and creativity: ethics can be an impulse for innovation instead of a constraint. Involving the public can make research and innovation policies more acceptable and accountable.
- For Educators: RRI enables development strategies that link education content to broader societal goals and engage learners to become responsible citizens. RRI inspires all levels of science education to adopt an inquiry approach to science. Formal and non-formal providers can use new tools and methods to integrate responsibility and responsiveness within RRI. Be inspired by RRI and facilitate educational programs that combine STEM with social, economic and ethical principles.
- For Business and Industry Innovators: RRI boosts a company's creativity and helps to overcome barriers to innovation. Companies become more competitive by aligning innovation with societal needs. RRI helps companies increase trust in them and safeguard their license to operate. Helps to avoid risks and sunk costs of market-non-take-up and to improve the company's image and reinforce its values.
- For Civil Society Organizations: RRI is a new framework for the meaningful participation of civil society in research and innovation. RRI can empower civil society to join science communities in solving the world's challenges. By fostering active participation in research, RRI leads to shared responsibility among all actors.

### T3.2.2. Principles of Responsible Research and Innovation and Core Values

RRI aims to create a society where R&I practices strive towards sustainable, ethically acceptable, and socially desirable outcomes. 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 R&I.

Numerous practices as of now focus on particular perspectives inside the RRI idea. In any case, critical improvement is conceivable, particularly in considering the comprehensive methodology given by RRI. RRI encourages some professionals to create new facilities for society as well. R&I communities aim to ensure that science is blended with democracy and make it possible to combine the activities under the theme of science. Hence, RRI implies that societal actors (researchers, students, university administrators, citizens, policymakers, business, third sector organizations, etc.) work together during the whole research and innovation process to align better both the process and its outcomes with the values, needs, and expectations of society.

RRI often leads to institutional change, commitment, and transferability of behavioral change, results and best practices across the entire institution by motivating and engaging internal actors. Moreover, RRI has gained relevance through policy, with the above mentioned six pillars deserving attention (ethics, gender equality, open access and data, science education, public engagement and governance), that largely affect the research dimension of RRI more than the innovation dimension.

Actors aiming at Responsible Research and Innovation commit themselves to the following principles:

- Transparency: by engaging in open innovation, reflecting on and openly disclosing the purposes and potential implications of innovations, as well as the associated uncertainties.
- Participation & Inclusion: by involving people of a broad diversity and different backgrounds on eye-level (inclusive innovation processes) and considering their needs.
- Governance: by capacity building for Responsible Innovation, fostering the links between innovation and CSR/Sustainability Management and implementing gender equality.
- Anticipation: by assessing risks and wider impacts (risk management and due diligence), considering ethical limitations, welcoming early warnings of negative impacts and mitigating harms.
- Sustainability: by orientating innovation towards Planet, People and Profit (triple bottom line) and increasing shared value (for the company and for society).

### T3.2.3. Clusters of Process Requirements

In order to conceptualize RRI, a framework suggested by RRI-Tools is needed. A framework where RRI outcomes emerge from process requirements, engaging in the practices of Responsible Research and Innovation for all stakeholders, leading them to become mutually responsive and share responsibility.

RRI-Tools, based on literature about responsible research and innovation, developed the framework (presented in Figure 1), which shows how four clusters of process requirements support in a dynamic, iterative manner, the RRI outcomes to find solutions for the societal challenges formulated by the European Commission, as one of the three main pillars of the Horizon 2020 programme (EC Horizon 2020, 2013).

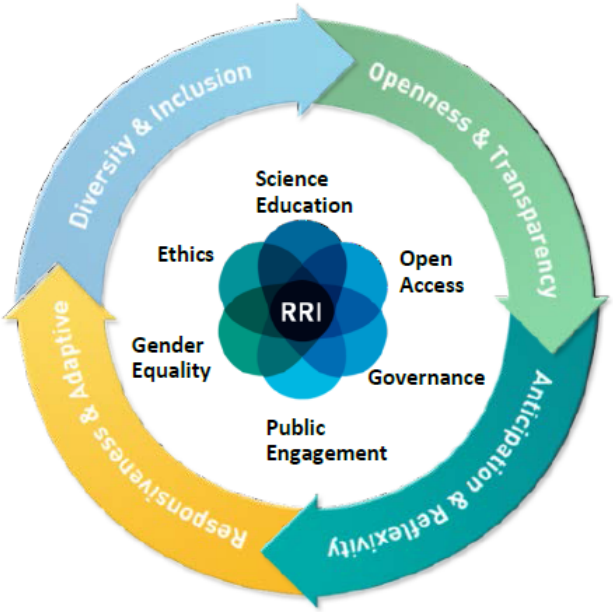


**Figure T3.2.1.** RRI process requirements (Source: Kupper et al., 2015)

RRI is about anticipating future outcomes of research and innovation processes. Outcomes are not specified individually but rather emerge from and/or are present in the description of the process requirements. Therefore, the integrated nature of processes and outcomes in practicing RRI needs to be pointed out.

The developed four clusters of process requirements (Kupper et al., 2015) consist of two requirements strongly linked to each other and result in RRI supporting the six policy agendas presented inside the circle.

These six' policy agendas' have emerged for reframing the six key dimensions identified by the European Commission for RRI: ethics, gender, governance, public engagement, open access, and science education.

A brief description of the four clusters of process requirements, according to Kupper et al. (2015) is presented below:

- **Diversity and 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, disciplines and perspectives. In this respect, inclusive practices should lead to diverse practices. In reverse, diverse practices are more likely to be inclusive.

- **Openness and transparency:** Openness and transparency are conditions for accountability, liability and thus the 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: information has to be tailored to stakeholders' needs to make sense to them.
- **Anticipation and reflexivity:** Anticipation both concerns understanding how the present dynamics of research and innovation practices shape the future, and envisioning the future. Thus, one enables oneself to act on future challenges. In order to act adequately and be open to changes in direction, also reflexivity is required. This reflexivity implies learning about the definitions of the problem(s) at issue, commitments, practices, and individual and institutional values, assumptions and routines.
- **Responsiveness and 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 behavior and the overarching organizational structures and systems in response to changing circumstances, new insights and stakeholder and public values.

## T3.3. MEASURING RRI OUTCOMES

### T3.3.1. RRI Outcomes and Relevant KPIs

RRI is about anticipating future outcomes of research and innovation processes. In the same spirit, however, it is hard, if not impossible, to specify these outcomes in advance of the development of actual R&I practices as a list of normative prescriptions that research and innovation processes have to fulfill. One reason for this is the wide range of research areas involved, coupled with the fact that R&I may have many different outcomes for each of them responsible. Indeed, as we see it, it would even be problematic to attempt to formulate criteria for all types of RRI outcomes in advance (https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_1085). Furthermore, the outcomes of RRI are divided into three categories, as presented in Table 3.3.1 below:

**Table T3.3.1.** RRI Outcomes (Source: Kupper et al. 2015)

| 1. Learning outcomes | 2. R&I outcomes | 3. Solutions to societal challenges |
|---|---|---|
| 1a Engaged publics | 2a Ethically acceptable | 3a Health, demographic change, and wellbeing; |
| 1b Responsible actors | 2b Sustainable | 3b Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy; |
| 1c Responsible institutions | 2c Socially desirable | 3c Secure, clean, and efficient energy; |
| | | 3d Smart, green, and integrated transport; |
| | | 3e Climate action, environment, resource efficiency, and raw materials; |
| | | 3f Europe in a changing world - inclusive, innovative, and reflective societies; |
| | | 3g Secure societies - protecting freedom and security of Europe and its citizens. |

- **Learning outcomes**

RRI should lead to empowered, responsible actors across the whole range of our socio-technical systems (citizens, scientists, policymakers, NGOs, CSOs, educators, businesses and innovators). Structures and organizations where these actors function should create opportunities for and support actors to be responsible, ensuring that RRI becomes (and remains) a solid and continuous reality. Below are some examples;

*-Shareholding and decision-making process (Diversity & Inclusion)*

Organizations' decisions and strategies are agreed upon between the legal representative, the scientific director, workers, and active shareholders.

*-Newsletter and Twitter account (Anticipation & reflection / Openness & transparency)*

While acknowledging that society's continuous and consistent involvement in the research and innovation process is one key aspect of RRI. We should involve stakeholders and society by promoting a permanent dialogue through our Twitter account and our open source monthly newsletter

- **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. Below are some examples;

*- Ethical acceptability (Diversity & Inclusion / Openness & transparency)*

*-Safe and Sustainable Outcomes (Anticipation &Reflection)*

- **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 endeavors should contribute to finding solutions for these societal challenges, presented in the table above. (i) However, some RRI actors (especially companies) have some RRI activities, and this usually does not amount to a systematic integration of RRI in all RRI actors. RRI key performance indicators (KPIs) should be developed so that RRI actors can monitor outcomes and progress. All RRI actors should pay attention to RRI outcomes and the possibility to monitor these through RRI KPIs (https://www.rri-prisma.eu/wp-content/uploads/2019/09/RRI_Key_KPIS.pdf). Working towards solutions to these grand challenges demands to take distance from the view that technology is just a 'tool' that people should start to use. They demand an integrated socio-technical innovation. Some examples 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;*

*-Secur*e societies - protecting freedom and security of Europe and its citizens.

Integrating the RRI processes and the outcomes is very important. In most cases, outcomes cannot be specified in advance of the development of actual R&I practices. One reason for this is the wide range of research areas involved, coupled with the fact that for each of them responsible R&I may have a plethora of different outcomes. Therefore, the central significance of the outcomes of R&I is that they constitute the very subjects that should be deliberated in the inclusive processes of anticipation, reflection and action that RRI aims to promote.

### T3.3.2 Different Approaches for RRI Key Performance Indicators

#### T3.3.2.1. The PRISMA-Project RRI KPIs

This project (received funding from the EU Horizon 2020) developed a practical guideline and contributed to a new standard for companies to build a responsible research and innovation strategy (RRI).

Identification and measurement of indicators to monitor the level implementation of RRI principles and actions at the company level could facilitate long-term adoption of RRI. In particular, it could help align RRI activities with key business drivers and processes, stimulate the continuous improvement of RRI "performances", and allow consideration of RRI aspects in regular sustainability reporting at the company level. These indicators should be considered as indicative and a starting point to develop KPIs that are more specifically tailored to the specific needs of a company. The same RRI KPIs could be adapted to different RRI Actors (Higher Education). The table provides an overview of PRISMA RRI KPIs (https://rri-tools.eu/about-rri?p_p_id=2_WAR_kaleodesignerportlet&p_p_lifecycle=0 ).

**Table T3.3.2.1**. Key Performance Indicators for Monitoring RRI

| | Item | RRI KPIs | Examples of quantitative parameters to measure KPIs |
|---|---|---|---|
| Anticipation & Reflection | 1 | Awareness of moral values | - Nr. of training sessions/meetings per year to learn and reflect on moral values connected to innovation strategy and core business |
| | 2 | Awareness of ethical issues of innovations | - Nr. of training sessions/meetings per year aiming to reflect on integration of social and ethical values into specific R&I/R&D projects |
| | 3 | Does the company embed moral values in its innovations? | - RRI principles formally integrated into the company's mission and vision (e.g. ethical code of conduct) |
| | | | - Nr. of R&I/R&D projects per year where moral values are actively and included into innovation strategies and technological design |
| | 4 | Does the company (actively) anticipate social effects of its innovations? | - Nr. of R&I/R&D projects per year where internal/external stakeholders were involved from the early stages in product development |
| | | | - Nr. of consultancy initiatives with other innovators and external advisors to discuss and identify social impacts of R&I/R&D projects |
| Inclusiveness | 5 | Stakeholder engagement | - Nr. of stakeholder engagement initiatives organized per year by the company |
| | | | - Nr. of R&I/R&D projects per year where active stakeholder engagement is foreseen into R&I/R&D plans |
| | | | - Nr. of R&I/R&D projects per year where engagement with end-users has been performed |
| | 6 | Gender Diversity | - Percentage of men and women involved in R&I/R&D function/teams in the company |
| Responsiveness | 7 | Transparency and accountability about RRI-relevant choices | - Formal communication strategy established at company level to ensure most relevant RRI choices are explained in key company documents and/or the website |
| | | | - Nr. of patents per year aiming to integrate non-financial values |
| | | | - Nr. of open access publications |
| | | | - Nr. of events or webpages or channels in social media (or similar) disseminating project results to the general public |
| | 8 | Learning mechanisms to address public and social values in product development | - Nr. of user-centered approaches per year formally integrated into the company innovation model (e.g. user-centered design, co-creation) |
| | | | - Nr. of user experience tools per year carried-out to respond (new) societal demands and developments |
| | 9 | Capacity to align to societal goals | - Nr. of R&I/R&D projects per year addressing socially/ethically-oriented products/services |
| | 10 | Active monitoring of RRI impacts | - Percentage of R&I/R&D projects per year that apply impact analysis strategies (e.g. risk management, ethical/social impact analysis, etc.) |
| | | | - Formal external auditing procedures (at least yearly basis) in place to monitor non-financial values of the company |

### T3.3.2.2. ORBIT Self-Assessment Tool

In practice, the ORBIT self-assessment tool is implemented in the form of an online survey (Stahl, 2017). The online survey consists of 10 main titles (introduction, your project, anticipation, reflection, engagement, governance, gender, open science, science education, ethics) (https://www.orbit-rri.org/tools/sat/#gf_81). To allow the identification of the level of

achievement of RRI in a particular aspect by a specific user, the majority of the survey questions take the form of a five-point Likert scale comment on a statement provided in the question, ranging from entirely disagree to agree.

## T3.4 RRI vs. LL

### T3.4.1. Living Labs (LL)

There are various definitions available for LL. The European Network of Living Labs (ENoLL), a platform established in 2006 to foster ICT-based innovations around the world, defines LL as: "user-centred open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings" (openlivinglabs.eu/aboutus). Other definitions, like the one by Leminem (Leminem 2015: 29), are similar and refer to LL as "physical regions or virtual realities in which stakeholders form public-private-people partnerships of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts." What is stressed in these definitions is that LL are 'innovation communities'.

There are, however, many different approaches to LL available (Dutilleul et al., 2010; Følstad, 2008; Leminen & Westerlund, 2016, 2017). Some of these approaches aim primarily at business innovations. LL are, for example, proposed as open innovation networks that allow businesses to exchange information and help each of them to create innovations that have a good match with user needs and that therefore have an easier start on the market (Leminen et al., 2012; Nystrom et al. 2011); LL are also considered as a way to effectuate crowdsourcing and bring the knowledge and expertise of diverse people together to use it by a business to foster an innovation project (Ståhlbröst & Lassinantti, 2015), or LL are combined with business model research to help innovative solutions find their way to the market (Rits et al., 2015). On the other hand, there are many examples of LL which aim to foster innovation for public goals, sometimes aiming at public sector innovation, which is often resistant to innovation (Schuurman et al. 2016); to identify 'needs' of commercial consumers as well as citizens to which the innovation needs to attend (Savelkoul & Peutz 2017); and over the last years LL have been proposed more and more often for more encompassing changes such as the development of smart cities or transitions towards more sustainable ways of living, which involve complex societal developments which need the participation of stakeholders across the quadruple helix, such as researchers and tech developers, businesses, governmental actors and citizens (Hossain et al. 2019); or LL are approached as tools for collaborative learning in 'in-vivo' settings of a multitude of such quadruple helix stakeholders (Van Geenhuizen 2019; Engels et al. 2019).

Given this variety, it is hard to say once-and-for-all what a living lab is. But it is possible to list some characteristics that are often mentioned in relation to LL in the literature, but which may not all apply to every example of LL:

1. LL provide real-life environments for conducting innovation activities, allowing to study not only the functioning of the innovation but also the interaction with societal actors.
2. The creation or set-up of LL is usually done by public-private-people partnerships (sometimes called 4Ps), including companies, researchers, government authorities, and users/citizens.
3. Users have a pivotal role in LL, which may include citizens and customers or future buyers of the product.
4. LL differ from just 'testbeds' or 'field trials' because the focus is not solely on testing and improving technological innovation but also on observing (and learning about) its impacts on society.
5. LL presuppose a relatively mature level of innovations: the innovations in LL are more mature than in-house R&D (where prototyping and field trials are more appropriate) but the innovations are less mature than would be found in pilot projects
6. Multiple stakeholders have a role in LL, and collaboration between them to realize technological and social innovation at the same time is considered important: co-creation is a term that is often used for this

In their review of the literature on LL, Hossain et al. (2019) distinguish between an approach in the US and a European approach. Both approaches share the concept of involving users in innovation activities in real-life environments. The North American approach, however, considers living labs as demo-homes, home labs, or houses of the future, which figure as designed test environments for innovation, whereas the European approach views LL as more complex platforms to study users' everyday activities and habits (like, inhabitants of cities or regions) and the ways they interact with new technologies (Hossain et al. 2019: 979). Furthermore, Hossain distinguishes in both 'schools' of living labs that follow two main paradigms: open innovation and user innovation (Hossain et al. 2019: 979)

Considering the open innovation paradigm, LL are seen as a form of open innovation, or open innovation networks. Open innovation presupposes that companies who develop innovations cannot rely just on their in-house expertise but need to bring in knowledge and expertise from outside their own company. Open innovation networks assume that stakeholders from various organizations should collaborate and innovate jointly, such as researchers from universities, governmental institutions, citizens and businesses. In line with these ideas about 'open innovation', living labs will bring people together, facilitate collaboration, and help develop and validate new products and services, using the diverse expertise available to do it.

According to the distinction by Hossain et al. (2019), the user innovation paradigm has a slightly different focus. According to this approach, a living lab is an innovation intermediary community that applies a user-centric approach to innovation. Users can be future customers of technologies and citizens who are expected to engage with technology. According to this approach, users have a key role to play in innovation activities, and there are various types of users which may come together in a LL to engage with the technology and study their various needs and wishes, but also to come up with innovative ideas which may eventually change the innovative product or service. User-driven innovation, user-centric design, co-creation, technical testing are key in this way of thinking about LL. Involving users in the early stages is expected to lead to unexpected and creative outcomes.

The above described EU and North American approaches of Living Labs, which may be working according to the open innovation and user innovation paradigms, have their primary focus on relatively concrete innovative products or processes. However, these last years, LL are increasingly used to address complex societal problems, sometimes referred to as "wicked problems" or even 'Grand Challenges'. Wicked problems are very difficult to solve societal or cultural problems because they lack clarity in both aims and solutions. Addressing them demands to change something at different and interconnected levels of society. Examples are 'making the food system sustainable' or 'transitioning towards the biobased economy' or 'making a city smart and sustainable', which requires changes that involve the entire system; including knowledge and innovation, the biological ecosystem, the behavior of individuals, social practices and networks, their institutional embedding and the government. In the past years, LL has increasingly been used to address such complex societal challenges (Ståhlbröst et al. 2015b; Favalaro et al. 2019; Sharp et al. 2017; Engez et al. 2021). As the complexity of the innovation aimed for enhances, so does the complexity of the social setting in which the living lab is organized or embedded, thus leading to reflections on how to do this sensibly or with innovative (digital) tools to participate in the (virtual) LL (Mačiulienė et al. 2020; De Bonis et al. 2017; Schaffers et al. 2011). Trend analysis also suggests that LL become more complex in their setup and practices as the emphasis of research on LL is moving away from a conceptual focus on what living labs are and who is involved in their ecosystems to practical applications of how to design and manage living labs, their processes, and participants, especially users, as key stakeholders and in novel application areas such as the urban city context (Westerlund 2018). Schuurman (2015) highlights that it is possible to analyze living labs at differing levels: at the macro level, the analysis focuses on the public-private-people partnership that carries out the LL activities, at the meso level, the focus of the analysis is on the LL projects and the innovation it aims for, at the micro-level the focus is on the specific methodology used in the LL to realize activities and reflection. The move in the literature towards a focus on design and management of the LL and towards different levels of analyzing them fits in the general tendency of LL to address more complex and encompassing societal problems involving various actors at multi-levels.

The table below is based on our reading of the literature, and it represents different purposes of Living Labs as a continuum, as they may range from learning about latent needs of users and citizens and developing products and services to attend to those needs to addressing complex societal (wicked) problems and systemic flaws in society.

Some authors stress responsible research and innovation as necessary in this landscape of approaches to living labs represented as a continuum. In the following, we will describe what responsible research and innovation are and what it means for living labs to contribute to responsible innovation. Not all LL coincide with a responsible research and innovation approach.

### T3.4.2 LLs having RRI perspective

Living labs have at first glance a lot in common with Responsible Research and Innovation (RRI). Nevertheless, living labs are various and not all approaches to living labs qualify as RRI. To distinguish between living labs that do support RRI and those that don't, it is important to first understand more of the background and purposes of RRI.

**Table T3.4.1.** Living Labs continuum

| Business and social innovation | Complex (wicked) societal innovation |
|---|---|
| development of marketable products and services | addressing complex social problems |
| means-goal effectiveness | system (design) approach |
| based on private values; responsible / sustainable generation of marketable added value. | based on public values; societal valuation, including social, cultural, economic power. Value disagreements |
| user defined | multi-stakeholder defined; eye for power distribution and equality |
| medium term performance indicators | long term impacts |
| direct project results | wider impacts in transition policy; understanding learning as output |
| interorganizational learning and learning with regulators and certification institutes, financiers, policymakers | learning together; combining a diversity of expertise; societal legitimacy (also invite non-consenting participants) |
| decision and business model-driven | openness and complete transparency in process |
| Governance: leadership and decentralized decision making; validation/testing of new solutions | Governance: leading towards social innovation, new ways of negotiation and decision making |

RRI is a concept that gained particular visibility over the last decade in the EU and refers to a process of research and development that considers scientific inquiry in a broader societal context (Owen, 2013; von Schomberg 2013). RRI fosters an open, multi-stakeholder collaboration including researchers, citizens, policy makers, businesses, third sector organizations, etc. to discuss the question of how science and technology should be shaped in the best possible way to not only contribute to solving today's problems but also create a world that will be desirable for future generations. More specifically, von Schomberg (2013) defines RRI as "a transparent, interactive process by 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 (to allow a proper embedding of scientific and technological advances in our society" (von Schomberg 2013: 9).

What is taken as a starting point for RRI is that there is not an immediate and easy 'match' between society and technological innovation. Society can also resist technological innovation, which may hinder its use as initially intended in some contexts. Further, society may use technological innovations differently than initially intended, which may substantially alter the societal purposes that the technology eventually serves. Considering complex (wicked) societal problems such as the burden of the present food production and consumption system on the environment, new technologies alone cannot reduce that burden. The technologies also need to become integrated into the (inter-) actions and habits of people. New (digital) technologies, for example, that are made to enhance food production with less burden on the environment, will demand farmers to thoroughly change the management of their farm and the organization of their daily work and their collaboration with other partners in the value chain. Suppose the farmers resist the use of these technologies, for example, because they are concerned that their

competitors will be able to look into the data or the government. In that case, the innovation may fail to find its way to daily practice. Furthermore, this concern of farmers reveals that digitalization does not only serve reduction of the environmental burden of farming, but may at the same time serve very different goals for different people, such as looking into each other's data and finding out what the competition is doing, or checking whether farmers comply with the law. This changes and complicates the societal values it serves and may complicate the discussion about its value for society and its eventual acceptance (Van der Burg et al. 2019).

Therefore, the 'human factor' is an important element in complex innovation processes: technologies cannot 'fix' problems all by themselves, but need the acceptance, care, and support of people in societies. According to a responsible research and innovation approach, technological innovation should be thoroughly intertwined with social innovation. Where the 'human factor' is insufficiently considered, technological innovations can lead to entirely unanticipated and sometimes unwanted consequences. Examples of this are often described: many fundamental research results fail to 'translate' to use products appreciated in society, due to lack of funding and lack of attention to the human factor. Both are brought forwards in explanations of the so-called 'valley of death' that needs to be bridged to bring innovations to society (De Saille et al., 2016). Failing to take the human factor into account may lead to hindered acceptance and adoption of the technology, but it can also lead to situations in which innovations have effects opposite to the ones that were originally intended by the technological innovation. A term often used to refer to this phenomenon is the 'Jevon's paradox' and often explains how technological innovations intended to reduce the use of natural resources eventually turned out to have the opposite effect (Alcott et al., 2012). Explanatory of this paradoxical effect lies in human behavior: when an innovation is introduced which allows using natural resources (say, coal, water, gas) more efficiently, they also become more attractive resources for industries, which leads to increased use as opposed to the intended decrease. The innovation has the opposite effect initially because the innovators failed to consider that human behaviour may also change as an effect of introducing new technology.

In this respect, RRI calls to take distance from the view that technology is 'just' a passive tool that serves human needs or interests. 'Just' aiming for user-centric design, such as some living labs do, therefore does not begin to cover the issues that technological innovation may raise. Technology is considered in RRI a world-shaping force, a force that also shapes us as inhabitants of that world, including how we look, how we deliberate, what we experience, what actions we take, with whom we interact, what our expectations are, how we distribute responsibilities, and eventually it also impacts our values. Recognition of this mutual shaping, co-evolution, or co-production of society and technology leads to the call to pay more attention in advance to the effects technological innovation may have on human (social) life. This attention was advised more 'upstream' when the research agenda is shaped (Van der Burg 2009; Abma et al. 2010; De Saille 2015; Gerber 2018), or 'midstream' alongside the research and development carried out on technology, but not so much 'downstream' when the technology is already finished developing and ready to be put on the market. The assumption behind pleads to get engaged

upstream and midstream rather than downstream is that there is more room to influence the technology that will eventually result and make it more acceptable to society (Fisher et al. 2006; Schuurbiers 2011; Flipse et al. 2013). Further downstream, the technology can no longer be molded in ways that society favors, as it has already developed into a marketable product and time, effort, and money have already been invested in it. Changing it at that point would be considered a waste of those investments and would therefore be more likely resisted.

Especially the broader and more complex societal problems and challenges for which LL are organized may probably call for an RRI approach to them. This broader societal interest is also the reason why policymakers have supported RRI. Given the perceived ways in which technologies change our world, policymakers were willing to abandon the linear model of technology development (starting with research, developed by industry, and adopted by humanity) and preferred a model that includes explicit arrangements for the governance of the innovation process in desirable ways for society (Rodriguez et al. 2013). Part of the motivation for this policy interest is the desire for rapid innovation, as innovation is often still trusted to offer goods to society to improve health, economic competitiveness, and wellbeing. But there is also increasing interest in fostering a more critical eye for some innovation's ambiguous value and inviting to turn it into a topic of normative reflection, deliberation and evaluation (Blok and Lemmens, 2016).

Usually, technological developments that attracted a lot of societal concerns were the focus of RRI research, such as genomics, genetically modified organisms, nanotechnology, synthetic biology, information and communication technology and robotics. These technologies have in common that they have potential high stakes but also imply a lot of uncertainty and possible adverse effects and changes in human (social) lives and/or their relationship with animals, plants and the material world around them. These broad changes, which affect the wider public, have inspired scholars to involve a broader array of stakeholders and laypersons in decision-making about the value of such technologies (Davies et al., 2010; Van der Burg 2016; MacNaghten et al. 2019). Although the nature of stakeholder engagement for RRI is still under debate and various strategies are proposed (Blok, 2019), all this work starts from the supposition, so eloquently argued for by Winner (1977, 2011), that similar to legislation, technology can also produce enduring ways to steer (and limit) human ways to interact. For this reason, not only scientists and developers of technology should decide about it, but citizens should have a say in where technology goes. Therefore, what is essential in RRI is a democratic ideal in which citizens have a say in the future development of the societies in which they live.

LL may fit with the general aims of RRI, but this is not necessarily the case; as Van Geenhuizen (2019) notes, who developed an RRI' filter' for LL in urban contexts, serving an RRI goal means that living labs are typically motivated by certain values. Given these values, the scope of LL that adopt an RRI perspective (RRI-LL) is (or should be) broader than it is in some realizations of LL, especially the LL that primarily serve what Van Geenhuizen calls 'means-goal effectiveness thinking' (MGE) and which have a focus on reaching intended impacts with an innovation. RRI-LL require exploring a wide variety of impacts of innovation beyond the ones intended by the

innovators. This is needed because innovations often have unanticipated and unintended impacts. Furthermore, societal actors may disagree on the social acceptance or (ethical) acceptability or desirability of these (various) impacts. The values of RRI ((ethical) acceptability, sustainability and societal desirability, care and stewardship for the future) demand to take these different evaluations into account. Based on these core values and process requirements of RRI, we can say what a LL looks like RRI-proof. This means that a LL needs to extend the focus to wider impacts besides the ones originally intended by the innovators and include a reflection on the rivaling perspectives of stakeholders on the value of those impacts.

As also discussed above, closely connected to the values that RRI-LL should serve are the process requirements for RRI-LL. There are various approaches to RRI related to process requirements, some of which include more elements and some less. Following the RRI-Tools approach discussed above, the AIRR approach proposed by Owen et al. (2013) has at least four elements addressed before: anticipation, inclusiveness, reflexivity and responsiveness. **Anticipation** requires that societal impacts are explored ahead of time, leaving room for a mapping of a variety of impacts on different types of stakeholders. **Inclusiveness** requires that other (societal) actors are included, including also citizens and/or end-users. **Reflexivity** demands that specific effort is made to enhance the reflection of stakeholders, inspiring them to consider the innovation from different angles by engaging them in dialogue with others. **Responsivity** eventually demands developers of the innovation to consider the viewpoints of other (societal) stakeholders. Some authors include more than these four elements, some less, but they all contribute to a common goal; which is to broaden and enrich the perspectives of the makers of technological innovation (including scientists, technicians, businesses, and sometimes policymakers) to help them make decisions that take into consideration the societal aspects of innovation, including the potential value conflicts to which these views might give rise.

Concerning LL, this means that not all LL qualify as 'RRI'. Active involvement of users and citizens in collaborative experimentation and experiential learning is a central element of virtually all LL. But not all of them make an effort to include a variety of stakeholders who may have different perspectives on the impacts and values. Sometimes participants in a LL are chosen so that their views on the purposes of the innovation coincide, or consensus is sought as to the impacts that innovation should bring about. While this makes it easier to set up a LL experiment and fits with Van Geenhuizens MGE thinking, it does not match easily with RRI as insufficient attention is paid to inclusiveness, reflexivity and dialogue. This would require making an effort to include diverse stakeholders who may have needs, interests and values that do not coincide.

Therefore, the goals that innovation is to serve should not be set in stone. There should be room for a broader exploration of different possible impacts and goals that an innovation could or should serve, which may be intertwined, and which may show that trade-offs need to be made regarding more and less attractive impacts. Furthermore, the room should be made for the possible occurrence of unanticipated and unintended impacts.

**Table T3.4.2.** Comparison between GEP-LL and RRI-LL

| GEP-LL | Overlap | RRI-LL |
|---|---|---|
| • reflection on cost structure and effectiveness<br>• customer segments and revenue streams<br>• definition of leadership and decentralize decision making<br>• clear definition of impacts to be achieved<br>• agreement on the value of the intended impacts | • participatory design, co-creation<br>• multi-stakeholder development of shared vision on innovation future and contribution by the LL<br>• incorporation of participative monitoring and evaluation<br>• Attention to legal issues of public policies and private accountability<br>• Concept of collective learning | • More attention for an exploration of a diversity of impacts, including unintended ones<br>• Effort to include diverse stakeholders who do not necessarily agree<br>• Openness towards disagreement about value and acceptance of the innovation<br>• Articulation of (tacit) normative background of the innovations |

RRI seeks to bring forward a variety of social and ethical values related to innovation and enriches an exclusive focus on business or societal goals. Therefore, an RRI approach may be particularly helpful for the shaping of the Living Labs intended to tackle the more complex societal challenges or wicked problems. To define the "right" type of impact, research and innovation usually depart from normative anchor points and such a value-driven base must be open to public debate and not be left up to experts alone to define. Therefore, especially for the more encompassing innovations seeking solutions to grand challenges, it may be important to adopt an RRI approach. The following table summarizes some of the differences between LL that adopt a purely means-goal effectiveness perspective (GEP-LL) and LL that adopt an RRI perspective (RRI-LL).

In view of the above and to develop RRI-LL, the LL approach needs to:

- Require those diverse stakeholders are included and share co-responsibility for innovation trajectories
- Combine business and societal innovation following the measure of ‘wickedness’ of the innovation challenge and the sociocultural context, using appropriate macro-, meso- and micro-level methodologies.
- Include ethical reflection from an early stage onward
- Articulate the normative base that forms the (tacit) background of the innovation and open it up to public debate;
- Promote self-reflecting and interdisciplinary science, responsive to societal needs and values;
- Provide a (digital) environment that facilitates and promotes social learning, interaction and trust-building among a diversity of stakeholders
- Extend performance criteria with ethical norms and reflection on power inequality and broader distribution of benefits and risks
- Manage the AIRR principles of anticipation (of long-term impacts), inclusion (stakeholders), reflexivity (research) and responsiveness (towards the future).

## T3.5. HOW TO EMBED RRI IN HEIs STRATEGIES

Embedding RRI principles in the innovation strategy of HEIs enables different opportunities but can also present some challenges, especially in the implementation phase. The processes should be coordinated delicately to deliver desirable RRI outcomes. An open, dynamic, evidence-based, co-created strategy can guide HEIs in fulfilling their role as change agents by advancing the skills pertinent to conducting RRI and promoting the governance agendas key to RRI in their organizations. By presenting valuable tools and methods, we intend to influence the strategies which can be developed and implemented by HEIs to embed RRI in their innovation spin-offs/start-ups/ scale-ups strategy. The tools and methods we suggest in this section are divided into three categories:

1. Raising awareness on RRI principles for all stakeholders
2. Living Labs as a setting for RRI: A Step-by-step plan for the set-up of a living lab in accordance with RRI principles
3. Valuable tools and methods that the stakeholders can use

For strategies on engaging the stakeholders and ensuring their participation and commitment in the RRI processes, please consult the following RiEcoLab toolkits: Toolkit (T1): Participatory engagement strategy for facilitating the entrepreneurial discovery process

- Toolkit (T4): Bridging public and private impact investors to support spin-offs/start-ups/scale-ups
- Toolkit (T6): Effective collaboration, innovation, entrepreneurship, participatory engagement and co-creation in a digital environment (DigComp and EntreComp)

and,

- The Stakeholder mapping methodology from WP3.

Report on the Opportunities, Obstacles and Needs of the Stakeholder Groups in RRI practices in Europe, developed by The RRI Tools, also presents essential insights and guidelines in this regard.

For strategies on initiating institutional change in the internal bodies of HEIs involved in research and innovation, please consult the following RiEcoLab toolkit:

- Toolkit (T2): Setting-up, institutionalizing and operationalizing the Ecosystem Integration Labs by bridging/upgrading existing research offices and knowledge and technology transfer offices

For strategies on implementing a measurement system, please consult the following RiEcoLab toolkit:

- Toolkit (T5): Implementation of an inclusive (operationally, environmentally, socially) performance measurement system to monitor the impact of the spin-offs/start-ups/scale-ups

### T3.5.1. Raising Awareness on RRI Principles for All Stakeholders

All stakeholders involved in the research and innovation practice become mutually responsive and share responsibility regarding the outcomes and process requirements (https://rri-tools.eu/documents/10184/217431/RRI+Tools+Project+Brief.pdf/183c8a96-c414-4fab-80b9-31ccecedaa47 ). Therefore, raising the awareness level of the stakeholders about the RRI principles is an essential part of the process. One of the ways to support the stakeholders' understanding is delivering informative and interactive training in a multi-stakeholder setting. Stakeholder-specific training can facilitate reaching the common ground when the language or knowledge of different stakeholders is wildly divergent.

Identifying the expectations, learning styles and learning outcomes of each stakeholder can support the process. RRI-tools identifies the primary learning outcomes for five types of stakeholder (policymakers, research communities, business and industry, civil society organizations and science educators), which are common to all stakeholders as well as specific to each stakeholder. The proposed learning outcomes in the above-mentioned document can be tailored according to the thematic of the relevant research and innovation attempt and to specific circumstances, challenges or aspirations. It is also crucial that the university community, including staff at all levels (lecturers, researchers, technicians, managers, communication officers), becomes acquainted with RRI. These ten questions to prompt reflection on practice can help tail the learning outcomes to various stakeholders and settings.

Some useful, stakeholder/institution-specific RRI training materials and approaches are as follows:

- a series of modules on RRI, the founding principles, applications, showcases, etc., developed by RRI-tools
- a compilation of materials to be used for training on RRI implementation in a company, developed by Centre for Social Innovation
- ten training programmes to teach university students about RRI, developed by Higher Education Institutions and Responsible Research and Innovation Project
- a comprehensive training session on RRI principles, organized by UNIMED for the Action Research Units of the Project RAISD - Reshaping Attention and Inclusion Strategies for Distinctively Vulnerable People among the Forcibly Displaced
- a training course devoted to identifying and avoiding scientific fraud and misconduct, developed by Training and Resources in Research Ethics Evaluation (TRREE)

Learning is a dynamic process. Different methods of transferring knowledge and experience should be considered while designing the training. Lecture-style or interactive workshops are among the most preferred methods since they unlock the flow of knowledge and experience. To reflect the dynamic nature of learning, models of teamwork and mentoring in multidisciplinary settings should be encouraged throughout the process.

Some alternative approaches to vitalize and facilitate the learning process are as follows:

- **Learning from errors.** Experimental investigations indicate that errorful learning followed by corrective feedback is beneficial to learning. Interestingly, the beneficial effects are particularly salient when individuals strongly believe that their error is correct: Errors committed with high confidence are corrected more readily than low-confidence errors. Corrective feedback, including analysis of the reasoning leading up to the mistake, is crucial (Metcalfe, 2017). Please see the open-access review article Learning from Errors for more details.

- **Promoting reflective learning among the stakeholders.** Reflective learning involves actively monitoring and assessing your knowledge, abilities, and performance during the learning process to improve the process and its associated outcomes (https://effectiviology.com/reflective-learning/). Please see Reflective Learning: Thinking About the Way You Learn for more details and please consult **Section 3: Measuring RRI Outcomes** and **Section 5: Self-Evaluation Tool for HEIs** of this toolkit.

### T3.5.2. Living Labs as a setting for RRI: A Step-by-step plan for the set-up of a living lab under RRI principles

As previously indicated, living labs may serve a multitude of goals, they may involve (a larger or smaller group) of heterogeneous stakeholders, and they may engage these actors in various activities. Following the distinction made in the dissertation by Schuurman (2015), we separate between three levels of analysis (p.184):

- Micro-level: Living labs as a set of methodologies or tools to involve end-users

- Meso level: Living labs as the given shape in the context of an innovation project, which has a concrete beginning and ending in time

- Macro-level: Living labs as a public-private partnership or infrastructure that includes stakeholders and organizations from diverse backgrounds to carry out living lab research or living lab projects that may endure over time. Usually, the macro-level focuses on innovations with a territorial link or focus (like a city or a region).

Here we focus primarily on the meso and macro levels: we will distinguish steps to be taken to shape living labs involving multiple stakeholders in projects and in forming public-private-people partnerships and infrastructures which encompass single projects and endure over time and may host a variety of projects focussing on complex social problems such as waste reduction, sustainable energy production/use, digitalization, circular economies, etc.

There are already various step-by-step methods available to shape living labs, focusing on the meso and macro levels. Some focus on developing innovations to give them a fluid and successful introduction into the market (Bergvall-Kareborn et al. 2009; Ståhlbröst et al. 2012); others aim for living labs that serve broader societal goals in cities or regions (Pye et al. 2018; Malmberg et

al. 2017). Building on these examples, we distinguished the four steps below for the general shaping of living labs and explained how they could be made to match RRI principles and process requirements. Below the steps, we have included a table of possible tools and methods that can give practical shape to these steps.

**Step 1: Inclusive setting of the innovation agenda**

Responsible Research and Innovation demand to tailor research and innovation to societal needs, demands and preferences. Therefore, citizens and end-users have to be involved from the beginning onwards, for example, in selecting questions or topics that innovators should focus on. Initiatives have been taken, for example, to involve citizens in shaping a research and innovation agenda, such as patients in the agenda for biomedical research (Abma et al. 2015; Abma 2018) or in the evaluation of research proposals and their selection for funding (O'Donnell et al. 2004), or citizens at large for all types of research and innovation. Arguments for that were that this is believed to increase the chances of successful implementation of innovations, increase the democratic legitimacy of science funding policy, but also that citizens and envisioned end-users have valuable experiential knowledge which can complement the knowledge of scientists and other innovators in defining the priorities that deserve attention. In addition, it is mentioned that end-users have a moral right to engage in decision-making on the research agenda since they are affected by it. Schölvinck et al. (2020) list these arguments, for example, for the involvement of patients in setting the agenda of biomedical research.

Not all innovation is science-based and funded by public research money. A lot of innovation is realized by companies and governments. Suppose the public is involved in setting the agenda for public research funding institutions. In that case, they will not be able to influence a lot of innovation that is taking place. For our purposes here, however, it may be argued that HEIs can take a role in making the innovations they seek to realize to respond to citizens' priorities. HEIs can take the initiative to engage citizens and shape a research and innovation agenda (e.g., once in three years) to which their work will respond. In this way, HEIs can take a role in making sure that the innovation they seek to realize in collaboration with companies or governments reflects the priorities of citizens from the very start onward.

**Step 2: Exploration of desirable and undesirable futures**

Given the research and innovation agenda shaped by citizens, innovators need to formulate a specific innovation goal. LL usually start with a general innovation idea, which is cocreated by partnerships involving the 'p'-representatives: public-private-people. This can be done in various ways.

As noted before, many living labs focus on identifying needs and aim to attend to these needs with their innovation. The living labs handbook developed by Malmberg et al. (2017) sketches how this process would proceed. They suggest that innovators start by distinguishing between the 'current state' and the 'future state', which is the desired situation that the innovation should help bring about. Following the approach of New Product Development, Malmberg et al. propose

to seek a 'problem-solution fit', in which the 'current state' contains a problem or need, which is imagined to be resolved or 'fixed' by the innovative solution in the anticipated 'future state' (Malmberg et al. 2017: 14). Hence, the 'exploration phase' of living labs involves a better understanding of the current state and its problems and needs by getting an overview of potential users' current habits and practices and what they experience as problems or needs. Malmberg et al. also advise seeking to dive deeper and articulate the latent needs, which are not immediately apparent, using explorative methods such as (participatory) observation, qualitative interviewing, focus groups, and dialogue. The resulting understanding of the needs, including the latent needs, leads to ideas about improving the desired 'future state' context. Using brainstorming sessions and co-creation techniques involves envisioned end-users developing innovation concepts that allow creating the current state (with problems and needs) towards the future state (in which the problems are resolved and the needs are met).

In an RRI line of thinking, this explorative phase of the LL would advise taking into account (a) disagreements between people about what the problems or needs are to which innovations seek a solution, and (b) the tendency of innovation to produce unexpected and unwanted effects because of the changes it brings about in the social context. Often innovators have a too limited perspective on the changes that their innovations can bring about, imagining that the context will stay the same and their innovation will only solve a problem. But in practice, people often change their ways in response to the arrival of new technologies, such as when energy-saving light bulbs lead to more energy use instead of less as leaving the light on becomes cheap. As the Jevons paradox mentioned earlier illustrates, innovations may have the opposite effect than intended initially if their consequences for people's choices and (inter-) actions are not taken into account.

In RRI literature, (technological) innovation is often not just regarded as a problem-solver. Still, as a world-shaping force that shapes human beings, including how they look, think, experience, act, relate, their expectations and responsibilities, and how those responsibilities are distributed (Swierstra et al. 2009; Klerkx et al. 2012). This view of human-technology relations as complex, profound, and life-changing roots in rich descriptions provided in Science and Technology Studies (Bijker and Law 1992; Borgmann 1984; Latour 1996; Verbeek 2005). Seeing technology in this way would demand to consider to look beyond the needs or problems that technologies are requested to resolve and explore the broader impacts that technology may have on human (social) life, the desirable ones and the undesirable, the unforeseen ones.

Adopting an RRI perspective to living labs requires engaging in a broader exploration of the future with innovation. This may demand HEI's start by making an overall stakeholder analysis related to the innovation at hand and engage them in a reflection about the future to come to a rich understanding of the changes that the innovation will bring about in human (social) life and the ethical questions this may raise. To do this, explorative techniques are needed, such as narrative scenario studies, visioning exercises, and backcasting experiments that prioritize desirable futures and work backward to identify the innovations (products and social processes) to realize them. This may serve to engage the various stakeholders in broader anticipation of the future,

which may provide insight into differences of opinion regarding the problems and the preferred ways to attend to them, and increases the chance that possible changes it can bring about in human action and interaction which effect the intended effect of the innovation can be anticipated.

**Step 3: Experimentation in 'real-life' co-evolution settings**

Specific for a Living Lab approach is the 'real-life' setting in which experimentation with an innovation takes place, which allows getting a better perspective on the performance of the innovation. According to Malmberg et al. (2017), this serves to 'test' the concept of the innovation developed in the previous phase and see whether it succeeds in meeting the needs it is supposed to meet. Based on this test, Malmberg et al. suggest that a decision should be made regarding whether to proceed with the innovation or return to the previous phase and re-design the concept.

As noted, however, RRI aims to consider the broader effects that innovations can have on human (social) life. This imposes specific demands regarding the choice or design of the living lab setting. It may be advisable, for example, to seek a variety of social contexts to experiment with the innovation. Different learnings may result, for instance, from experimentation with a (digital) innovation on small farms growing diverse crops through the year, as opposed to large industrialized farms which grow a single crop (Bronson 2015). Similarly, autonomous driving cars may function differently in a provincial city in Canada where car traffic is organized in a pretty straightforward way, compared to a European city containing next to vehicles and pedestrians, trams, bikes, and motorcycles (Engels et al. 2019).

An RRI approach to living labs would require looking at living labs as an occasion to experiment with the co-evolution of (technological) innovation and society. Not all living labs succeed in doing that. Sometimes they are designed in a way that avoids discussion about the societal or governance aspects; for example, when self-driving cars are introduced in parts of a city and those interacting with it are asked to act as if (controversial) governance arrangements to make their use acceptable are already in place. Starting from an RRI perspective, it would be better to design and use living labs as is proposed by Engels et al. (2019) as an opportunity to co-develop the technology as well as the social and regulatory frameworks in tandem. This would mean that experimentation in living labs should look at the performance of the technology and describe the social meanings, including the controversies and value conflicts that it raises. Disagreement about the desirability of innovation should be recognized and used as an occasion to reflect and seek the dialogue, and this should be an integrated part of living labs.

In an RRI approach to LL, looking at the innovative (technological) product and the social context in which it is to land is imperative. Both aspects demand attention in connection to each other, as the experimentation phase's goal is to understand better the performance of the innovation and its societal meaning and value. Real-life settings (or 'as real as possible') allow to experiment with the scenarios developed in the previous step 2 and find out whether they are realistic,

feasible and assess whether they are as desirable as expected. This can be researched through ethnographic research, qualitative interviews, focus groups and dialogues.

**Step 4: Evaluation of the innovation**

The goal of living labs is to put the innovation to the test in a real-life context, which allows assessing its performance. Malmberg et al. (2017) propose to use the experimentation as an occasion to compare the actual performance of the innovation in the living lab with the exploration phase, during which a perspective was shaped to the ' future state' that the innovation aimed for. Based on the living lab performance of the innovation, it is possible to evaluate whether the innovation successfully produced the intended initial results: the described future state in the exploration phase provides the benchmark for assessing the performance of the innovation during the experimentation phase.

However, an RRI perspective needs to make room for the experimentation phase to provide new insights into the desirability of the perspective to the future developed in the exploration phase. This means that this perspective to the future may require revision. An evaluation may need to re-write the scenario, adding elements that foster the more fruitful co-evolution of the innovation in society and listing desired changes in either the innovation product or the context in which it is to land. This may result in a list of 'to-do's not just for the developers of the (technological) innovation or the product, but also for other actors, such as managers and employees of organizations in which the innovation is to land or governments. Given that representatives of the quadruple helix are already engaged, this evaluation phase would help align activities and help actors take up their roles in the innovation process.

### T3.5.3. Useful Tools and Methods for RRI-proof living labs

Many different methodologies could be used to carry out the four steps described above. Making use of the RRI tools that were provided in a previous project, we distinguish possible tools to be used in every step in the table below (https://rri-tools.eu/en/).

There are also other useful tools to be found to do these steps. We have assembled some of them in Table 6. These can also be selected to conduct some of the steps in an RRI way of conducting living labs.

**Table T3.5.1**. Tools and methods of the four steps

| **Step 1**<br>**Agenda setting** | **Step 2**<br>**Exploration of the future** | **Step 3**<br>**Experimentation** | **Step 4**<br>**Evaluation** |
|---|---|---|---|
| To make an inclusive research and innovation agenda, it is important to obtain a broad overview of the population targeted by the research and innovation activities. For example, a biomedical research agenda may focus on a different part of the population than agricultural innovations. The map of relevant population members to include should, pay attention to diversity (gender, age, socioeconomic status, ethnicity, etc.). | To make sure that the exploration is carried out in an inclusive manner, it is again important to do a stakeholder analysis, related to the innovation at hand. It is important to include diverse stakeholder group and pay attention to gender, socioeconomic status ethnicity etc, as well as to their relative power/influence over the innovation at hand (such as for biomedical research, farming, security etc.). It is also important to consider including stakeholders which may not be stakeholders yet but may become stakeholders in the future. | Real-life settings (or 'as real as possible') allow to experiment with the scenarios developed and find out whether they are realistic, feasible and assess whether they are as desirable as expected. This can be researched by means of (participatory) observation ethnographic research, qualitative interviews, focus groups and dialogues. | After the experimentation phase ends, the outcomes have to be described and evaluated with respect to the scenarios developed in step 2. This will be done during reflective focus groups and/or dialogues with stakeholders. Based on the experimentation, stakeholders are invited to reflect on (a) the realistic feasibility and (b) desirability of the scenarios that were originally preferred.<br><br>This may lead to (a) a list of changes that need to be made to the scenario that was originally preferred, or (b) to the technology. |
| To shape a research and innovation agenda, it is first important to engage members of the population and then to prioritize themes on the eventual agenda. Engagement can involve in-depth (group) interviews with members of the population, focus groups and/or dialogues. Prioritization concentrates on converging the issues to create an informed focus. This can be done through a Delphi study or online questionnaires (e.g., SurveyMonkey, Typeform, or Google Forms). | Diverse stakeholders should be engaged in a reflection about the future with the innovation, in order to explore potential impacts and reflect on their value. Narrative scenario studies, socio-technical scenarios and visioning workshops are often used for this purpose. What is important is to pay attention to the diversity of impacts that an innovation can bring about, for various people and to look how these impacts are assessed in various ways by different people. In the analysis, it is important to keep track of the variety of impacts that diverse stakeholders bring forward, as well as the different ways in which they evaluate | | Based on the evaluations of stakeholders, different options may result. Scenario's will have to be revised, including the steps that have to be taken to realize them. Possible methods to do that are: scenario writing and backcasting workshops.<br><br>Furthermore, the evaluation may lead to new insights into the (technological) innovation product. A list may be made of values that need to be included in the design of the product and a method of value-sensitive design can be employed to turn them into design |

| | | | |
|---|---|---|---|
| | them. It is important to distinguish and note value questions and conflicts. | | requirements for the product. |
| After the agenda has been set, it needs to be implemented by HEIs. This means, for example that HEIs have to consider how they want to make sure that researchers and innovators align their proposals with the agenda. This can be done, for example, by using the agenda for the internal assessment of internal assessment of proposals, or by requiring researchers and innovators to relate to the agenda in their proposals for funding in internal funding programmes and calls. Including stakeholders in programming committees and scientific advisory boards can also help. | After the scenarios have been shaped, the test environment should be selected or designed. This can be done using a backcasting experiment, which involves stakeholders in a workshop and invites them to think 'backwards': on the basis of a preferred scenario, the stakeholders identify the steps that ought to be taken to get to the preferred scenario. This preferred scenario, as well as the steps taken to get there, are input for the design of the experimentation environment (the living lab) where the technology as well as the social constellation around it is realized and experimented with. This allows to 'test' the technology, but also the 'preferred social scenario' around it. | | |

**Table T3.5.2**. Useful tools and methods that the stakeholders should be equipped with (Sources:
(1) https://wial.org/action-learning/
(2) https://rri-tools.eu/en/how-to-stk-bi-how-to-boost-creativity-and-involve-people
(3)https://rri-tools.eu/en/how-to-stk-bi-how-to-consider-future-impacts
(4) https://behavioralscientist.org/a-new-model-for-integrating-behavioral-science-and-design/)

| Method | Description | Uses |
|---|---|---|
| Lead User Method | The Lead User method is based on recognizing that innovations are often driven by particularly progressive users and customers and not by the manufacturers. Lead users are advanced users or inventors, pioneers in their field, who feel the needs before the masses have them. They should be involved at the earliest possible stage. LEAD users are often dissatisfied with the products or processes on the market, benefiting greatly from an innovation themselves and providing precious inputs. They know the product well, have already thought about its weaknesses and possibilities for improvement and are highly motivated. However, finding them can be tricky. Consulting companies have specialized in tracking down lead users. *continue reading* | • Boosting creativity in multi-stakeholder settings<br>• Problem identification |
| Crowd-sourcing | Crowdsourcing uses unique internet platforms to address many people quickly and to involve them in the different phases of an innovation process. This can be, for example, | • Boosting creativity in |

| | | |
|---|---|---|
| | troubleshooting or optimizing the usability of the new software (crowd-testing). It is also straightforward to conduct surveys on the needs of potential customers. The gathering of ideas (crowd-sourcing) and the search for joint financing (crowdfunding) are also part of this. The advantages of crowdsourcing are its speed and wide reach. Its disadvantages may be that you do not know exactly who will participate and that the communication only takes place in writing (which, compared to a direct meeting, shortens the content and makes it almost impossible to ask questions). *continue reading* | multi-stakeholder settings |
| Headstand Method | The desired result is available as a question, e.g., "What can we do so that our customers get XY? However, the "upside down" question "What can we do to make sure that our customers do not get XY in the first place? If enough ideas have been developed here, findings from these are transferred to the original question. The method helps to break out of entrenched patterns of thought and to look at the essentials. Besides, answering the headstand question can be a lot of fun and thus stimulate the flow of ideas. *continue reading* | • Boosting creativity in multi-stakeholder settings<br>• Problem-solving<br>• |
| Action Learning | Action Learning tackles problems by first asking questions to clarify the exact nature of the problem, reflecting and identifying possible solutions, and only then taking action. Questions build group dialogue and cohesiveness, generate innovative and systems thinking, and enhance learning results. The components of the action learning process are as follows:<br>1. A problem (that is urgent, significant, and the responsibility of the team to resolve)<br>2. An action learning group or team<br>3. A process of insightful questioning and reflective listening<br>4. An action taken on the problem<br>5. A commitment to learning<br>6. An action learning coach<br>*continue reading* | • Problem-solving<br>• Team building |
| How to consider future impacts | Foreseeing the potential impacts of innovation is an essential part of RRI. RRI-Tools suggests impact assessment by (1) identifying multiple effects of innovation, (2) determining the effects of innovation, (3) (co)designing the effects of innovations and (4) acknowledging challenges and limitations of impact design. The approach suggests three different techniques and tools for impact assessment, among others, that can be employed: observation of trends that generate new markets, promoting "out-of-the-box" thinking, and development of scenarios (the story of possible future development). *continue reading* | • Impact assessment |
| Employing behavioral science in design problems | This is not exactly a tool but more an approach that can be applied to RRI. Behavioral science can contribute to the field of design that is a "strategic lens" for "embracing user context, recognizing the need to solve at the level of systems while also keeping one eye on the future by building solutions that are designed to adapt". Behavioral science deals with the struggles with uncertainty, cognitive biases and heuristics that can hinder adherence to innovation and often renders insight or evidence that can shed light on innovation strategies. *continue reading on how design problems can benefit from behavioral science*<br>Some of the relevant cognitive biases that can help solve design problems are bounded rationality, choice overload, confirmation bias, and the endowment effect. | • Problem-solving<br>• Design thinking<br>• Innovation design |

## T3.6. SELF-EVALUATION TOOL FOR HEI

This section covers the necessity of developing a self-evaluation tool that will use the results of Section 3 to evaluate the level of embeddedness of RRI in the HEIs.

### T3.6.1. Existing Self Evaluation Tools for RRI (RRI-Tools)

This section should be grouped under at least two steps being relevant to the RRI-Tools concept. As a first step, best practices should be defined for HEIs, and for the second step, self-assessment tools for RRI should be developed. In the first step, the quality criteria serve as a framework to evaluate the degree of responsibility for HEIs (Yusuf et al., 2017). Coupled with the right methodology, the criteria are used to select (very) promising RRI practices collected through the Stakeholder Consultation in the context of the RRI Tools project. In the second step, the quality criteria serve as indicators for the self-assessment tool that is to be developed by the RRI Tools activities. RRI tools act as a facilitating mechanism that explains the RRI principles to its users while ensuring the implementation of the adopted principles. Thus, these tools contain user guides, facilitating users to understand and apply RRI principles (Groves, 2017). To sum up, different quality criteria might provide specific guidance to various stakeholders in different ways advancing RRI. Tools such as the self-evaluation tool should provide more structure than the generic list presented in this report.

The quality criteria evaluated in this context aim to draw a helpful framework for people working in entrepreneurship and innovation within the scope of HEIs and in various institutions and organizations. For example, experts who make plans in research and development departments can take their work to different innovative approaches by taking advantage of these criteria. If this material matches the RRI vision, the requirements identified will create an extra dimension in creativity. The core factors that make up the RRI vision can be summarized in the following three items.

- factors related to cooperation and power,
- factors that ensure the social and moral wellbeing of people and, in doing so, can incorporate future sustainability plans into the process,
- factors based on process improvement, which are compatible with the principle of cooperation for individuals and institutions.

Self-assessment tools are an essential element of the work done within institutions and organizations concerning RRI tools. A mastery of available self-assessment tools is necessary to explain the development of HEIs and the basic principles they have adopted. Therefore, this section is an excellent guide to explain the main features of self-assessment tools. The RRI process operates so that the outputs of research and innovation are compatible with the needs of society. While doing this, the stakeholders contributing to the process should think specifically about the RRI self-evaluation tools, take responsibility and operate in solidarity. Therefore, it is necessary to develop and disseminate good practices to disseminate RRI culture on a solid basis. In this way, social and technical studies progress by supporting the views of the participants. It is essential to use this mechanism to develop shared views in self-evaluation tools with a good communication network.

The idea of a self-assessment tool is by no means novel, not even in the context of RRI. The probably most prominent example of such a tool is the RRI-tools self-reflection tool (https://www.rri-tools.eu/self-reflection-tool). Several projects in the area of RRI have developed either full-blown self-assessment tools or documents or other activities that serve a similar purpose. The first one was probably developed by the Karim project, which went under responsible innovation diagnosis in ICT. This project focused in particular on small and medium-sized enterprises active in the area of ICT. A third example is the responsibility navigator that was a result of the ResAgorA project (http://responsibility-navigator.eu/navigator/).

### T3.6.2. Customizing the Self-evaluation Tool According to the Needs of Different Stakeholders

There are many opportunities for self-evaluation tools to design and then deploy existing applications. This means that the systemic improvement in RRI tools can easily be shaped according to needs in the future. This is the main goal in the development of new self-evaluation tools. The developed self-evaluation tools have a guiding effect on entrepreneurs who want to advance in research and innovation. It also acts as a trigger for supporting activities and new ideas to implement RRI objectives. In addition to this individual benefit of the customized self-assessment tool, there is a second purpose that it is hoped to achieve. This is the development of a baseline that will allow RRI to compare projects, users, technologies, or sub-disciplines. The idea here is not so much that it would be possible to identify objective measures or metrics of RRI. Instead, an attempt to quantify stages of RRI development will provide input into discussions about areas worth developing further.

The idea of a self-evaluation tool is related to the RRI tools concept, but it is not directly related to it. The number of case studies in this field is increasing day by day. In RRI, there are self-evaluation tools developed using RRI tools or some new related projects. RRI tools constitute a significant factor in the development of self-evaluation tolls. For example, models in which responsibilities are shared according to needs are at a level that will attract the attention of many businesses. In addition to the existing tools, many studies and project proposals state the necessity of using RRI tools in self-evaluation tools. There are different evaluation factors to consider when developing self-evaluation tools models in business development processes:

- Motivation (purpose)
    - Motivation to do the research
    - Motivation to engage with RRI-tools
    - Ethics (intended outcomes)
- Process
    - Anticipation
    - Engagement
    - Reflection
    - Governance
    - Ethics (research ethics)
    - Responsiveness

- Outcomes (product)
    - Gender/equality and diversity
    - Open access
    - Social justice/inclusion
    - Sustainability
    - Science education

The personalized self-assessment tool should serve the principle of accessibility. To increase working efficiency, it should be accessible to everyone. However, certain types of users and interests may be appropriate to use the service offered for a specific purpose. Below are the key beneficiaries of customized self-assessment tools that might be useful and accurate.

- Researcher: The researcher can work on a project proposal to obtain funding from public institutions or organizations. This proposal must comply with the RRI requirements. Self-evaluation tools to be made in this direction will also be shaped to support business efficiency.
- Leader: The leader is responsible for measuring whether the work carried out in a body responsible for research and development matches the existing standards. Since the organization they work in is busy finding funding and getting incentives for new projects, these people need to support the process using effective customized self-evaluation tools. This is beneficial depending on the optimization of the process due to the use of effective self-evaluation tools.
- Organization: The organization is the structure whose establishment purpose and scope of activity are focused on research and development and which try to produce added value in terms of social and moral values, among the organization's objectives.

As well as designing customized self-evaluation tool formation activities, it is necessary to monitor the activities and receive feedback with an effective method. Although the evaluations are shaped as systematic measurements, they can also consist of studies in surveys. By evaluating the results obtained, it is also possible to comment on the efficiency of connecting self-evaluation tools with RRI tools.

## T3.7. BEST PRACTICES / CASE STUDIES

A selection of best practices/case studies based on different already implemented projects related to RRI and Living Labs are briefly presented below. Links to the sources of the information are provided for further reading and exploration.

### T3.7.1. V4Innovate

Technology alone does not create an energy transition. But the energy transition cannot be achieved without innovative technologies and complementary business models. This requires socially acceptable technologies and business models. Therefore, a research project V4InnovatE

addresses the social acceptance conditions for technical energy transition innovations on which the diffusion and thus effectiveness of innovations for energy transition goals depends.

**Source 1:** https://www.v4innovate.de

### T3.7.2. Gonano Project

The business case for co-creation seems to look stronger if it is interpreted broadly as the potential to realize the value in the broader sense for all innovation actors. For researchers, co-creation could help define new inroads for research, gain access to future technology users, and attract new funding sources. For policymakers, co-creation could offer solutions to wicked problems that carry broader stakeholder support. The GoNano experiences provide initial clues to the potential added value for producers, researchers and policymakers. However, to make a convincing business case for co-creation, many more compelling examples are needed of the added value of adopting iterative, product-focused, transdisciplinary collaborations as part of innovation processes in research, innovation and policymaking.

Download the report here: GoNano D5.4 – The business case for co-creation. Read the full report here: D-2.1 Method and manuals for pilot studies Gonano Project Youtube Channel: **https://www.youtube.com/channel/UC3QGpL7UIG7F4HalyIaW06A**

**Source 2:** http://gonano-project.eu/about-gonano/

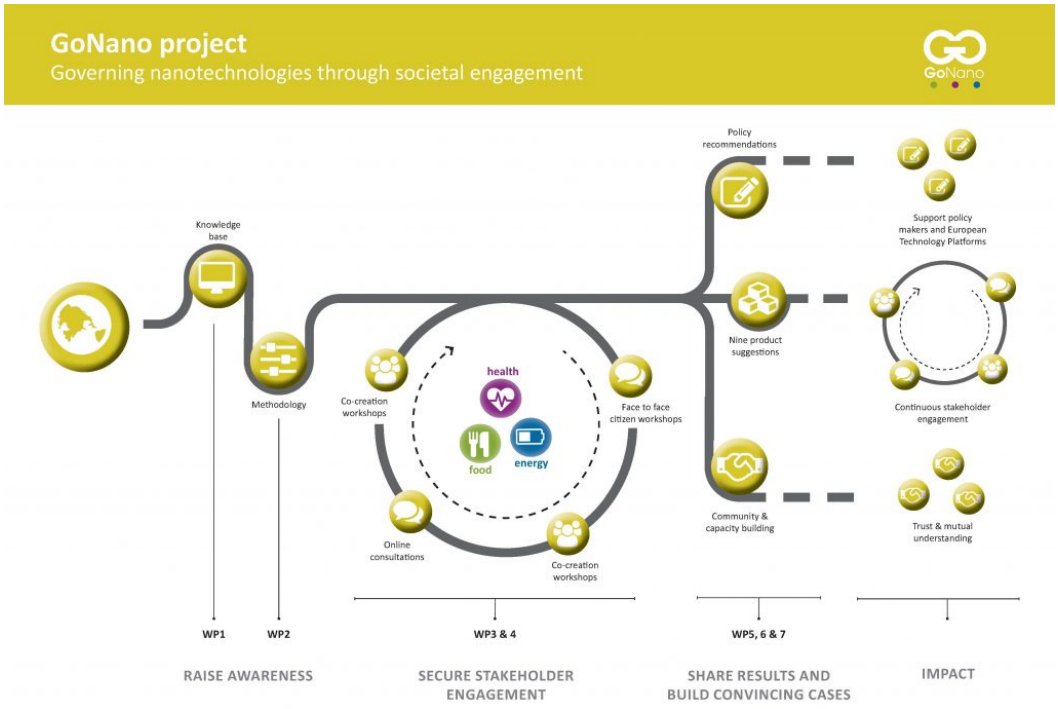


**Figure T3.7.1**. Governing nanotechnologies through societal engagement

(Source: http://gonano-project.eu/about-gonano/)

### T3.7.3. Newhorrizon

NewHoRRIzon is a project that aims at further integrating Responsible Research and Innovation (RRI) in the research and innovation systems on national and international levels. The concept RRI is an approach that intends to bridge gaps between science, research and innovation communities and society at large by fostering more inclusive, anticipatory, open and responsive research and innovation systems. In this frame, multiple stakeholders (from research, business, policymaking, education, and civil society) are involved in research and innovation on the project and system level to better align its processes and outcomes with society's values, needs, and expectations. The first big step was the operationalization of RRI into the following six key elements: ethics, gender equality, governance, public engagement, science education and open access.

**Social Labs in NewHorrizon**

Click on the Social Labs in the same image in the link below to get more information.

**Source 3:** https://newhorrizon.eu

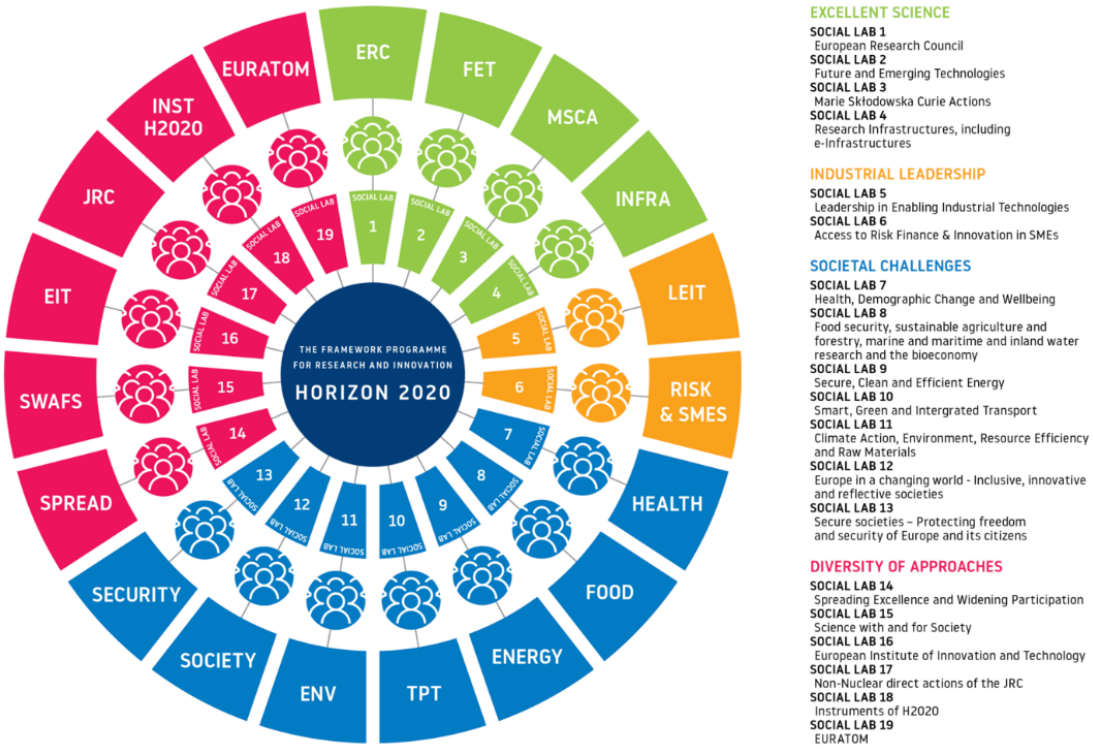


**Figure T3.7.2.** Living Social Labs (Source: https://newhorrizon.eu)

### T3.7.4. Social Labs as an Inclusive Methodology to Implement and Study Social Change: The Case of Responsible Research and Innovation

First, RRI results from complex, distributed social interaction mainly amongst academics (theorizing about RRI), policymakers, researchers, and innovators (implementing RRI). Therefore, it must be regarded as a social phenomenon. Second, the properties of RRI are not yet known in advance, nor can they be reduced to the individual contributions of the actors involved. Instead, they gradually come into existence during and resulting from the social interactions of the different actors. This process of emergence can be understood as a hermeneutic process. To capture the overall phenomenon, we must understand the interaction between individual contributions (Gurzawska, 2020).

**Source 4**: https://www.tandfonline.com/doi/full/10.1080/23299460.2020.1787751

### T3.7.5. Prisma

The *PRISMA-project* developed a practical guideline and contributed to a new standard for companies to build a strategy for Responsible Research and Innovation(RRI).

Starting points: 1) Pilots with eight different companies in the field of automated cars, internet technology, drones, biotechnology, synthetic biology, and nanotechnology, 2) Safe-by-Design, 3)End extensive consultations with industry and standard organizations.
Prisma Project Youtube Channel:
https://www.youtube.com/channel/UCQiRX8z6QIBHFfanlmvftLA/videos
**Source 5:** https://www.cencenelec.eu

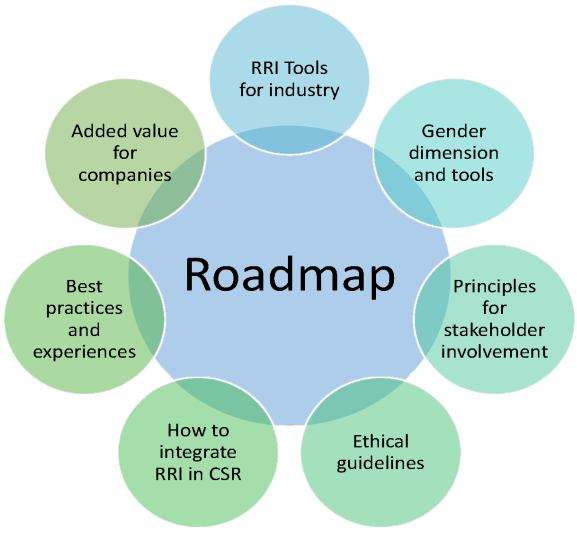


**Figure T3.7.3.** Roadmap of the PRISMA Project (Source: https://www.cencenelec.eu)

### T3.7.6. Fit4RRI

Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policymakers, business, third sector organizations, etc.) work together during the whole research and innovation process to better align the process and its outcomes with the values and expectations of society.

RRI has **6 key components**: 1) Public and Societal Engagement, 2) Open Access, 3) Gender equality, 4) Ethics, 5) Science Education, 6)Governance

**Source 6**: https://fit4rri.eu/project/

### T3.7.7. RRI-Practice

RRI-Practice is a 3-year project under Horizon 2020. Its aim is to understand the barriers and drivers to the successful implementation of RRI both in European and global contexts; to promote reflection on organizational structures and cultures of research conducting and research funding organizations, and to identify and support best practices to facilitate the uptake of RRI in organizations and research programs. The project will review RRI related work in 22 research conducting and funding organizations and develop RRI Outlooks outlining RRI objectives, targets, and indicators for each organization.

**Source 7:** https://www.rri-practice.eu

### T3.7.8. ENoLL

The European Network of Living Labs (ENoLL) is **an international non-profit association** that aims **to promote and enhance user-driven innovation ecosystems**, more precisely, the Living Labs concept globally. ENoLL focuses on facilitating knowledge exchange, joint actions and project partnerships among its historically labeled +475 members, influencing EU policies, promoting living labs and enabling their implementation worldwide.

**What are Living Labs?**

Living Labs (LLs) are defined as user-centered, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings. LLs are both practice-driven organizations that facilitate and foster open, collaborative innovation and real-life environments or arenas where both open innovation and user innovation processes can be studied and subject to experiments and where new solutions are developed. LLs operate as intermediaries among citizens, research organizations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses. LLs have common elements but multiple different implementations.

**Source 8:** https://enoll.org/

### T3.7.9. Covid-19 and the Onlineification of Research: Kick-Starting a Dialogue on Responsible Online Research and Innovation (RORI)

The COVID-19 crisis opened up discussions on online tools and platforms for academic work, e.g. for research (management) events originally designed as face-to-face interactions. As social scientists working in responsible research and innovation (RRI), we have to find new approaches to open up a dialogue on Responsible online Research and Innovation (RoRI), and deliberate particular socioethical opportunities and challenges of the onlineification in collaborative theoretical and empirical research. An RRI-inspired' going online' approach would mean, we suggest, trying to make academic events and research activities more inclusive, researchers' attitude to their work more reflective and suggest processes that are more responsive to societal needs and ethical concerns. For such systematic reflection, we recommend using the RRI-heuristic provided by Owen et al. and applying the dimensions of 'Anticipation, Inclusion, Reflection and Responsiveness' (AIRR) to identify and reflect on the dilemmas involved in 'going online' in one's research.

**Source 9:** https://www.tandfonline.com/doi/full/10.1080/23299460.2020.1789387

### T3.7.10. Co-Creating Smart Cities

This case study describes the T-City initiative and uses it as a best practice example of including Responsible Research and Innovation into the transformation process connected with making cities' smart'. The initiative aimed to showcase how modern information and communication technology can sustainably improve the quality of life and community living in Friedrichshafen. Starting with a general description of the initiative, the case study then focuses on the project area 'Health and Support'. It examines two specific projects to illustrate best practices for Responsible Research and Innovation. It shows that the goals and perspectives of different stakeholders can be united and that a win-win-situation can be generated. The T-City initiative was an inclusive approach in which societal actors worked together during innovation processes and became mutually responsive to each other to co-create the smart city of Friedrichshafen.

**Source 10:** https://www.fosteropenscience.eu/node/2368

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