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REINFORCING

Responsible tErritories and Institutions eNable and Foster Open Research and inClusive Innovation for traNsitions Governance

D.1.1 – ORRI Taxonomy

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SUMMARY

The major general target for REINFORCING is to empower EU institutions and territories to make tangible and long-term progress in the implementation of ORRI to steer the Green Deal and fair transition's governance. The REINFORCING vision is that institutions and projects with different levels of expertise can easily interact with other actors, learn from peers, and receive the support they need to take concrete steps in their journey to ORRI implementation. For this purpose, among other objectives, the REINFORCING project aims to create a virtual platform which will function as a One-Stop Source (OSS) for Open and Responsible Research and Innovation (ORRI) related tools, resources, and practices in Europe. The deliverable at hand serves these targets by reviewing current implementation of RRI principles, identifying existing gaps in ORRI implementation, and developing a taxonomy for the organisation of the OSS platform.

For these purposes, we conducted a scoping review on relevant literature, based on thematic interests, to explore the field of ORRI to identify the state of art in terms of its implementation across Europe and finding gaps in its implementation. This was done by consulting selected experts and by searching for literature in various databases. In addition to the scoping review of relevant literature, we completed a review of 201 EU-funded projects related to ORRI. The third data source were the semi-structured qualitative interviews conducted with 19 ORRI experts, mainly including thought leaders and practitioners in the field of ORRI (researchers, representatives of firms and policymakers).

Integration of ORRI principles into research and broader institutional contexts requires adaptation and innovative approaches. As some of the major elements of ORRI are anticipation of social and environmental impacts of research and innovation (RI) as well as engagement of stakeholders and citizens in the process to democratise it, foresight and anticipatory governance are introduced as promising tools bearing an array of reflexive-anticipatory heuristics and facilitating a more democratic development of science, technology, and innovation endeavours. At the same time, efforts at establishing foresight and anticipatory governance always need to be contextualised within the specific socio-political landscapes and require critical self-reflection: anticipatory governance may facilitate openness in innovation processes and the future development of socio-technical systems, or function as instrumental legitimization for predetermined normative milestones.

ORRI needs to become a permanent practice in organisations to have a sustainable impact on R&I processes. Therefore, the deliverable discusses institutionalisation understood as a process of becoming a permanent part of a society, system, or organisation (Cambridge dictionary on-line). These questions are enlightened from the theoretical perspectives of

neo-institutionalism, institutional entrepreneurship, and deep institutionalisation. While these approaches help to understand various aspects of institutionalisation processes, some of the practical conclusions are that the focus should be on tangible activities on the organisational level, and on building relevant linkages to sustainability and social responsibility-related policies, that can provide support for various ORRI activities.

ORRI is always situated in some specific context in which research and innovation occur which emphasises the need to tailor ethical, societal, and environmental considerations to these contexts. The deliverable focuses especially on organisational and territorial perspectives because they provide the institutional frameworks, resources, and collaborative platforms necessary to integrate ethical, societal, and environmental considerations into research and innovation processes. Some of the major observations include the complex nature of designing and implementing responsibility-related initiatives arising from intertwined local and global challenges, conflicting stakeholder demands, and a lack of implementation support. It can also be noted that despite many attempts and initiatives, also promoted and supported by the EU Commission, the operationalization of RRI in firms and regional policies is still in its infancy.

Practical implementation takes place alongside territorial and organisational processes in a wider policy landscape consisting of global and societal grand challenges. Therefore, the deliverable also discusses mission-oriented research and innovation policy, open science, and public engagement in R&I and R&I democratisation. Mission-oriented research and innovation policy is thought to provide a framework for addressing societal and environmental concerns. Similarly, open science appears to be contributing to an acceleration of research on global challenges, while empowering citizen participation and promoting equity and inclusivity. Public Engagement in R&I and R&I democratisation are considered important as they enhance, for instance, relevance and responsiveness in scientific research and innovation as well as foster trust in science.

In WP1, the REINFORCING Consortium has also conducted a gap analysis of the topics which have been less addressed or require more attention in the implementation of ORRI. As a general observation, actors interested in implementing ORRI approaches need to achieve systemic changes in society towards responsibility, sustainability, and transparency by acting as mediators, enablers, facilitators, and institutional entrepreneurs. To this end, practical tools and approaches are needed.

Following the review and analysis, the final part of the deliverable presents a two-dimensional taxonomy for structuring the OSS platform for ORRI.

1 INTRODUCTION

The major general target for REINFORCING is to empower EU institutions and territories to make tangible and long-term progress in the implementation of ORRI to steer the Green Deal and fair transition's governance. The REINFORCING vision is that institutions and projects with different levels of expertise can easily interact with other actors, learn from peers, and receive the support they need to take concrete steps in their journey to ORRI implementation. For this purpose, among other objectives, the REINFORCING project aims to create a virtual platform which will function as a One-Stop Source (OSS) for Open and Responsible Research and Innovation (ORRI) related tools, resources, and practices in Europe.

The deliverable at hand serves these targets by summarising the results of the REINFORCING WP1 "CONSOLIDATING evidence base" tasks 1 and 2 aiming to review previous and ongoing EU-funded, ORRI related projects, identifying best practices of implementation and institutionalisation, identifying current gaps in the implementation of ORRI and providing inputs for addressing them through REINFORCING grants. It should be noted that this deliverable is not an exhaustive, detailed report of all the collected documents and data, that would most likely require several hundreds of pages. The collected material will be used more widely in the platform and to identify potential funding targets for upcoming REINFORCING cascading grants.

In addition, the deliverable introduces a tentative ORRI taxonomy i.e., structuration of ORRI information to be used in the ORRI platform. It is tentative in the sense that only practice will show how functional it is and whether it needs to be adjusted to better serve ORRI information retrieval purposes.

For these purposes, we have conducted a review of Open Science (OS) and RRI projects paying particular attention to outcomes and relevant tools they have produced. These are the main components of the ORRI approach. We have reviewed relevant publications and interviewed key actors of selected projects and practitioners from institutions and territories. A framework of ORRI implementation dimensions and challenges was developed to guide the work. The framework with its reasoning is introduced in chapter 2 together with the utilised data and methods. This is followed by the results of the review in chapters 3 and 4. While the framework covers the conditions and challenges comprehensively, due to limited time and resources, we have focused on the most relevant dimensions in the vast domain of implementation of ORRI.

In addition, as indicated above, one task was geared towards identifying gaps and shortcomings of the current state of the art of ORRI through various approaches including an analysis based on the literature and project review as well as on a face-to-face workshop involving key actors. The results of the gap analysis and workshop are reported in chapter 5. The ORRI taxonomy which will be used as a structuration principle for the ORRI related information in the OSS platform is introduced in the final chapter 6.

2 ORRI REVIEW FRAMEWORK AND DATA

In this review we use two interrelated concepts: Responsible Research and Innovation (RRI) and Open and Responsible Research and Innovation (ORRI). RRI has many definitions but broadly it refers to the anticipation and assessment process by which various societal expectations and impacts of research and innovation are considered to make it socially and environmentally sustainable. For instance, for the European Commission, RRI "means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society". ORRI, in turn, reflects the emphasis of open science and innovation as part of the RRI practices. While open science has been embedded in the idea of modern science and been all the time part of the RRI thinking, it has been increasingly emphasised by the European Commission since its vision of the Open Innovation, Open Science, Open to the World (3Os) during the latter part of the 2010s. Its significance has also increased with the constant expansion of the open science movement (see chapter 4.2). The REINFORCING project emphasises this organic interconnectedness and supports ORRI related practices and processes. However, in the review, we are mostly using and discussing RRI as it is the predominant term in the literature we are reviewing and referring to. When we discuss and refer more widely to open and responsible research and innovation related practices and ideas as a whole, we use the term ORRI.

The following review collates relevant sources and expert perspectives on key aspects and dimensions of RRI. The reviewed material will be used to support projects funded through the REINFORCING cascading grants and the "One Stop Source" information platform. The aim of this scoping review was to scout the vast literature on ORRI and related discourses, thereby creating a "map" of the field of ORRI-related research and practice. The resulting report thus provides useful signposts for inclined organisations looking for entry points into this vast field.

To guide the scoping review, the REINFORCING WP1 team developed a framework connecting various aspects of the ORRI concept, ORRI-related change management, and relevant contextual factors. The following figure 1. summarises our view of the major concepts, approaches, and contextual conditions inspiring and affecting ORRI in theory and practice.

One can read the figure starting from the inner circle down in the figure to the outer circle up in the figure. The starting point is to understand and grasp the essential aspects of creating sustainable change in organisations. As we know there are a plethora of such

models (e.g. Demers 2007) and we have selected to represent more closely the well-known approach of institutional entrepreneurship as a model which is "summarising" the most essential aspects and questions of how to create and manage sustainable organisational or social change starting from the vision creation and proceeding via mobilisation of allies towards stabilisation phase. This approach has already been used in an RRI context for example by the Co-Change project to explain and support the uptake and institutionalisation of RRI[1].

A major issue for all the RRI related governance processes is anticipation (e.g. Owen and Pansera, 2019; von Schomberg, 2013): foreseeing the future impacts of applied scientific results, innovations, and technologies. Anticipation is about ensuring the realisation of socially and environmentally desirable results of research and innovation processes. The ideas and process of so-called anticipatory governance crystallise several aspects that are at the core of the whole ORRI process, introducing the sensitivity to values, inclusion of stakeholders, and democratic governance of processes.

These processes always take place in some wider context: like Matryoshka dolls, change processes are stacked from the smallest to the largest. In our case, nested contexts start from organisations, and widening step by step, to territorial contexts, positioned within wider national cultural, policy and economy-related "landscape" factors. All levels are in constant interaction with each other and affect the overall change process. Therefore, ORRI governance needs to consider territorial and organisational contexts. As the broadest and most crucial contextual layer, policymaking stipulates thematic priorities. In this review, we focused on mission-oriented innovation policy and societal challenges it seeks to address.

[1] Toolbox on implementing RRI on organisational and system levels. RRI Solution Cards - Challenges and solutions for implementing institutional change in RPOs and RFOs; https://zenodo.org/records/7703702#.ZAb6HnbMI2w

Figure 1. Review Framework

The review has been conducted as a mixture of expert selection of the framework topics, relevant literature, and keyword searches from databases. The participating experts have wide previous experience on the topics they have selected for the review. All the reviewed literature has been listed in the references list at the end of this document. For the review we utilised a common review template which can be found as annex (2). In addition to the selected literature review we completed a review of 201 ORRI related projects[2] by using a simple template including two synthesising questions: "What are the objectives and results of the project?" and "What kind of REINFORCING relevant approaches, methods and tools have been created in the project?" In addition, we listed links to the project's Cordis-website, tools it had provided, and other relevant project-related links. All the reviews have been conducted and stored using the review template.

The third data source for gap analysis were the semi-structured qualitative interviews conducted with 19 ORRI-related experts, such as key practitioners and leaders in this field (researchers, representatives of firms and policymakers). We were especially interested in interviewees´ views on successful implementation of ORRI, gaps and barriers in its implementation, possible tensions, and the longevity of implemented responsibility related changes. The interviews were conducted in two phases: First round during a workshop as

[2] The list of the reviewed projects can be found as an annex (1) and the projects are collected into a dataset, which can be found from the Reinforcing project site in Zenodo: https://zenodo.org/communities/reinforcingproject/records?q=&l=list&p=1&s=10&sort=newest

one-to-one interviews and second round as separate one-to-one interviews. The major themes and questions during the first round of interviews were:

- *The current state of the art of RRI,*
- *Responsibility & sustainability initiatives in Europe,*
- *Major deficiencies / gaps in RRI research and/or practice of implementing RRI,*
- *Needs to enhance RRI/sustainability/responsibility,*
- *What kind of opportunities for transformation in R&I ecosystems emerge when applying sustainability and responsibility values into smart specialisation?*
- *What kind of tensions are also associated?*
- *How can indicators help/hinder these processes?*
- *What are the prospects of RRI/sustainability/responsibility?*

The second round of interviews focused more on project level experiences and the interviews included as major questions the following:

- *Can you briefly describe the (process of successful) implementation of RRI-inspired practices (i.e., institutional changes) in terms of stakeholder engagement, new organisational standards, entities, or bodies (e.g., gender, ethics boards or labs)?*
- *What were the major barriers and enablers encountered during RRI implementation?*
- *Were there any good practice models (such as new approaches, practices, tools) arising from the project? If so, which ones? Please list and add resources (weblinks, documents, etc.)*
- *Do you think these practices and measures will stay in the long term? If so, why and how? And if not, why?*
- *Based on your project and experience, what do you consider as the "next frontier" in RRI practice and research?*

In the following, we first discuss the results of the review based on the above introduced framework and then discuss the "gaps" identified in the data.

3 APPROACHES AND STRATEGIES FOR INSTITUTIONALIZING ORRI

As discussed above, integration of ORRI into research and broader institutional contexts requires thoughtful adaptation and innovative approaches. There are various reasons for the challenges of institutionalisation, or, in other words, stable implementation[3], including e.g.,

- While ORRI encourages collaboration across disciplines, involving scientists, policymakers, industry, civil society, and the public, this kind of work can be complex due to varying perspectives, communication gaps, and conflicting priorities.
- Embedding ORRI requires sustained commitment, which can be challenging in a competitive and rapidly changing environment.
- ORRI suggests cultural changes in research organisations including open science practices, engagement with stakeholders, and considering ethical implications. This may cause resistance and fostering cultural change demands time and leadership support.
- Researchers may lack skills or incentives to engage with ORRI e.g. traditional funding models emphasise scientific excellence and economic impact.

In the following section, we address these challenges by discussing three bundles of conditions for institutionalising ORRI. The first one concerns the creation of a shared and future-oriented understanding of the responsibility targets and a basis for concerted action towards more open and responsible research and innovation practices. Anticipatory governance is a prominent approach to fostering stakeholder and citizen inclusion, value sensitivity, future orientation, and principles of good governance. A more actor-centric and hands-on approach to the institutionalisation challenges is provided by institutional and organisational theories applied in the RRI context. Since various contextual factors affect the stable implementation of ORRI, this section also discusses the influence of various territorial and organisational contexts that require specific attention.

3.1 Governance towards socially desirable ends

Foresight is recognized as a key instrument for promoting responsible innovation (Urueña et al., 2021). Since its conception about a decade ago (Owen et al., 2021b), RRI has been

[3] Institutionalisation is understood here simply as a process of becoming a permanent part of a society, system, or organisation (Cambridge dictionary on-line)

concerned with the question how research and innovation ought to be governed to ensure an orientation towards socially desirable ends. In this regard, anticipation and the mutual responsiveness of science and society have emerged as central notions characterising the required shift in the governance of and approach to research and innovation. To explore how research and innovation can be directed towards socially desirable ends, this section discusses the notions of anticipatory governance and mutual responsiveness based on a review of key publications.

Six Deficits of Research and Innovation Systems

In his contribution to the International Handbook on Responsible Innovation, Von Schomberg (2019) attests six deficits of the global research and innovation systems that RRI should address in an effort to direct research and innovation towards socially desirable ends: (1) an exclusive focus on risk and safety of governmental regulation, (2) market deficits in delivering on societally desirable innovations, (3) a lack of alignment with broadly shared public values and expectations, (4) a focus on the responsible development of technology and technological potentials rather than on responsible innovation, (5) a lack of open research systems and open scholarship as a necessary condition for responsible innovation, and (6) a lack of foresight and anticipative governance for the alternative shaping of innovation in sectors.

The proposed strategies for change to address these deficits include (1) professional bodies that explore desired outcomes coupled with governance mechanisms that steer research and innovation processes towards these outcomes, (2) strengthening the role of public bodies and public funding to compensate for market deficits, (3) broad stakeholder involvement and public-private partnerships, (4) shifting the focus from technological potential to an anticipation of intended and unintended impacts (anticipatory governance), early and broad involvement of stakeholders and the public in general (deliberative governance), the systematic use of normative principles such as "privacy by design" (or the precautionary principle), and integrating insights, methods and tools from the social sciences and humanities whenever appropriate, (5) open science and scholarship, which implies a shift from publishing to sharing knowledge, early and openly, and from publishing and writing proposals[4] to delivering on societal relevance, as well as open research and innovation, which involves all relevant stakeholders in the co-production of knowledge and

[4] Research policy and funding play a significant role in the governance of research and innovation. Von Schomberg points to the self-referentiality of the scientific system and the focus on scientific excellence, commonly measured based on third-party funding and scientific publications, as key drivers of the reproducibility and the productivity crisis in science. Radical proposals to change the system of allocating funds and increasing the overall productivity and societal relevance of the scientific systems include a self-organising funding allocation system providing a basic research budget to research professors (Bollen et al., 2019) and lotteries (Gildenhuys, 2020).

outcomes, and (6) steering research and innovation processes into a meaningful democratic direction based on broad public deliberation, foresight practices, impact assessments of the socio-economic impacts on functional systems (such as the agri-food, the energy or the mobility sectors) for various options and scenarios, and normative technology design.

In short, the key ideas to establish a mutual responsiveness of science and society include broad stakeholder involvement, public deliberation, open science and open innovation and anticipatory governance accompanied by sophisticated assessments. Thereby, directionality towards socially desirable ends can supposedly be induced into research and innovation systems.

The Challenge of Inclusive Participation and Open Deliberation

Notably, notions such as deliberation, participation and open science which are heralded as solutions and approaches to rendering science more socially responsible and societally responsive come with institutional, conceptual, epistemic, and political concerns. Formats, methods and practices of deliberation, participation and openness have been scrutinised and problematized, especially in the fields of science and technology studies and transdisciplinary research. Institutionally and practically, a known problem is finding a room full of pensioners following an open call for participation. This observation does not only relate to practical questions such as choosing times and formats allowing broader societal participation but also to institutional questions of funding and the allocation of resources. While scientific researchers are paid for (some of) their time, this does not necessarily apply to NGOs, CSOs or individual citizens invited to participate in research projects. If participation is equated with voluntarism, it is not regarded worthwhile (or worth their while) by many. Conceptually, epistemically, and politically, recent developments recognize the (eco-)systemic nature of participation formats in the decentralised governance of socio-technical innovation systems (Braun & Könninger, 2018; Chilvers et al., 2018) and call for recognition of "participation as constitutive of (not separate from) systems of technoscience and democracy" (Chilvers & Kearnes, 2020, p. 348). In this regard, important considerations have addressed appropriate moments and processes of opening or closing (decision-making on) technological innovations (Stirling, 2008, 2010). Regarding the question when and how to open scientific research and political decision-making to public participation has since received considerable attention. Complementary to technology readiness levels, societal readiness has been proposed as a concept to trace and improve the societal maturity of research projects by asking researchers to anticipate, reflect, include, and respond at different, crucial phases in their

projects. To this end, the EU-project NewHoRRIzon (GA No 741402) developed the Societal Readiness Thinking Tool (Bernstein et al., 2022).

Foresight and Anticipation: Importance, Potential and Practice

Over the preceding decade, there has been a proliferation of normative frameworks designed to enhance the responsible governance of research and innovation, with an emphasis on better alignment with societal demands and expectations. An overarching feature common to these frameworks and proposals is their reliance on foresight and/or anticipation as a pivotal intervention mechanism (Urueña, 2023). Current scholarly inquiry delves into the principal challenges explicitly or implicitly targeted by anticipation, alongside the methodological approaches associated with them. Urueña (2023) discerns a methodological fragmentation in the treatment of these diverse challenges. In response to this fragmentation, he advocates for a multi-foresight methodology which embraces the various challenges posed to foresight/anticipation and at the same time evades the uncritical concretization of future scenarios.

Urueña et al. (2021) challenge the presumed solidity or unquestioned acceptance of anticipatory strategies used to guide responsible innovation often associated with foresight exercises. They specifically emphasise the importance of recognizing that the development of foresight strategies heavily relies on the unfolding dynamics of foresight processes (Urueña et al., 2021, p. 2). The heuristic adaptability of foresight contributes to the establishment of this anticipatory tool as a key asset in advancing more responsible research and innovation methodologies. Urueña et al. (2021) underscore the imperative to comprehend the genesis of foresight heuristics in relation to the unfolding, underlying dynamics. They assert that the extent of "openness/closure" inherent in foresight activities is shaped throughout the ex-ante, ex-dure, and ex-post processes, which are contingent upon the social relationships underpinning their development. The primary inference drawn from this insight is that a prerequisite for foresight practices to serve as "instruments for" responsible innovation is to concurrently render them "subjects of" responsibility. This necessitates scrutinising the socio-epistemic interactions informing the design and execution of foresight practices, alongside monitoring how their emergent heuristics are translated into actionable strategies.

The advocacy for the advancement of more responsible research and innovation has increasingly penetrated research and development policies, in the European Union and elsewhere. Specifically, within frameworks such as "Responsible Research and Innovation" (RRI) and "Open Science," policies advocate for the necessity to render innovation dynamics transparent and subject to debate, even concerning the underlying preferences and expectations influencing them. Responsibility is thus conceptualised predominantly in anticipatory terms, entailing collective stewardship in the present for the futures facilitated

by innovation endeavours. This normative conceptualization, highlighting the politicisation of constructing the future through innovation and underlying goals or objectives, is, however, situated in a context where the predominant approach to the future within innovation systems is deeply rooted in a capitalist imperative of technological advancement and economic expansion. Therefore, Rodríguez et al. (2020) contend that while anticipation—viewed as an interventionist practice—can provide valuable *responsibilization* strategies, the extent of its disruptive potential hinges upon in how far underlying future scenarios (or imaginaries) diverge from current techno-economic commitments or cultural imperatives.

Smolka and Böschen (2023) propose broadening R(R)I engagement methodologies from confined settings to innovation ecosystems through methodological adjustments to Socio-Technical Integration Research (STIR): Firstly, they investigate the ability of innovation ecosystems to incorporate societal considerations into research and innovation processes. Secondly, engagement research can enhance systems-level capacity for responsible governance by fostering reflexivity among actors operating across various levels or spheres within an innovation ecosystem, thereby co-steering governance decisions. Since the advocacy for a 'systemic turn' in Responsible Innovation and Responsible Research and Innovation (R(R)I) originates from dissatisfaction with engagement research, their research structures interactions between science and society to align research and innovation endeavours with societal concerns. However, its predominant focus on the micro-level practices of actors within specific events or confined contexts often overlooks the systemic intricacies of these processes. Smolka and Böschen (2023) introduce the concept of the innovation ecosystem to address the complexities, openness, and mutual learning inherent in responsible innovation governance. Responsible innovation ecosystem governance, in this context, pertains to the capability of diverse actors to contemplate socio-ethical dimensions across different facets of the ecosystem. To foster systems-level capacity building, they propose three adaptations of STIR: workshops facilitated by engagement agents, multi-stream engagement facilitated by brokers, and a multi-method research approach addressing networked responsibility. This methodological framework seeks to incorporate an *ecosystemic* perspective into R(R)I engagement research. The nature and ramifications of changes induced by emerging technologies such as AI and machine learning pose challenges in terms of anticipating and shaping their impacts. Similar complexities extend to downstream effects of legislation and regulation governing these technologies. To cultivate a more resilient experimental governance framework, methodological approaches include three fundamental components, facilitating the identification of practical solutions: anticipation, inclusion, and holism (Andrade et al., 2023). References to experimentation are already evident in national AI strategies, as are calls for regulatory sandbox approaches to the integration of emerging technologies.

However, a key inquiry arises regarding how the potential of experimentation can be systematically harnessed to evaluate impacts in technology development and deployment, as well as associated regulatory frameworks, while also fostering openness and mutual trust through an inclusive and holistic governance paradigm (Andrade et al. 2023). Andrade et al. (2023) offer three key considerations:

1. What prerequisites are necessary for testing and experimentation to become a primary regulatory approach in technology governance, integrated throughout various stages of legislative and regulative processes?
2. How can collaborative engagement among governments, technology firms, academia, and civil society facilitate experimentation with regulatory frameworks?
3. In what ways can experimental approaches to policy making and regulation cultivate transparent, trustworthy, and evidence-based policies for emerging technologies?

A series of case study analyses examining the design, development, or implementation of various new and emerging technologies is conducted to evaluate their governance implications. This assessment is facilitated by employing a robust experimental governance framework, comprising three key elements: (1) anticipatory governance, (2) stakeholder-inclusive governance, and (3) holistic governance. Andrade et al. (2023) characterise each element by a provisional definition and a compilation of governance approaches and tools. Governance approaches encompass instruments associated with contemporary experimental governance of emerging technologies, such as regulatory sandboxes, testbeds, and policy prototyping. Governance tools, on the other hand, encompass methodologies aligned with the three components, offering tangible solutions for the implementation of anticipation, inclusion, and holism within the experimental governance framework. The insights derived from the analysis are categorised according to each governance approach: Regulatory sandboxes demonstrate the capacity to advance aspects of both anticipatory and stakeholder-inclusive governance. However, they appear to impede experimentation due to their predominant focus on adherence to existing regulations. Nonetheless, there is evidence of a shifting trend, with regulatory sandboxes increasingly being utilised to inform future policies and update existing ones.

There is a lack of research investigating the influential effects of anticipation on contemporary governance decisions, particularly amidst the imperative for urgent sustainability transformations (Muiderman et al., 2022). Muiderman et al. (2022) endeavour to elucidate the interconnections between various perspectives on anticipatory governance and endeavours to steer policies and actions toward transformative changes. They amalgamate frameworks pertaining to anticipatory governance and transformation to scrutinise diverse outlooks on the future and their ramifications for present-day actions

aimed at transforming food systems (Foresight4Food), thus offering novel insights for both theoretical understanding and practical application. Within the global Foresight4Food network, Muiderman et al. (2022) discover that most foresight practitioners adopt hybrid approaches to anticipatory governance, blending fundamentally disparate assumptions about the future. Despite the diversity in envisaged food futures, anticipation processes predominantly yield recommendations aligned with prediction-oriented forms of strategic planning, intended to mitigate future risks. Furthermore, they illustrate that much anticipation for transformation employs the language of deep uncertainty and deliberative action without fully grappling with its repercussions. Consequently, opportunities for reshaping future food systems are overlooked due to implicit assumptions that govern anticipatory governance in this domain. They highlight and propose a combined framework aimed at fostering reflexivity among researchers and practitioners related to how assumptions regarding crucial human systems, such as future food system scenarios, influence the prioritisation/marginalisation as well as the inclusion/exclusion of actions aimed at transforming these systems.

Despite a pressing need to better understand the influence of anticipation processes, such as scenario planning, on present governance decisions, empirical investigations on the matter are scarce. Muiderman et al. (2023) conducted an inquiry into how assumptions regarding the future either broaden or restrict anticipatory governance actions across numerous climate-focused anticipation processes, concentrating on four Global South regions: West Africa, South Asia, Southeast Asia, and Central America. Employing a bespoke analytical framework, Muiderman et al. (2023) identified four distinct approaches to anticipatory governance and correlated these with the concept of expanding or constraining possibility spaces for action. Across the four regions, they observed that many anticipation processes foster dialogue concerning deep uncertainties and diverse worldviews. However, these discussions often culminate in predominantly technocratic and linear planning actions in the present. Notably, in the Central American context, anticipation processes more frequently deviate from this pattern, particularly when transformative aspirations are articulated. The inclination towards technocratic futures and linear planning methodologies, coupled with a predominant reliance on the global futures industry centred in the Global North, may restrict the inclusion of culturally, socially, and politically diverse, as well as regionally embedded, future perspectives in anticipation processes.

Heo and Seo (2021) conceptualise anticipatory governance as a "system of systems" utilising foresight methodologies to formulate future plans and take action. Despite the recent proliferation of various anticipatory governance frameworks, practical guidance for newcomers in this field is scarce (Heo and Seo, 2021). In their study, they conducted a comparative country analysis to derive insights beneficial to newcomers navigating

foresight-linked anticipatory governance endeavours. Through the evaluation of anticipatory governance levels in Finland, the UK, the Netherlands, and Korea, divergent outcomes of foresight-linked anticipatory governance initiatives were observed across each country. Simultaneously, a shared fundamental element emerged, denoted as future receptivity, representing the human capacity to accept and comprehend the value of foresight. Future receptivity is posited as a foundational element for newcomers to surmount entrenched short-termism and facilitate stakeholder coordination in foresight efforts, transcending transient systemic alterations or organisational adjustments. In conclusion, recommendations are proposed to cultivate future receptivity among newcomers. Firstly, governments are advised to prioritise public education and training initiatives aimed at enhancing future literacy and proficiency among both the populace and governmental officials. Secondly, governments should establish mechanisms for public participation, such as nationwide networking platforms, empowering the public to shape diverse future perspectives and influence foresight outcomes.

A study conducted by the Organisation for Economic Co-operation and Development (OECD) in 2021 elaborates essential insights concerning the effective institutionalisation of strategic foresight within government entities. It elucidates overarching themes derived from countries and organisations harbouring well-established government foresight systems, which can offer guidance for the institutionalisation of strategic foresight in other governmental bodies and organisations. Several imperative needs have been identified in this context:

1 The imperative for tailoring the national foresight ecosystem to the specific contextual requirements.
2 The necessity for garnering support from high-level decision-makers.
3 The cruciality of preserving the role of foresight in challenging prevailing assumptions.
4 The necessity for inclusive processes encompassing diverse perspectives and disciplinary approaches.
5 The potential for widespread participation to enhance the legitimacy of foresight endeavours.
6 The requirement for adequate resource allocation.
7 The need for training and support for public servants to enhance foresight capabilities.
8 The necessity for generating timely, pertinent, and actionable outputs that are beneficial to decision-makers.

The process of scaling up and institutionalising strategic foresight within governmental structures necessitates navigating various balancing acts. This involves striking a balance between maintaining adequate independence to offer insights that challenge decision-

makers' perspectives while also ensuring proximity to high-level decision-makers. Additionally, there is a need to reconcile the commitment to participatory approaches that incorporate diverse stakeholders with the imperative to avoid excessive politicisation or misrepresentation in the media. Successful institutionalisation hinges upon policymakers and foresight professionals effectively managing these dilemmas within their specific contexts.

Conclusion: The Configuration of Foresight Ecosystems

The configuration of foresight ecosystems is inevitably shaped by historical, cultural, social, and political factors inherent to their respective countries and institutions. At the same time, there are shared elements evident in cases of successful institutionalisation of strategic foresight that can serve as guiding principles for governments seeking to enhance their foresight capabilities. In the context of normative constructs such as Anticipatory Governance (AG), Responsible Innovation (RI), and Responsible Research and Innovation (RRI), foresight functions as an inclusive anticipatory approach aimed at expanding the horizons of values, processes, and potential outcomes that shape, contest, and negotiate innovation dynamics (Urueña et al., 2021). Positioned as an intervention tool, foresight triggers a diverse array of reflexive-anticipatory heuristics, thereby facilitating a more democratic development of science, technology, and innovation endeavours. These heuristics are diverse and aim to enable the exploration of alternative plausible or desirable futures, bolstering actors' proficiency in future thinking and scenarios (Urueña et al., 2021).

Anticipation, when employed as an interventionist resource to foster the problematization and collective construction of representations of socio-technical futures, thereby legitimising and guiding current scientific-technological practices, assumes the role of a heuristic tool capable of promoting more responsible research and innovation dynamics (Rodríguez et al., 2020). Anticipatory practices must always be contextualised within the specific socio-political landscapes in which they occur. Depending on these contexts, anticipation may function either as a disruptive instrument, facilitating critical-reflexive openness within socio-technical systems, or conversely, as a constraining factor, directing the governance of science and technology toward predetermined normative milestones that resist debate (Rodríguez et al., 2020). Urueña (2023) emphasises the pivotal role of social scientists in fostering arenas for reflection. The realm of science has evolved into a multifaceted and materially invested endeavour, mirroring both the strengths and weaknesses inherent in contemporary democratic societies (Fuller, 2002). Meanwhile, the journey towards establishing an experimental anticipatory, inclusive, and holistic approach to governing emerging technologies continues (Andrade et al., 2023). Nonetheless, there are early indications of promising shifts that collectively signify the development of a robust

experimental governance framework. In this regard, three gaps need to be addressed (Andrade et al., 2023):

- A cultural gap: characterised by the absence of conducive conditions for stakeholders to engage in governance processes.
- An operative gap: delineated by the constraints hindering the advancement of current policy approaches.
- A governance gap: denoting the absence of arenas for multi-stakeholder collective action.

Regulatory sandboxes may provide a setting for both anticipatory and inclusive governance approaches and are increasingly utilised to inform future policies and update existing ones. However, their focus on ensuring compliance with existing laws appears to limit the scope for holistic experimentation (Andrade et al., 2023). *Testbeds* are capable of fostering stakeholder-inclusive governance and, to some extent, anticipatory governance by facilitating collaborative experimentation among diverse stakeholders. However, their effectiveness varies based on the intensity, diversity, and quality of collaboration, posing a challenge to scalability beyond local contexts (Andrade et al., 2023). *Policy prototyping methodologies* exhibit compatibility with holistic governance approaches. Interestingly, these methodologies also contribute to anticipation and stakeholder inclusiveness. Nevertheless, their scalability depends on the broader legislative landscape. Therefore, a strategic integration of multiple governance tools across all stages of the policy process is essential for success (Andrade et al., 2023).

Factors hindering foresight heuristics include design-based constraints, methodological oversimplification, socio-epistemic biases, and lack of responsiveness (Urueña et al., 2021). These factors may lead to closure in the exploration of potential futures. Identifying and addressing these factors are crucial tasks to uncover socio-technical constraints that restrict the envisioning, anticipation, and pursuit of some plausible or desirable futures (Urueña et al., 2021).

3.2 Implementing and institutionalising RRI in Europe

As discussed in the preceding sections, the broad and diverse issue of *responsibility* in research and innovation is a longstanding theme in Europe (Owen and Pansera, 2019). During the past decade, the concept of Responsible Innovation (RI) and its policy-oriented neighbouring concept of Responsible Research and Innovation (RRI) have been the objects of considerable attention. The conceptual umbrella of Responsible Innovation emerged from scholarly debates around issues of engagement between science and the broader society (Owen and Pansera, 2019), while the concept of Responsible Research and

Innovation (RRI) originated from policy debates within the EU. As a governance concept, RRI seeks to find societally oriented alternatives to "technoscience" through activities such as ethical standards, codes of conduct, gender equality actions and open access practices (Forsberg et al., 2018). RRI was popularised in particular by the Horizon 2020 program line "Science with and for Society" (SwafS), which included a specific funding line for the implementation of RRI-related institutional changes (Delaney and Iagher, 2020).

Unsurprisingly, the implementation and institutionalisation of RRI-related practices has encountered many structural tensions, on the one hand between societal and corporate interests as well as between scientific excellence and economic value creation on the other (Blok and von Schomberg, 2023). Indeed, a key issue for the governance of RRI institutionalisation processes is related to the question of how to best address the tensions that arise from the normatively oriented and top-down-led attempts to change long-standing institutional logics, norms, and values, while simultaneously encouraging diverse bottom-up initiatives (Moan et al., 2023). Following the call by scholars such as Cohen (2022) for an improved understanding on how to institutionalise RRI, we will look at the issue of RRI implementation and its long-term institutionalisation in Europe.

Following the scholarly work of the researchers such as Randles (2016), institutionalisation can be understood as the process of embedding RRI practices to achieve desirable organisational change in a manner that enables RRI to become an integral part of the organisational identity, structure, and culture without being dependent on the continuous efforts of a few people (Szüdi et al., 2023; Steen et al., 2018). Institutionalisation often occurs either through top-down steering or via bottom-up activities (Randles et al., 2016), with the latter often being described as *de facto rri*, consisting of practical responsibility-related activities that actors are already engaged in and the embedding of novel interpretations of responsibility by translating these notions into new practices, processes, organisational structures, as well as R&I outcomes (Randles, 2016, p.20).

As such, the focus of this section will be oriented towards the organisational level analysis, on how RRI-based practices and initiatives can be embedded into organisational culture for example through organisational learning. In doing so, we distinguish between RRI as a policy instrument, which has been studied rather extensively, and the tangible, *de facto rri*, practices within an organisation (Steen et al., 2018). The scholarly debate on the successes and failures of institutionalising and implementing RRI has focused mostly on the issue of policy (macro) level institutionalisation (e.g., Tabarés et al., 2022; Griessler et al., 2023; Loeber et al., 2023; Daimer et al., 2023), while the organisational (meso-level) institutionalisation of the broader concept of Responsible Innovation had, until recently, only been explored in few case studies such as the Arizona State University

(Dabars & Dwyer, 2022) and the UK Engineering and Physical Sciences Research Council (Owen et al., 2021a). More recent research has offered fresh perspectives on the organisational level of RRI institutionalisation by covering issues such as the drivers and barriers of institutionalisation processes (e.g., Forsberg & Wittrock, 2023; Szüdi et al., 2023). Finally, some complementary perspectives on these studies have been offered for example by Ivanova et al. (2023) who focus on the contextual dynamics of RRI integration in the corporate sector.

Lessons from a Decade of RRI – The Challenge of "Deep Institutionalization"

Despite a flurry of activities geared towards making research and innovation activities funded by the EU more responsible, recent scholarship argues that the implementation and institutionalisation of RRI in Horizon 2020 has been limited and fragmented (e.g., Griessler et al., 2023; Loeber et al., 2022; Daimer et al., 2022; Tabares et al., 2022). Indeed, the introduction of the concept of RRI as a cross-cutting element to the Horizon 2020 research program did not lead to long-lasting institutionalisation of RRI as a policy practice. Yet, the experience and insights gained during the hey-days of RRI conceptualization and research, largely financed through Horizon 2020, may well inspire and underpin the research and innovation activities funded through its successor, the mission-oriented Horizon Europe programme. In this regard, co-creation may serve as the linking-pin between the two framework programmes (Robinson et al., 2020).

Several scholarly accounts focusing on the issue of RRI implementation argue that there has been an extensive focus on conceptual and theoretical analysis (Blok and von Schomberg, 2023) as well as on research and policy issues (Forsberg and Wittrock 2023) at the expense of a more practical understanding on how to transfer RRI into organisational practice (Owen et al., 2021b). This can be seen at least partially as the result of the RRI research community focusing too much on itself, rather than on the many other actors in the field of disruptive technology and innovation such as engineers (Blok and von Schomberg, 2023). Another issue has been that the RRI community has focused on (semi-) public research practices at the expense of the increasingly important dimension of private sector innovation (Ivanova et al., 2023). Finally, as Steen et al. (2018) point out, it has simply been easier to create individual RRI-related activities and projects than it has been to embed RRI into organisational culture and structure on a practical level.

Several strands of literature are of relevance regarding the institutionalisation of changes on the organisational level. In this section we will focus particularly on the theoretical lenses of *neo-institutionalism*, *institutional entrepreneurship*, and *deep institutionalisation*. To start the process of explaining why RRI implementation and institutionalisation has at least partially failed in Europe, we draw on the concept of Deep Institutionalisation (DI).

As a conceptual device, DI has been developed for the study of value-driven organisational and institutional change processes in the field of RRI (e.g., Randles, 2016). DI can help to analyse how RRI can be interpreted, translated, and contextualised into organisational practice. Based on a rough outline of the deep institutionalisation process, change often starts at the level of dominant institutional logics, discourse, and narratives, followed by the slow maturation and embedding of experimental changes in institutional practices and organisational routines, finally ending up with a systemic consolidation of changes as widely shared norms, standards, and governance practices (Daimer et al., 2023, p.38-39).

As such, DI is a long-term process that takes several years, if not decades. The process of implementing and institutionalising RRI practices into organisational culture is often characterised by what is felt by many practitioners as unduly demanding requirements related to organisational practices, values, and resources, particularly because the RRI paradigm offers little in the way of concrete instructions (Tabares et al., 2022). Even more challenging is the fact that the institutionalisation of RRI tends to question the core beliefs of the science and society relationship implicit in R&I activities, often consisting of economic imperatives, scientific autonomy, and bureaucratic managerialism (Owen and Pansera, 2019). In short, the relationship between the value laden RRI concept and the dominant perception of R&I as a neutral and objective technical process has been problematic (Griessler et al., 2023; Tabares et al., 2022).

By analysing the institutionalisation of RRI in H2020 through the concept of DI, Griessler and Blok (2023) argue that in all the dimensions of the concept, the institutionalisation process has fallen short. For one, the RRI community was not able to challenge the dominant innovation paradigm with their own narrative. From another perspective, the failure to create the preconditions for the systematic consolidation of RRI has led to major disparities in the implementation of RRI across Europe. In short, RRI has been too "fragile" as a policy concept to be successful (Griessler et al., 2022, p.171).

Indeed, the efforts to implement and institutionalise RRI have often been hampered by what Friedland and Alford (1991) describe as contradictory institutional logics such as the tension between market capitalism and political democracy. If institutions are broadly understood as constraints that shape human interaction both through formal laws and informal behavioural norms (North, 1992), then the multiple co-existing, and sometimes contradictory, institutional logics can be seen as shaping the behaviour and structures of organisations that exist within an institutional system (Meyer and Rowan, 1977). In the research and innovation (R&I) context, the incumbent institutional logics of *the autonomous ivory tower*; *the utilitarian logic of the entrepreneurial university*; and *the managerial logic driving the bureaucratization of universities* frame what it means to 'be

responsible' within the R&I community (Owen et al., 2021a, p.2-3). Therefore, the institutionalisation of RRI-related changes within an organisation also requires the *deinstitutionalization* of current behaviours, structures, and processes. In the literature this is often referred to as the displacement of incumbent logics, in other words, as the replacement of currently established institutional logics with novel logics (Thornton et al., 2012). To understand these change processes, we need to study the insights provided by institutional theory.

Institutional Theories: Neo-institutionalism & Institutional Entrepreneurship

Besides deep institutionalisation, the different ways in which RRI institutionalisation has succeeded and failed in Europe have been analysed through various *institutionalist* theories. For example, Ivanova et al. (2023) have looked at how EU-funded projects have applied discursive frames to help institutionalise RRI in the business sector. By utilising discursive institutionalism, their approach emphasises the interplay between ideas, discourses, and institutions in creating change through a constant process of reframing. Another popular approach has been that of neo-institutional theory. For example, Forsberg and Wittrock (2023, p.690) have linked neo-institutional theory together with organisational learning theory to highlight how institutional learning processes often start through various external adoption pressures. Indeed, one conclusion drawn from the extensive evidence presented by Forsberg and Wittrock (2023, p.698,703) is that the successful institutionalisation of RRI seems to require national and supranational policies to motivate the adoption of RRI-practices, as predicted by neo-institutional theory (e.g. DiMaggio & Powell, 1983). Similarly, the observed importance of gaining legitimacy for RRI practices as a part of successful organisational change (Wittrock et al., 2021, p.48) means that RRI should be integrated into a broader organisational agenda to gain the legitimacy required for institutionalisation (Forsberg & Wittrock, 2023, p.707), again as predicted by neo-institutional theory.

Moreover, in accordance with organisational learning theory, RRI-related practices can be seen as being implemented through explorative trial-and-error learning through various feedback loops between individuals in their local contexts (Forsberg & Wittrock, 2023, p.707). This "translation" work is often conducted by so-called "change agents" or "institutional entrepreneurs" who utilise the available resources at hand to transform institutional arrangements or create new institutions (Maguire et al., 2004; Garud et al., 2007; Battilana et al., 2009; DiMaggio, 1988). The potential role of these change agents as champions for RRI has been emphasised by various authors (e.g., Randles, 2016; Owen et al., 2021a), since it is believed that individual change agents can help to create long-term organisational change (Hardy and Maguire, 2008).

These notions lead us to the concept of *institutional entrepreneurship*, which provides a dynamic perspective on the role of individuals as agents of change. Institutional entrepreneurship emphasises that since organisational practices are shaped by actions of individuals, pioneering actors can enact institutional changes (Leca et al., 2008). However, since the creation of new types of institutional arrangements requires substantial resources, institutional entrepreneurs need to be able to motivate and mobilise others to join their cause to succeed (Battilana et al., 2009). Moreover, despite the central role of individual agency in institutional entrepreneurship, the change agents are also seen as a part of a broader institutional context, which both restricts and enables the possibility for action (Leca et al., 2008).

Therefore, the idea behind institutional entrepreneurship is to transcend the long-standing social science debate on structure versus agency by combining the notions of institutional continuity and conformity with the aspects of novel change and creative agency (Garud et al., 2007). As such, institutional entrepreneurship has emphasised how institutional entrepreneurs and change agents seek to break "with existing rules and practices associated with the dominant institutional logic(s) and institutionalise the alternative rules, practices, or logics they are championing" (Garud et al., 2007, 962). In short, institutional entrepreneurship emphasises how actors shape and transform institutions through visions of divergent change and by mobilising allies to translate the vision of change into reality. From the point of view of RRI, institutional entrepreneurship can highlight how sustainable and long-term RRI-related organisational changes can originate from bottom-up and small-scale changes. To complement these theoretical insights, an understanding on the practical dynamics of organisational level RRI institutionalisation is needed.

Drivers and Barriers of RRI Institutionalization

The organisational adoption, implementation, and uptake of RRI in practice requires an understanding of different incentive factors, drivers, and practices. For example, it is known that good practices such as specific RRI-related organisational policies, dedicated organisational units, RRI-inspired training programs, and various guidelines (Forsberg & Wittrock, 2023, p.707) can enable the institutionalisation of RRI. However, to better understand the deeper dynamics of RRI implementation and institutionalisation, one should look at the different enabling and inhibiting factors that influence the success and failure of various RRI-related changes. The drivers and barriers of RRI are often grouped and typologized according to different theoretical and methodological lenses. For example, Wittrock et al. (2021, p.10-11) analyse the issues of RRI implementation by applying a neo-institutionalist perspective by William Richard Scott (1981) to distinguish between *structural* issues, *cultural* issues, and *interchange* dynamics based on a typology by Scott

and Davis (2007). A similar approach focusing on neo-institutionalism is utilised by Szüdi et al. (2023) in a recent article.

According to these authors, the *structural* aspects that influence RRI implementation can be seen to include factors such as national policies, regulatory frameworks, formalised roles and positions, mandates, procedures, routines, objectives, and responsibilities within organisations (Wittrock et al., 2021, p.24; Szüdi et al., 2023, p.61). In terms of the most important structural drivers for RRI institutionalisation, mid- and top management involvement are found to be the key factors (Szüdi et al., 2023, p.61). Many of these structural factors partially overlap with the second aspect of RRI institutionalisation, the so-called *interchange* dynamics. These include the various forms of interactions with other organisations in the broader environment such as in the policy landscape and research culture (Szüdi et al., 2023, p.61-62). As an example, a barrier or a driver for RRI institutionalisation related to the interchange aspects could be a lack of pressure related to RRI or, conversely, a strong interest towards RRI, coming from the external environment of an organisation (Wittrock et al., 2021, p.41-42). The third aspect influencing RRI institutionalisation consists of the *cultural* aspects which include informal and tacit organisation structures that influence the adoption of RRI standards and practices through different values, identities, and perceptions (Szüdi et al., 2023, p.61). An example of a cultural barrier that inhibits RRI institutionalisation is the perception of RRI as another burden on the freedom and autonomy of science.

It is also important to notice that often the same specific factor can be, both a driver and a barrier for RRI institutionalisation, depending on the situation. For example, the access that a change agent has vis-à-vis the top management, or the absence of such an access, can be a key factor in explaining the success of RRI institutionalisation (Steen et al., 2018, p.4). Building on these notions, Wittrock et al. (2021, p.39,47-48) have found that *structural* factors are the most important both for *enabling* and *constraining* RRI institutionalisation. If structural drivers are not in place, RRI-related initiatives and actions become fragmented because of common structural barriers such as lack of resources, incentives and policies that would support RRI institutionalisation. Conversely, the aspects of RRI that are most institutionalised in Europe are related to ethics, gender issues and open science which have been the object of the strongest structural measures (Forsberg & Wittrock 2023, p.698). The observation that organisational practices seem likely to change only with sufficient structural measures in place, is in line with the notions of neo-institutionalist insights, which emphasise that "organisations align with their environments, and seek to obtain legitimacy by complying with widespread norms of perceived good conduct and organisation" (Wittrock et al., 2021, p.34).

Indeed, according to Forsberg et al. (2018) and Wittrock et al. (2021), a common lesson gained from the experiences arising from over a decade of RRI-related projects is the significant degree to which organisational, institutional, as well as both national and supranational environments and their dynamics influence the implementation of RRI. While some of these dynamics are outside the scope of any organisation, such as legislation and academic incentive systems, any aspiring change agent must nonetheless carefully consider and analyse the contextual setting in which the desired RRI-related change processes is meant to take place, since the context affects the degree to which a relevant theory of change should be tailored and translated to fit the demand (Wittrock et al., 2021, p.118; Forsberg et al., 2018).

Broadly speaking, RRI-related organisational changes can be seen as incremental or transformative in nature. Transformative changes often encounter resistance because of concerns related to scientific autonomy or because of lack of incentives to engage in activities such as public engagement; while incremental changes are easier to achieve but contain more uncertainties in terms of their long-term impacts (Wittrock et al., 2021, p.118). It is important to align the RRI-related changes with real organisational needs (Steen et al., 2018, p.5).

This process of aligning RRI-related changes with organisational goals requires institutional entrepreneurs who have a legitimate status within the organisation as well as the support of the top management (Steen et al., 2018). Besides internal organisational drivers, these change agents should be able to capitalise on external pressures by combining the structural level drivers with relevant interchange drivers, such as policy frameworks, to legitimise and institutionalise RRI in their organisation (Wittrock et al., 2021, p.34). Despite the importance of individual change agents, the successful implementation of bottom-up grassroots level RRI-activities requires support from the meso-level of institutions to anchor individual activities into broader organisational rules, norms, and routines, in addition to external influences from the macro-level of national and EU-level policymaking (Griessler and Blok, 2023, p.280). Indeed, aspiring institutional entrepreneurs need the ability to create compelling visions of the future and attractive narratives of change to and mobilise stakeholders towards the implementation of the desired institutional change (Garud et al., 2007, p.962). One way to achieve this is to focus on organisational learning processes.

Institutionalisation of RRI through Organisational Learning

Recently there has been a renewed interest in organisational theory and organisational learning in the field of RRI institutionalisation[5]. For example, Forsberg and Wittrock (2023) have utilised the perspective of organisational learning from the angle of how good practices are adopted. Basing their analysis on empirical work conducted in a dozen of research performing and research funding organisations, they conclude that organisational learning processes proceed more successfully when they are geared towards the individual aspects of RRI (such as societal engagement or open science) rather than on the full complexity of the RRI as an umbrella concept.

This touches upon the classic understanding of the learning organisation that Senge (1990) has put forward. Senge argues for the utilisation of holistic system thinking as the basis for organisational change through collaborative and individual learning processes. More recently, scholars such as Randles and Lasch (2016) have further argued that substantial changes, such as the ones associated with comprehensive RRI practices, require the replacement of a whole variety of norms and institutional logics. Obviously, this does not take place overnight and implies a change of the whole research culture within an organisation (Von Schomberg, 2024 forthcoming). In contrast, following Senge (1990), Ten Holter et al. (2023) argue that the processes of replacing existing norms with newer practices can be reinterpreted by using systems thinking approaches. In this process existing practices are reinterpreted and adopted under the umbrella of new requirements. Ten Holter et al. (2023) observed that through the lenses of systems thinking and learning organisation existing practices such as research ethics and research integrity can be placed under the broader umbrella of Responsible Innovation that aims to connect science with society.

Another example of the utilisation of organisational learning comes from the *NewHoRRIzon* project (Griessler, 2023), which adopted and adapted Zaid Hassan's concept of *Social Labs* for the policy-uptake of RRI objectives by means of quadruple helix -based pilot actions. The project established 19 social labs reflecting research and innovation policy objectives of the EU framework Programme Horizon 2020. Similarly, Braun et al. (2023) explored the potential of Social Labs as a type of learning organisation and concluded that they can help to provide practice-informed, normative orientation in various institutional settings. Major takeaways concerning the employment of Social Labs include the observation that they hold a great potential for bottom-up policy uptake, but that the Social Lab concept also revealed that "RRI needs support on the meso-level of institutions to mature single pilot

[5] See: special section of the Journal the Learning Organization, volume 30, issue 6, 2023

activities; to anchor them in organisational rules, norms, and routines" (Griessler and Blok, 2023).

Concluding remarks

In their recent study, Forsberg and Wittrock (2023) asked whether RRI, as an overarching umbrella concept, can provide guidance for institutional change through various good practices. What they found was that the role of RRI as an umbrella concept might obscure the "qualitatively different nature of the individually important practices that are bundled together" (Forsberg & Wittrock, 2023, p.707). Indeed, as we have already noted, it is important to distinguish between *RRI* (upper case), referring to the policy instrument of the EC, and *de facto rri* (lower case), referring to the tangible practices within an organisational context (Steen et al., 2018, p.2). Instead, there has been a shift from RRI towards concepts such as Open Science and broader Mission Orientation. Despite this shift, the potential option of replacing RRI with a neighbouring concept such as Open Science might only add further complexity to the issue of democratic, normative, and societally sensitive R&I (Forsberg & Wittrock, 2023, p.707-708).

Therefore, instead of arguing about the most relevant concept that grasps the various aspects and dimensions of responsible innovation practices, the focus should be on tangible, so-called *de facto rri*, activities on the organisational level, and on the building of relevant linkages to meso- and macro-level policies, such as sustainability and social responsibility-related policies, that can provide support for various RRI activities. These observations highlight that the successful implementation and institutionalisation of RRI practices requires a process of contextualization that considers the specific organisational cultures and practices.

3.3 Varying contexts of ORRI implementation and institutionalisation

The contextualization of ORRI is important because it recognizes the diversity of contexts in which research and innovation occur and emphasises the need to tailor ethical, societal, and environmental considerations to specific circumstances. By embracing contextualization, researchers, innovators, R&I managers, policymakers, and other stakeholders can develop more inclusive, responsive, and sustainable approaches to research and innovation that address the needs and aspirations of diverse communities. More concretely this is crucial because research and innovation activities occur always within diverse social, cultural, economic, and environmental contexts. What may be considered acceptable or ethical in one context may not necessarily be appropriate in another. By understanding the specific needs, values, and concerns of context specific

stakeholders, research and innovation organisations can develop solutions that are responsive to the realities of the local context. In general, contextualization emphasises flexibility and adaptability in the application of ORRI. While there are overarching ethical and societal norms that guide responsible research and innovation, the specific implementation of these principles may vary depending on the context.

In the following section we pay specific attention to the organisations and territories because they provide the institutional frameworks, resources, and collaborative platforms necessary to integrate ethical, societal, and environmental considerations into research and innovation processes. By leveraging local context, engaging stakeholders, aligning policies, building capacity, and fostering collaboration, territories and organisations can drive meaningful change towards more responsible and sustainable research and innovation practices. There are also various territory and organisation specific challenges which need to be considered in the implementation of ORRI. Just to mention a few, for instance, territories often have complex governance structures involving multiple levels of government, regulatory agencies, and stakeholders. Coordinating ORRI initiatives across these different entities can be challenging, particularly if there are overlapping jurisdictions and divergent interests. On the level of organisations, ORRI may mean a cultural shift, including changes in attitudes, behaviours, and decision-making processes. This, in turn, may cause resistance to change as entrenched practices hinder efforts to promote responsible research and innovation.

In the following we first discuss organisational tensions and challenges in the implementation of responsibility and ORRI. We then move to review territorial aspects, first on a general level, drawing on several studies, and second, by conducting a deeper dive into the Balkan countries as a specific territorial context of the REINFORCING. The reason for this selection is the fact that in Balkan regions the implementation of ORRI has been challenging. While we have seen significant rise in the research and innovation activities in Balkan regions, alignment to the EU targets for R&I still needs support to enable responsible, open and sustainable development of R&I systems.

Evolving organisational contexts and tensions in implementing responsibility

At the level of organizations such as private companies, the issue of sustainable development faces many challenges, including climate change, biodiversity loss, resource depletion, worker welfare challenges, forced labour, child labour and corruption, to mention a few. Increasing awareness and legislative requirements, particularly in the EU (CSRD 2022; CSDDD 2022), have made sustainable development objectives a central issue for companies.

The role of companies in promoting sustainable development is widely recognised (Mio et al. 2020). The phenomenon has been approached from different perspectives, such as corporate social responsibility (CSR), corporate citizenship, business ethics and stakeholder engagement (Strand et al., 2015). In addition, corporate sustainability (CS) approaches business management by examining the role of sustainability in the business environment, in relationships with other organisations, networks, ecosystems and wider society (Engert et al., 2016; Montiel & Delgado-Ceballos 2014). However, no consensus has been reached in defining CS (Meuer et al., 2020; Montiel & Delgado-Ceballos, 2014), which is why it has been characterised as an essentially contested concept (Lankoski 2016).

CSR has been defined in various ways (Jiang 2020), but it could be described as being corporate practices that go beyond legal mandates related to trading, health and safety, human rights, consumer and environmental protection, and reporting. (Roszkowska-Menkes, 2021). CS, in turn, could be defined as the application of sustainability at the firm level, covering both short- and long-term economic, environmental, and social aspects of company performance (Ashrafi et al., 2018). Paolo Taticchi and Melissa Demartini (2020; cf. Oliveira et al 2023) propose instead that sustainability in business goes beyond profit-driven strategies. It encompasses how corporations respond to climate change, water management efficiency, health and safety policies, supply chain management, treatment of workers, and fostering a corporate culture of trust and innovation.

Modern idea of CSR has a long history starting from the 1950s and 1960s (Agudelo et al. 2019). During those days the concept was usually social responsibility instead of corporate social responsibility. One of the pioneers, Davis (1960) defined it as actions that consider interests other than the financial or technical aspects of the company, supporting national economies and promoting human dignity (Carrol 1999). Over the next decades the understanding of the concept of corporate responsibility was expanding. For instance, influential Committee for Economic Development (CED) stated that companies should conduct economic actions by considering social values which concerned e.g., environmental conservation, relations with employees, and fair treatment of customers (ibid.). However, significant expansion and wider acceptance of CSR took place only during the 1990s when, for example, Global Reporting Initiative (GRI) was established to provide sustainability reporting guidelines for companies. Over the next decades, GRI was developed extensively, and it is currently used by thousands of companies world-wide[6]. Number of initiatives followed during the next decades like the UN Global Compact (UNGC) as a voluntary initiative for companies to adopt socially and environmentally sustainable policies and reporting practices. UNGC is currently the most widely adopted CSR initiative among companies (Rashe 2020). Another important milestone during the past decade were

[6] https://www.globalreporting.org/about-gri/

the UNESCO SDGs adopted in 2015, which have become increasingly potential targets and sources of innovation also in the private business sector (Azmat et al. 2023).

The CSR thinking has evolved step by step from the idea that responsibility consists of compliance with laws, via reducing negative impacts and saving costs towards seeing CSR as an integrated strategic choice and firm´s purpose driven action. This includes the idea that CSR is understood widely including social and environmental sustainability and it is integrated in the firm's vision, mission, and strategy. The concept of purpose-driven firms emphasises the importance of creating strong mission statements and purpose-driven strategies connecting economic, human, social, and environmental values (Gibson 2022; Hansmeyer 2018). This concept is also related to the idea of shared value creation including the idea that firms can create economic value and simultaneously address societal needs and challenges. Shared value creation may also be a competitive advantage as shared value principles can drive innovation and growth by connecting to the solving of social and community challenges (Agudelo et al. 2019; Harvard Business School[7]). Some of the related recent ideas include regenerative economy (e.g. Jain 2021) and doughnut economics (Raworth 2017). A regenerative economy aims to positive contributions for both nature and society by actively restoring and replenishing resources and thus going beyond mere avoiding of negative social and environmental impacts (Jain 2021;Regenerative economy, Smith School of Enterprise and the Environment[8]). Doughnut economics refers to the idea that humanity and economy should be limited within socially and environmentally sustainable boundaries. The model consists of the "doughnut's" inner circle, which encompasses the foundations for human well-being, such as food, water, healthcare, and education. The outer ring represents the planetary boundaries, beyond which environmental degradation occurs. Economic development should aim to bring our economic activity within the inner circle, ensuring that everyone's basic needs are met without exceeding environmental limits.(Raworth 2017; 2019) The model has been widely discussed and recently, for instance, Brussels has adopted the Doughnut Model as a guiding framework to transition to a more sustainable economy[9].

As this short overview indicates there has been and are several constantly evolving ideas relating to CSR and CS. It is also clear that the operational business environment is in flux. This does not include only above-mentioned ideas, climate change, other crises like pandemics, or geopolitical changes but also new policy frameworks and regulations, which

[7]Institute For Strategy And Competitiveness: https://www.isc.hbs.edu/creating-shared-value/csv-explained/Pages/default.aspx
[8] https://www.smithschool.ox.ac.uk/research/regenerative-economy
[9]https://eu-mayors.ec.europa.eu/sites/default/files/2023-12/2023_CoMo_CaseStudy_Brussels_EN.pdf

are setting new sustainability and responsibility requirements for firms. In the European context perhaps most notable recent such regulations concerning firms are:

- The Corporate Sustainability Reporting Directive (CSRD) which entered into force 2023 and is setting the rules by which companies have to report the social and environmental sustainability. The reporting takes place by using European Sustainability Reporting Standards (ESRS) and it concerns all large companies and all listed companies excluding listed micro-enterprises.[10]
- The EU Taxonomy Regulation, which entered into force 2020 and sets out the conditions which an economic activity has to meet to qualify as environmentally sustainable. It is meant to provide a common definition framework of economic activities that can be considered environmentally sustainable.[11]
- The EU Corporate Sustainability Due Diligence Directive (CSDDD) proposal, which was adopted by the Committee of Permanent Representatives in the European Union on 15 March 2024.The final voting will take place in the European Parliament in April 2024. The directive provides rules for companies regarding human rights adverse impacts and environmental adverse impacts, and on a company's liability for violations of its obligations under the directive[12].

Despite these developments in recent decades, CSR is still challenging to implement in companies for many reasons (Fatima & Elbanna 2023; Abbate et al. 2024, van der Byl & Slawinski, 2015). For one, there is still a "major mismatch" between business activities and the global state of the environment and society (Dyllick & Muff 2016, p. 157; ibid.). Integrating CSR into business logic is not without problems, and various tensions may arise (Carmine & de Marchi, 2022; Hahn et al., 2018; van der Byl & Slawinski, 2015). Companies must balance short-term economic goals with longer-term sustainability (Slawinski & Bansal, 2015). Designing and implementing sustainability initiatives is complex because there are many local and global problems to address, as well as there are many stakeholders with conflicting demands (Haffar & Searcy, 2017). The tensions that arise from such balancing can cause problems, although they can also keep organisations alert and dynamic (Clegg et al., 2002).The question is also of contextuality of CSR implementation causing complexity: It is highly contextual across industries, countries, time, and pool of stakeholders (Fatima & Elbanna 2023)

In the context of CS and CSR, reducing complexity, or alternatively finding new ways to deal with complexity, is likely to be one of the key issues in both science and practice

[10] Corporate sustainability reporting - European Commission
[11] EU taxonomy for sustainable activities - European Commission
[12] EU Corporate Sustainability Due Diligence Directive (CSDDD) proposal has been adopted | DLA Piper.

(Engert et al., 2016). The literature on tensions related to sustainability (Carmine et al. 2023; Luo et al. 2020; Gonzalez-Gonzalez 2019; Hahn et al., 2015, 2018; van Bommel, 2018) has adopted a 'paradox theory' from organisational studies (originally e.g. Lewis 2000; cf. Lewis & Smith 2022) to examine tensions. An organisational tension can be defined as "two phenomena in a dynamic relationship that involves both competition and complementarity" (English, 2011). Organisational tensions are systemic incompatibilities, not only individual-level value and perspective differences. They manifest themselves as social structures and action patterns which are interpreted differently depending on the actors' positions or activities. In this sense, tensions are a property of a system (Nieminen et al., 2020.) The concept of paradox refers to opposing but related elements that coexist over time (Lewis & Smith 2022; Schad et al., 2016; Smith & Lewis, 2011). According to Smith and Lewis (2011), paradoxes arise from the inherent characteristics of organisations and their environments, while Putnam et al. (2016) say they are socially constructed. Recently, researchers have sought to combine these two perspectives (Hahn & Knight, 2021; Schad & Bansal, 2018). For example, Hahn et al. (2014) argue that taking sustainable development seriously requires leaders to accept and adapt to conflicting economic, environmental, and social forces without trying to eliminate them (cf. Luo et al. 2020).

Responses to organisational paradoxes can be defensive or active. Defensive responses including splitting the tension and reaction formation, provide short-term relief without providing a new way to work within or understand paradox. Splitting may be structural with different poles compartmentalised into different organisational units or hierarchical levels, or temporal, with different poles dominating at different times. However, excessively aligning with one pole of the paradox usually generates opposition to the other pole. Polarised responses are evident when actors become unwilling to engage in compromise, potentially resulting in spiralling conflict and vicious circles. The extent of conflict arising from different defensive responses varies. However, they are avoidance tactics that ignore longer-term ways to reconceptualize the actors' experience of paradox. (Gonzalez-Gonzalez 2019; Luo et al. 2020; Jarzabkowski et al., 2013.)

By framing tensions as paradoxes, companies can avoid the trap of assessing sustainability issues solely in terms of their economic impacts (Luo et al. 2020; Hahn et al., 2015, 2018; van Bommel, 2018). For example, an active and honest dialogue, engaging and exploratory approach often help organisations to embrace new perspectives for the tensions and continually rebuilding of organisation (Bushe & Marshak, 2016).

The categorization of organisational tensions developed originally by Smith and Lewis (2011; see also: Lewis & Smith 2022) is often used to categorise different tensions:

- Belonging / Identity: Competing values and roles cause individual and collective conflicts and thus generate tensions
- Organising: Internal dynamics (culture, structure, leadership) generate tensions around collaboration and competition, empowerment and direction, and flexibility and control
- Learning: Multiple time horizons (short-term vs. long-term focus), change towards sustainability, processes of renewal, and innovation reinforce tension between building upon, and destroying the past
- Performing: Multiplicity of stakeholders and goals, (also different competing sustainability goals), generate tensions

For example, the following tensions have received attention when studied tensions related to CS and CSR: personal vs. organisational sustainability agendas; corporate short-term vs. long-term orientation; tensions related to structures, processes, and technology; and efficiency vs. resilience. (Carmine et al. 2023; Luo et al. 2020; Hahn et al., 2015.).

Previous calls to adopt a paradox approach in CS research (van der Byl & Slawinski, 2015) have been answered, but the concept of paradox is used ambiguously. A recent literature review by Carmine and De March (2022) concludes that the field lacks clarity on what the concept of paradox refers to, limiting the theoretical and practical impact of studies. Furthermore, the ontology of paradoxes is contested (Hahn & Knight, 2021; Schad & Bansal, 2018). There is also a risk of approaching all tensions as unresolved paradoxes if the paradox approach is applied as an interpretive schema without defining the substantive basis of the paradoxes (Schad & Bansal, 2018). Over-expansion of the concept may limit its potential to generate knowledge (Alvesson & Spicer, 2019) and interpreting tensions as paradoxes may hinder effective decision making (Hahn et al., 2014). While a paradoxical approach may be suitable for approaching complex CS problems (van der Byl & Slawinski, 2015), not all problems are equally complex and management approaches and response strategies should be chosen according to the characteristics of the problem causing the tensions (Lewis & Smith 2022; Smith & Lewis, 2011).

Hahn and colleagues (2014; cf. Luo et al 2020; Gonzales-Gonzales et al. 2020) have proposed two cognitive frames in CS – a business case frame and a paradoxical frame – and explored the differences between them. In the paradoxical frame, thinking is based on the logic that economic, environmental, and social concerns are juxtaposed, while in the business case frame, thinking aligns environmental and social concerns with economic objectives. The paradoxical frame contains a combination of multiple attributes with

different rationales and has a complex structure and many frame elements. According to Hahn and colleagues (2014), integration in the paradoxical frame is based on a high degree of connectedness with a plurality of reinforcing, neutral and conflicting relationships. In the paradoxical frame, tensions are treated with acceptance. The business case frame is quite the opposite: the structure is simple with a small number of frame elements and a low degree of connectedness. In that approach, tensions are treated as threats to be eliminated. However, neither of the frames alone brings a sufficient managerial response. While the paradox frame is more creative, the business case frame brings practicality. Both are needed for success. In fact, on the managerial level, mixed teams may be more successful in implementing innovative responses to sustainability challenges. (Hahn et al., 2014.)

While CSR has been widely acknowledged as a key component for the uptake of responsible innovation (RI) in industry, responsible innovation calls for a wide range of new corporate practices of responsible innovation activities from legal and ethical aspects to leadership, business models, roles, and responsibilities to generate broader societal impacts.

Jarmai et al. (2020) frame responsible innovation (RI) as collection of tangible company practices which points towards responsibility as a strategy. This approach includes both being r*esponsible* in their innovation activities / processes (operations & increasingly value chain) as well as being r*esponsive* to societal needs by creating products and services. Companies can become responsible in their innovation activities in two main ways by utilising (1) RI as business case, or (2) RI as decision support system. RI needs to go beyond legal requirements (in terms of compliance) but refer to company values, innovation practices as well as consumer and stakeholder interaction. However, RI does not seem to be yet tailored toward business, but business is willing to implement elements of RI. Learning from pioneers among peers is identified as an important first step towards understanding how RI can be made operational. Lubberink et al. (2017) explore how companies can engage in RI practices. They provide a framework for operationalisation of AIRE dimensions and knowledge management (KM), i.e., how can they enhance AIRE. Open innovation is considered informative for KM (sustainable innovation, social innovation/social entrepreneurship).

Martinuzzi et al. (2018) explore corporate motivations to adopt (R)RI, the state of implementation, and the role of stakeholders. Based on their analysis, RRI links up with two key challenges dominating the current business landscape: (1) the accelerating global race to innovate to maintain competitive advantage, and (2) the struggle to maintain public trust in business. RRI thus represents areas of opportunity, but also for potential conflict.

A qualitative analysis of relevant literature found specific aspects of RRI adoption in industry environments:

- Industry players consider responsible research – which they associate with research integrity - to be different from responsible innovation – which they relate to societal impacts.
- Implementing RRI in companies might require a broader acceptance of instrumental motives (e.g. profit seeking) as a necessary precondition to establish RRI.
- RRI practices can be widely implemented at the operational level even when innovators are unaware of RRI (also called *de facto* rri).
- Industry partners tend to consider broad impacts or long-term consequences as a secondary concern.

More recently, Li et al. (2023) examined drivers and barriers for RI through the lens of environmental protection practices in companies. Companies may not be aware of their responsibility to innovate, which in turn causes certain 'short-sightedness' in terms of innovation. When exploring internal-external mechanisms driving corporate innovation they found the following drivers: first, tackling social challenges is associated with gaining legitimacy; secondly, external institutional pressures; and thirdly, demands of stakeholders (consumers, public forces). Barriers comprise the need for profitability, insufficient resources to implement responsible innovation and the lack of ethical considerations in organisations and systems. Drivers and barriers interact with each other guided through market, policy, and normative pressures, but also by the internal motivation for responsible innovation.

RI scholars agree that there is a lack of research on RRI implementation in industries in general terms; especially in fields distinct from current 'hype' around AI or digitalization. There is also a lack of knowledge on what leads to micro-implementation of RRI practices in industry. Risk perception and perceived long-term consequences of R&I activities, in general, are of secondary or minor concern. R&D-intensive firms with customers as intermediaries do not consider how their innovations affect society. Participatory approaches in industry focus on clients and end-users, wider societal inclusion still rare. There is also misalignment of RRI concepts, tools, methodologies used in scientific and policy discourse with current industry practices which is rooted in long-standing debates around CSR, shared value, ethical relationship (Dreyer et al., 2017).

Overall, industry has so far been reluctant to implement RRI principles, even though in practice they already implement some in their activities (what is consequently labelled *de facto* rri). Potential is identified in terms of leveraging responsibility as business strategy, business case, and decision support systems. RI as business strategy (Jarmai et al., 2020) requires to (1) understand most critical elements to address (2) reflect case-specific on potential benefits, (3) establish management and employee commitment, and (4) establish plans and roadmaps. As middle management and employees have been found (ibid.) to have deeper understanding on the functioning of RRI in industry than upper management (as they are often subjects of study), they may be viable points of entry for increasing the attractiveness of RI in companies.

Moreover, there is thus a clear need to increase exchanges of information/resources between RRI and industry players. There is also a perceived need for planning support for implementation and monitoring- via practical frameworks and tools such as roadmaps or KPIs. Knowledge management may be a viable inroad for RI and important governance principles (Martinuzzi et al., 2018).

Territories

The territorial adoption of Responsible Research and Innovation (RRI) has been a matter of special interest during the last years of the 8th Framework Programme for Research and Innovation also known as "Horizon 2020". The European Commission (EC) deployed an ambitious strategy around RRI for its adoption into the European Research Area (ERA) during the development of Horizon 2020 (Owen et al., 2021b; Tabarés et al., 2022). Several funding opportunities across the programme were offered during the period 2014-2020 and around different emerging technologies such as Artificial Intelligence (AI), robotics, additive manufacturing (AM) or nanotechnologies, among others (Gutiérrez & Ezponda, 2019; Stahl & Wright, 2018; van de Poel et al., 2020; van Hove & Wickson, 2017). In these funding opportunities, particular attention was paid to different stakeholders that play important roles in different research and innovation (R&I) contexts such as universities, technological institutes, funding organisations, business, or business associations, to diffuse and operationalize the six keys of the normative vision of RRI pushed forward by the EC.

However, the adoption of the RRI concept into regional innovation systems across the EU only attracted special interest during the last years of the programme, especially during the period 2018-2020. That is why some projects were funded during this time by the EC for promoting the diffusion and adoption of the concept on a territorial basis and spreading its diffusion and adoption by regional stakeholders such as development agencies,

innovation agencies, regional governments, and regional clusters, among others. These stakeholders were, in most cases, not familiar with the concept of RRI, but they had significant familiarity with the concept of smart specialisation strategies (S3), which was another popular concept in Horizon 2020 (Foray, 2016; McCann & Ortega-Argilés, 2015) which can be considered a valuable context in which integrating the RRI approach.

In fact, S3 strategies were developed by the EC for addressing the innovation gap between the US and the EU after the failure of the Lisbon strategy, becoming one of the regional backbones of the EU R&I policy during Cohesion Policy Programming 2014-2020 (Tabarés & Bierwirth, 2023). S3 strategies were introduced as a prerequisite for EU regions that wanted to have access to European Structural and Investment Funds. These plans of regional specialisation around competitive advantages and assets helped regions to identify and prioritise among research capabilities for deploying increasing efforts to the commercialization of R&I outputs. Smart specialisation during the period of 2014-2020 attracted a significant interest by many regions and different efforts were developed by the EC to offer a dedicated platform that can help EU regions into its operationalization with different materials such as reports, tools and guidelines (https://s3platform.jrc.ec.europa.eu/). The rationale of S3 strategies pivots around the promotion of economic growth and competitiveness across European regions through the involvement of a broad spectrum of local R&I stakeholders in a process of identifying regional strengths and comparative advantages followed by selecting a limited number of priority areas for R&I investment (Foray, 2016; McCann & Ortega-Argilés, 2016).

RRI can be a valuable approach in the S3 context since also S3 foresees multi-stakeholder engagement processes for a significant orchestration of a diversity of stakeholders around R&I processes and regional planning, even if S3 does not recognize the importance of civil society organisations (CSOs), citizen platforms and citizen associations in these domains (Fitjar et al., 2019; Hassink & Gong, 2019; Thapa et al., 2019). At the same time, during the last years of the Cohesion Policy Programming 2014-2020, S3 also faced a reorientation phase with the inclusion of sustainability as a new guiding principle (McCann & Soete, 2020). A value that was not included into its conceptualization and that was added as an effort to confront the new societal demands and expectations concerning R&I policies (Miedzinski et al., 2021). In this regard, the adoption of RRI at the regional level as well as the reorientation of S3 towards sustainability seems to demand new tools and instruments for improving the governance of R&I ecosystems (Magro & Wilson, 2019) and the incorporation of other kinds of stakeholders and expertise that can go beyond the classical conceptualizations of R&I (Edwards-Schachter, 2018; Tabarés Gutiérrez & Arrizabalaga, 2023).

A good example of this situation is the tensions and challenges that the "Twin Transition" raises on a significant number of territories across the EU. The deployment of renewable technologies and facilities across different territories such as wind farms have raised significant societal concerns regarding potential impacts on diverse sectors such as tourism, farming, or agriculture. That is why the EC also speaks about a "Just transition" to refer to the responsible adoption and promotion of green and digital technologies that can help mitigate the significant challenges that climate change imposes on EU territories, as well as create opportunities for economic development based on technology and innovation (Muench et al., 2022). In this regard, multi-stakeholder engagement processes at regional level can facilitate shared regional pathways based on public deliberation and the discussion of different interests and visions from various actors (Grillitsch & Sotarauta, 2020). RRI is well suited for this with a sound conceptual grounding and a significant number of tools.

The EC has funded several projects devoted to territorial RRI. These projects were funded under a specific topic called "Supporting the development of territorial Responsible Research and Innovation" that was located in the Science with and for Society (Swafs) subprogramme of Horizon 2020[13]. In total, 11 projects were funded by the EC on this topic (see table 1 below).

[13] See https://cordis.europa.eu/programme/id/H2020_SwafS-14-2018-2019-2020/en

Project acronym	Project full name	Coordinator	European regions engaged	Cordis link
CHERRIES	Constructing Healthcare Environments through Responsible Research Innovation and Entrepreneurship Strategies	**ZSI**	Murcia (ES), Orebro (SE) and Cyprus (CY).	https://cordis.europa.eu/project/id/872873
DigiTeRRI	Responsible Research and Innovation approach for Transitioning the Traditional Industry Regions into Digitalized Industry Territories	**AIT**	Grand Est (France), Styria (AT) and Värmland (SE).	https://cordis.europa.eu/project/id/873010
RIPEET	Responsible research and Innovation Policy Experimentations for Energy Transition	**ZSI**	Ostrobothnia (FI), Outer Hebrides (UK) and Extremadura (ES).	https://cordis.europa.eu/project/id/101006295
RRI-LEADERS	Leveraging Leadership for Responsible Research and Innovation in Territories	**ARC**	Western Macedonia (EL), Sofia (BG), Thalwil (CH) and Sabadell (ES).	https://cordis.europa.eu/project/id/101006439
RRI2SCALE	Responsible Research and Innovation Ecosystems at Regional Scale for Intelligent Cities, Transport and Energy	**APRE**	Vestland (NO), Overijssel (NL), Kriti (EL) and Galicia (ES).	https://cordis.europa.eu/project/id/872526
SEERRI	Building Self-Sustaining Research and Innovation Ecosystems in Europe through Responsible Research and Innovation	**NRI**	Nordland (NO), B30 Catalonia (ES) and Lower Austria (AT)	https://cordis.europa.eu/project/id/824588
TeRRIfica	Territorial RRI fostering Innovative Climate Action	**WILA Bonn**	Barcelona (ES), Belgrade (RS), Brittany, Normandy and Pays de la Loire (FR), Poznań (PL), Minsk (BY) and	https://cordis.europa.eu/project/id/824489

			Oldenburger Muensterland (DE).	
TeRRItoria	Territorial Responsible Research and Innovation Through the involvement of local R&I Actors	**ESF**	Central Macedonia (EL), Emilia Romagna (IT), Trøndelag (NO), North East-Romania (RO) and Gabrovo (BG).	https://cordis.europa.eu/project/id/824565
TetRRIS	Territorial Responsible Research and Innovation and Smart Specialization	**VTT**	Tampere (FI); Karlsruhe (DE), Cantabria (ES) and Szeged-Timisoara (RO/HU).	https://cordis.europa.eu/project/id/872550
TRANSFORM	Territories as Responsive and Accountable Networks of S3 through new Forms of Open and Responsible decision Making	**FGB**	Lombardy (IT), Brussels (BE) and Catalonia (ES).	https://cordis.europa.eu/project/id/872687
WBC-RRI.NET	Embedding RRI in Western Balkan Countries: Enhancement of Self-Sustaining R&I Ecosystems	**UNS**	Montenegro (ME), Vojvodina (RS), Srpska (BA), Skopje (MK) and Kune-Vain-Tale Lagoon (AL).	https://cordis.europa.eu/project/id/101006279)

Table 1. EC funded projects territorial RRI projects

These projects aimed to promote and diffuse the concept of RRI into different EU regions, many times creating synergies within the S3 discourse (TetRRIS, TRANSFORM and TeRRItoria), as well as with other major trends in the ERA such as climate change adaptation (TeRRIfica), digitalization (DigiTeRRI) sustainability (SEERRI, WBC-RRI.NET, RRI-LEADERS and RRI2SCALE), energy transition (RIPEET) and health (CHERRIES). The funded projects involved a significant number of regional stakeholders through a variety of participatory methods and advocated more citizen engagement. These projects engaged a significant number of EU regions into their pilot activities (see table 1), but as it can be also observed the distribution of these activities were not balanced. Regions from Nordic countries (Norway, Sweden and Finland) as well as Mediterranean ones (Spain, Greece, Italy and France) were the most common ones in these projects.

These projects developed a significant number of tools that can be of interest for the REINFORCING Open-Source Shop (OSS). Furthermore, the projects demonstrated a broad spectrum of topics within the domain of RRI, spanning across various sectors and disciplines to address societal challenges and promote sustainable development. Most of the initiatives concentrated their efforts on promoting public engagement and participation with citizens, fostering open dialogues, hubs, and labs. A strong focus on key principles such as inclusiveness, transparency, anticipation, and responsiveness were also commonly recognized. Most of the projects involved the development of pilots with regions and territories, thus aiming to integrate RRI into their S3 and regional development policies.

Thematic priorities of these policy experiments, as depicted in figure 2., vary across several sectors, from healthcare and climate action to territorial development and digital transformation. Each of these projects have provided valuable contributions, insights, and methodologies to address societal challenges and promote sustainable development. For instance, the CHERRIES project focused on engaging the public and stakeholders in healthcare-related discussions, while RRI2SCALE operated in the context of smart cities, transport, and energy. The RIPEET Project allocated a particular emphasis on energy transition, together with TeRRIFICA, with the unique focus on approaches to climate change adaptation action in EU and non-EU regions.

The projects also collectively demonstrated a diverse and comprehensive approach to advancing RRI across various sectors and disciplines. Through the development of indicators, roadmaps, and guidelines, they offer frameworks for evaluating and guiding regional RRI activities that can be applied in ongoing and future regional activities. The

resulting tools also facilitated knowledge sharing and capacity building, thereby paving the way for sustainable and responsible R&I ecosystems.

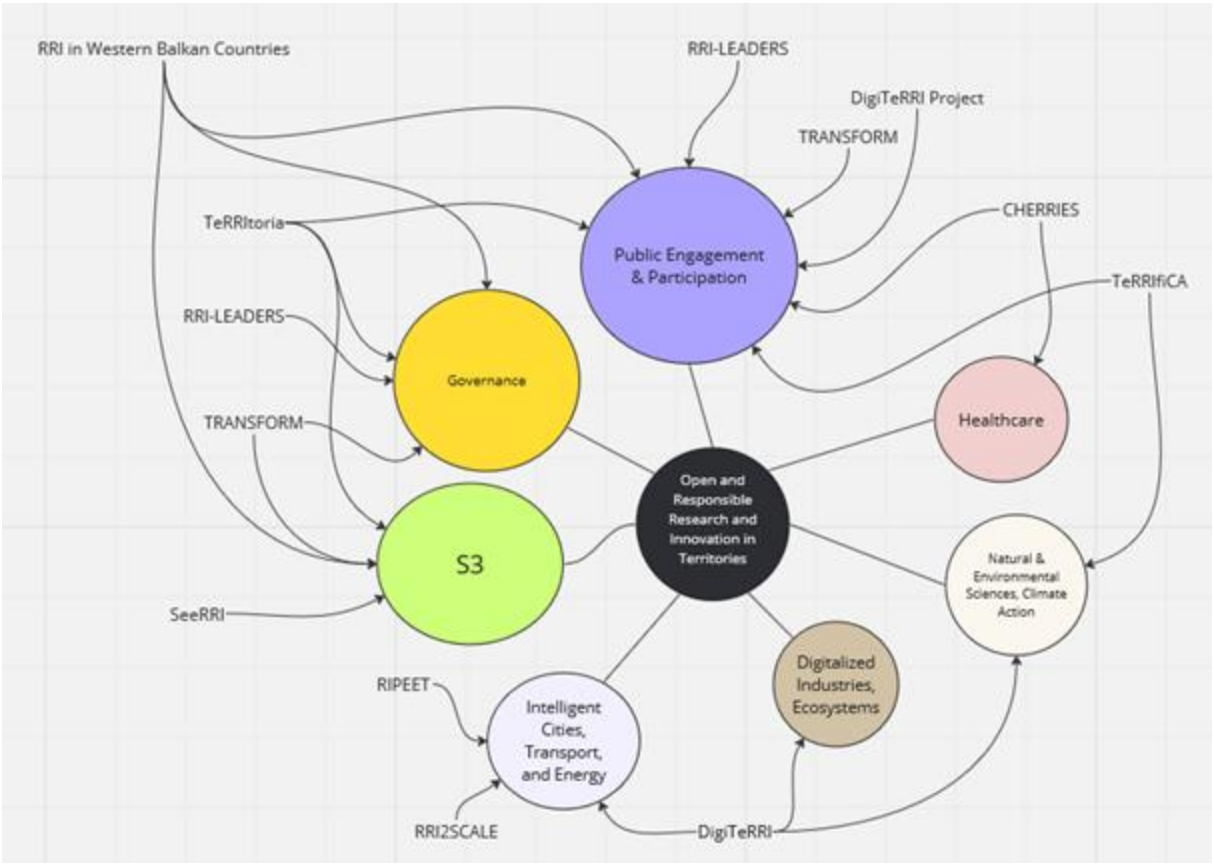

Figure 2. Themes of territorial RRI projects

The adoption of RRI at territorial and/or regional level is a recent phenomenon that has been facilitated in the EU by the funding for the 11 mentioned projects. At the same time, many regional authorities are still unfamiliar with the concept (Mehari et al., 2022). Empirical insights are often lacking and are incomparable between different regions and countries, due to the different particularities and contexts where these policy experiments have been delivered. The operationalization of RRI in regional policies is still in its infancy as there has been a recent and limited number of projects associated to this theme and there are no clear incentives at hand for promoting these kind of policy interventions (Casale Mashiah et al., 2023; Panciroli et al., 2020). In a similar vein, the diffusion and adoption of the RRI concept across ERA has been uneven, irregular, and diverse (Tabarés et al., 2022). In relation to the adoption and institutionalisation of the RRI keys, there is a diversity of RRI scores across the different countries that form the Union (Mejlgaard et al., 2018). This uneven distribution and diffusion of the concept and its keys across Member

States also constitute a barrier for its further adoption and implementation or institutionalisation.

It is also important to mention that both RRI and S3 are concepts that have been promoted in other countries such as Australia and New Zealand (Fløysand et al., 2021). Beyond the popularity of these concepts in the academic community, it is also worth mentioning that there are other significant trends arguing for the implementation of responsibility at territorial level. In fact, it seems that a "cultural turn" has taken place in innovation studies and the importance of contextual and cultural particularities is becoming a growing matter of interest (Macq, 2021; Pfotenhauer et al., 2023). The contextualization of "responsibility and its implications" into the territorial dimension is not only a matter of interest restricted to RRI. Other policy paradigms such as transformative innovation, mission-oriented innovation policy or social innovation confer a paramount importance to responsibility and its implications (societal engagement, accountability, fairness, equality, or anticipation among others) in regional development. At the same time, the trade-offs, and potential conflicts of values that the Twin Transition imposes across territories is another factor calling for territorial responsibility approaches (Miedzinski et al., 2021; Muench et al., 2022).

In this regard, it is also important to stress that geography is missing from RRI. The high-level principles that RRI aims to address are not easy to grasp on a territorial level. The "societal framing" of the concept at territorial level, as well as the question which stakeholders should be engaged remain unclear (Fitjar et al., 2019). This lack of clarification and contextualization demands the operationalization of RRI dimensions and keys in particular territorial contexts. It also calls for dedicated processes supporting the development of a shared and common understanding of RRI in a particular territory and by a particular set of actors. Pre-existing notions of responsibility in a territory are also important for identifying "de facto rri" features (Randles et al., 2016) at territorial level. Other popular concepts like sustainability can also create impediments for the adoption of RRI by stakeholders (Ladikas et al., 2019), but it also can create synergies for its adoption.

As mentioned earlier, RRI and S3 share synergies such as the need for orchestrating stakeholder engagement at regional level, but also significant tensions, such as "which stakeholders" should be engaged. The two concepts can benefit from each other as the two can be complementary due to their different approaches (macro-level perspective vs. geographical approach) and can contribute to a more inclusive and societally aligned territorial development (Fitjar et al., 2019; Thapa et al., 2019). RRI and open innovation (OI) also share several synergies (Long & Blok, 2018) and platforms for collaboration between stakeholders are some of the instruments and tools that can be used by RRI and

S3 paradigms for operationalization and implementation at territorial level (Martikainen et al., 2021). At the same time, RRI and S3 can also be conflicting concepts as the two paradigms promote different values. There are conflicting visions around the importance of economic growth and competitiveness that forms the centre of S3 discourse (Hassink & Gong, 2019; Tabarés Gutiérrez & Arrizabalaga, 2023). RRI does not have this impetus for economic imperatives associated to R&I and it argues for reflexivity and responsibility, which can be an impediment as these two concepts require different timings than the usual acceleration associated to the "time to market". This conflict of values between the two becomes explicit when policy plans embrace values such as sustainability and/or responsibility, thus demanding other kinds of priorities, instruments, and tools, that are usually not well considered by private actors that try to maximise economic profits.

Another problem that usually emerges with the operationalization of RRI at territorial level relates to the need of measuring the impact of these initiatives and the difficulties associated with them. The transformative processes that RRI enables at territorial level are difficult to capture through quantitative indicators (Dreyer et al., 2020). Commonly, regional policymakers must justify their budgets and initiatives through quantitative indicators that usually include productivity measures for R&I outputs such as number of publications, patents, jobs, etc. This hegemonic, narrow, and restricted view on the societal impact of R&I ecosystems hinders capturing the value and benefits associated with transformative processes that emerge from the application of RRI. Specific metrics for RRI have been developed by the MORRI and Super-MORRI[14] projects during the last years, but they are still difficult and sometimes impossible to be contextualised for the territorial context. Others have emerged in the field of transformative innovation arguing for a more formative approach to the evaluation of research and innovation policies (Molas-Gallart et al., 2021).

These approaches are still in their infancy and have not been popularised among policymakers. In addition, there are no clear incentives for the adoption of RRI related policies as such for policy makers (Casale Mashiah et al., 2023), as well as for regional stakeholders which can be a major force of transformation at territorial level. The development of territorial ORRI initiatives has been majorly associated with EU projects and the promotion of these policy experiments only through project regimes can also reinforce the risk of projectification of these initiatives (Felt et al., 2023). In contrast, it is also important to stress the adoption of alternative frameworks for policy evaluation that can facilitate the collective reflection and the uptake of RRI and sustainability-related practices. Moving away from classical understandings of regional R&I policies can

[14] https://super-mORRI.eu/

contribute to the development of a shared understanding of what are the common societal needs and expectations to be pursued by regional stakeholders and the accountability mechanisms that demand to be operationalized.

At the same time, increasing the sense of responsibility in regional R&I policy is also needed for extending the current configurations of regional innovation systems to incorporate other regional stakeholders such as citizen associations or citizen platforms. These regional stakeholders will also demand new frameworks and tools for collaboration. The nature of RRI as a multidimensional, interactive, and co-creation-based phenomenon that demands active participation of a diversity of stakeholders, that can contextualise, operationalize and deploy RRI practices and principles in a particular territory (Dreyer et al., 2020; Fløysand et al., 2021; Mehari et al., 2022) also asks for a reconfiguration of the metrics and instruments to assess these interventions.

The Balkan countries as specific territorial context

Geographically, the Western Balkans countries are part of Europe, mostly surrounded by EU Member States. Indeed, the EU is strongly engaged and involved in political, socio-economic, and sustainability-related activities in this region. The European perspective relying on merit-based prospect of EU membership has significantly helped the Western Balkan countries to achieve overall political and economic reforms and advances, followed by improved democratic processes, which are in the EU's own political, security and economic interest. Hence the EU's core interest in the Western Balkans could be described as a geostrategic investment in a stable, strong, and united Europe based on common values, as well as an investment in the EU's security, economic growth, and influence to strengthen democracy, the rule of law, and the respect for fundamental human rights. On the other hand, a credible EU accession perspective could be defined as the key driver of political, economic, and societal transformation at national and regional level in the Western Balkans (Directorate General for Neighbourhood and Enlargement Negotiations, 2018). A significant step towards a more solid Union was already made through visa liberalization for the Western Balkan countries, which has significantly improved regional cooperation, thus fostering more open societies. Advancement of transnational cooperation between the countries in the region has also been defined as one of the policy recommendations to advance the Sustainable Development Goals in the Western Balkans, published in the framework of the WB2EU project co-funded by the EC under its Erasmus+ Jean Monnet programme (Fattibene et al., 2023). Realising this recommendation could be facilitated by a set of common targets among the Western Balkan countries that harmonises the different legislations and involves the civil society more effectively. This, in turn, could contribute to advancements in other policy areas such as a transnational

network of renewable energy as a security infrastructure, as well as to a decrease in the percentage of young people neither in employment nor in education and training (Fattibene et al., 2023).

Notably, the process of joining the EU is far more than just a technical process. Instead, it represents a generational choice based on the overlap of fundamental values among included parties. At the same time, the achievement of EU accession is fully dependent on the objective progress achieved by each country. It could also be noted that the core values integrated in the EU membership conditions significantly correlate with RRI pillars and dimensions. Hence, efforts to increase the openness of innovation processes and other RRI-related aspects are well aligned with vital reforms required by the EU accession process. Although significant progress has already been made both in terms of reforms and to overcome the devastating legacy of war and conflict, several crucial areas still require comprehensive and convincing reforms, including rule of law, fundamental rights and good governance, competitiveness, and regional cooperation and reconciliation solving currently open bilateral disputes (Directorate General for Neighbourhood and Enlargement Negotiations, 2018), to enhance collective integration, security, prosperity and social well-being.

Although the growth rates of several economic indicators in the Western Balkans are higher than in the EU, e.g. North Macedonia is the regional frontrunner in terms of a business-friendly environment, outperforming the OECD and OECD-EU averages (OECD, 2020), some other critical parts of the region's economies are uncompetitive, with undue political interference and an underdeveloped private sector with low potential to compete and withstand market forces in the EU (Directorate General for Neighbourhood and Enlargement Negotiations, 2018). Further efforts are thus required to build stronger innovations-based and skills-based economies to address high unemployment, especially among the young, to increase prosperity and to create novel business opportunities. Significant advancements are especially required in the fields of limited access to finance, unclear property rights and complex regulatory environments. Advances in these sectors have already been visible since the first steps towards digitalization in the public and private sector have been made (OECD, 2020). One of the major challenges yet to be addressed is respect for fundamental rights, starting from freedom of expression and independence of media as key pillars of democracy, the protection of minorities and the fight against discrimination, with enlarged inclusivity efforts aimed at the well-being of vulnerable groups and the LGBTQIA+ -community, as well as in ensuring gender equality (Directorate General for Neighbourhood and Enlargement Negotiations, 2018). Regarding gender equality, the public sector in the Western Balkans is highly comparable with OECD and OECD-EU averages (OECD, 2020).

The fundamental values that the EU relies on must be spread and embraced widely across the Western Balkans, at the level of foreign and regional policies right down to what children are taught at school, to ensure further prosperity of Europe as a whole. Although the quality of life and education has been improved since 2009 based on several metrics, such as student performance in standardised reading, mathematics, and science tests (PISA), the proportion of citizens satisfied with the educational system is still lower in the Western Balkans (57 %) compared to OECD-EU average (68%) (OECD, 2020). The necessity to address the challenges and provide an environment for mandatory political, economic, and social transformation relies on the engagement of different stakeholders from all strands of the quadruple helix, including the political, academic and private sectors, civil society organisations and citizens themselves.

From an RRI perspective, the nature of these dynamic and multi-layered interactions among quadruple helix actors in the Western Balkan countries was already practically investigated in the EC-funded project WBC-RRI.NET and summarised in the policy brief "Co-creating Responsible Research and Innovation activities: Experiences from the Western Balkans" (WBC-RRI.NET, 2022a). The policy brief notes that closing the knowledge gap among different stakeholders as well as reconciling the various interests of citizens, the private sector, the academic community, and government representatives have posed a challenge to RRI implementation in the Western Balkans. Another challenge identified relates to political instability in the Western Balkan region, which may hinder the development and implementation of regional innovation policies. Furthermore, trust issues emerged as one of the challenges, especially in terms of a lack of trust in regional authorities, as well as assumptions that public engagement actions are only used to legitimise the actions of expert elites. On the other hand, the project found that highlighting successful examples of regional efforts at advancing RRI can attract interest from new key actors from the quadruple helix. Therefore, the project activities also included a mapping of good RRI practices in the Western Balkan region (WBC-RRI.NET, 2022b). Overall, the Western Balkan economies still lack strong innovation ecosystems with close relationships between the academic community and industry, and require further efforts directed at collaboration, mutual learning, and creating "win-win" situations.

The policy brief by the WBC-RRI.NET project also elaborated several recommendations for each level of quadruple helix engagement in RRI implementation (WBC-RRI.NET, 2022a). Civil Society Organizations (CSOs) have been identified as an important bridging actor able to translate scientific results to information that is more understandable and relatable to citizens, and to strengthen the mutual responsiveness between science and society by utilising scientific data to support their causes and providing valuable data for scientific analysis and publication. In short, CSOs should be supported as key actors in the promotion

of citizen engagement in science and the mobilisation of academic communities towards more open and multidirectional scientific communication. The institutional culture in the academic sector should be built on RRI principles at its core to strengthen academic integrity, ethics and inclusivity, as well as openness towards the community at the institutional, individual and infrastructural level. Furthermore, professional development, training, and knowledge exchange related to RRI should be incorporated into curricula and educational programs as schemes for the continuous education of academic staff. When it comes to the private sector, social dimensions of technological development and innovation should be systematically considered in the context of socio-constructivist and human-centred R&D approaches. Debates surrounding citizen concerns should be particularly considered. Several key RRI issues require special attention from the private sector, such as ensuring gender equality in leadership positions, supporting women in research and development in industry, and promoting networks for female entrepreneurs. Ethical procedures and practices should also be strengthened in R&I business operations. Local and regional governments play an important role in embedding RRI principles within a specific territory and ensuring their implementation and sustainability. Additionally, intergovernmental organisations, such as the Regional Cooperation Council, are key to facilitating a regional approach and identifying regional priorities. Public sector stakeholders need to be better prepared to engage in RRI processes, reduce administrative and bureaucratic burdens and promote implementation of RRI principles. Legislative and regulatory frameworks should adequately encourage RRI practices, such as access to and reuse of data and scientific results, IPR (intellectual property rights) management and protection, addressing gender-based violence, etc. Different funding schemes and support should be carefully integrated with RRI aspects, such as ethics, open standards, or gender equality, in evaluation, selection, and monitoring processes. Overall, initiatives that bring research and innovation closer to citizens should be financially supported (WBC-RRI.NET, 2022a), which is one of the goals pursued by the REINFORCING project.

4 DRIVERS OF ORRI

In the following chapter, we will discuss the various drivers behind ORRI. Aside from their far-reaching policy implications, the trends and drivers calling for or necessitating ORRI also create a wider background or landscape for institutional changes on the level of organisations and territories. In other words, they are cross-cutting issues affecting and affected by all research and innovation efforts.

The first subchapter discusses how pressing societal and environmental challenges have led to mission orientation in research and innovation. Mission-oriented policy is thought to provide a framework for addressing societal and environmental concerns, delivering more impactful solutions, as well as fostering multi-disciplinary collaboration, and eventually leading to long-term sustainability and well-being. By focusing efforts and resources on areas of critical importance, mission-oriented approaches are considered as a way to pool resources and thus help harness the transformative potential of research and innovation.

The second subchapter deals with open science, its importance, and challenges. Open science forms a core feature of ORRI and connects to mission orientation as it is considered to accelerate innovation processes, and to empower citizen participation as well as promoting equity and inclusivity. By embracing open science principles and practices, science and society can better advance knowledge and innovations and contribute to positive societal change.

Open science is closely related to societal engagement and democratisation of R&I, which are discussed in the third subchapter. Engagement and democratisation are considered important as they may enhance relevance and responsiveness in scientific research and innovation, foster trust in science, empower citizens and communities, as well as promote equity and inclusivity.

The final subchapter shortly discusses ethical implementation of AI as a concrete example of implementation of ORRI principles. At best, AI may help to address grand societal and environmental challenges, while it should be developed openly, engaging users/citizens, and respecting human rights.

4.1 Societal Challenges and Mission orientation in research and innovation

As is the case with most policy concepts and policy discourses, ORRI did not develop in isolation. Like any other policy initiative, the quest to transform our research and innovation systems to become better aligned with societal needs and values should be understood in the broader context of the developments in the science, technology, and

innovation policy (STI-policy) field. One of the key shifts in STI-policy of the last decades was the so-called "normative turn" (Daimer et al., 2012) beginning in the 2000s, according to which STI-policy was increasingly reoriented from primarily focussing on economic objectives towards addressing societal challenges as well. Mission-oriented innovation policy, which can be interpreted as an attempt to operationalise the new policy paradigm, received increased attention over the last five to ten years. Related to this are policy initiatives that can be summarised under the label of transformative innovation policy. In this section, the broader shifts in STI-policy will be briefly presented, and it will be discussed how these developments have been relevant for ORRI. As RRI and, in recent years, ORRI, have been strongly promoted by the European Union, the specific European aspects of these policy developments will be considered as well. In the final part of this section, possible connections, and joint perspectives between ORRI and the developments at the level of the overarching policy landscape will be discussed.

STI-policy in the OECD underwent considerable changes over the past decades – both regarding political aims as well as to the underlying rationales and conceptualisations. Overall, since the post war period, three main phases of STI-policy paradigms can be identified (Breitinger et al., 2021; Lindner et al., 2024a).

The first paradigm primarily focussed on establishing and expanding the science systems, thereby emphasising the generation of fundamental knowledge (OECD, 1972). The conceptual foundation of STI-policy at the time was primarily shaped by neoclassical economic thinking (Solow, 1957; Arrow, 1962) and a predominantly linear conception of the innovation process (Pavitt, 1976). Consequently, governmental interventions were justified by the need to compensate for market failures in processes of generating the public good knowledge.

The second STI-policy paradigm started to unfold during the 1970s. In view of weak economic performance after the end of the long period of economic growth of the post war decades and intensifying international economic competition, fostering science, technology and innovation were increasingly identified as viable means to contribute to economic ends. Due to the growing pressure on STI to contribute to economic growth and competitiveness and new approaches in economic thinking about technology and innovation, basic assumptions about the nature of the innovation process were revised, eventually leading to the rise of the systems of innovation approach in STI-policy thinking (e.g., Freeman et al., 1982; Lundvall, 1985; Nelson, 1993). Regarding innovation, a more complex, non-linear understanding replaced the previous conception, and the crucial role of interactions between heterogeneous actors of the innovation system was increasingly acknowledged. Within this paradigm, the chief task of STI-policy was to improve the performance of the

innovation system, and the systems of innovation heuristic provided policymakers in the OECD with important conceptual guidance on how to design STI-policy.

While economic rationales were the main justifications for government interventions during the first two phases of STI-policy, these predominantly economic objectives were increasingly complemented by other normative policy goals from the 2000s onwards. STI were called upon to address pressing societal challenges such as climate change, sustainability, and health. Highly influential steps towards preparing and driving forward this paradigmatic shift were the Aho Report (2006), urging STI-policy to address more directly societal problems, and the Lund Declaration of 2009 (Swedish Presidency, 2009), calling research and innovation to focus on the "Grand Challenges of our time". In effect, the directionality of research and innovation gained importance in the funding of STI. In view of the rapidly intensifying climate crisis and influential policy initiatives such as the adoption of the Sustainable Development Goals by the United Nations in 2015 and internationally agreed targets for reducing greenhouse gas emissions, STI was ever more faced with demands to contribute more effectively to solving societal problems and to support sustainability transitions. In fact, numerous programmes incorporated elements of directionality within the policy frame of addressing "Grand Challenges". Yet, it was conceded that effective measures to mobilise scientific knowledge and innovation for the needed transformative change were not readily available (Lindner et al. 2021) or existing instruments were too slow and ineffective in generating societal impact. Against this background, approaches such as transformative innovation policy (Diercks et al., 2019) and the so-called "new mission-orientation" in innovation policy (Mazzucato, 2018) became influential. A rather puzzling observation is that despite the obvious similarities between the societal challenges paradigm and the policy concept of RRI in terms of their dedicated societal needs-orientation, these two policy discourses by and large developed in mutual ignorance.

Figure 3 provides an overview of the three main STI-policy paradigms in terms of their rough chronology and their main rationales for policy intervention. Analysed from the chief policy problem of STI-policy during the respective phases, all three paradigms can be characterised as attempts to address specific structural failures (cf. Weber and Rohracher, 2012). The first paradigm was preoccupied with responding to market failures, the second identified systemic failures as the main rationale to justify STI-policy, and the third and most recent paradigm is about addressing transformative failures. It is important to note that each new policy-paradigm did not replace the previous one. Instead, the phenomenon of policy-layering can be observed, according to which important elements of the preceding paradigm continue to be in place. In effect, this policy-layering can entail considerable

tensions both between and within the paradigms and may cause a lack of policy coherence (Lindner et al., 2024a)

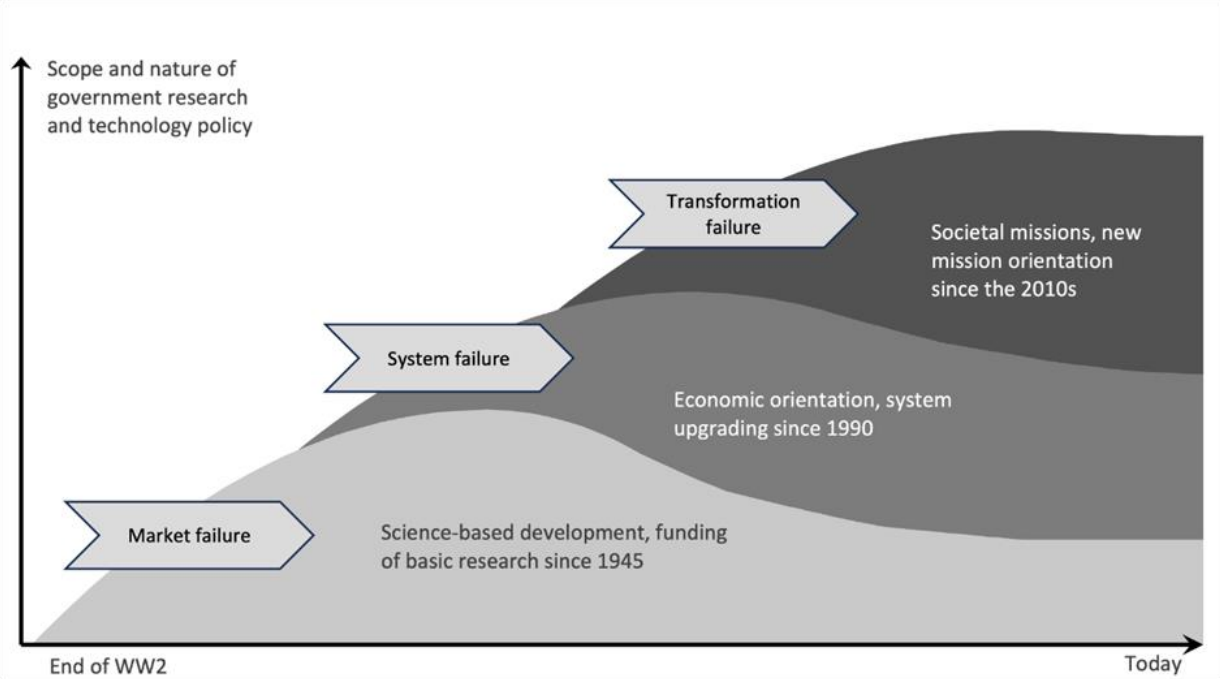

Figure 3. Main phases of STI-policy in the OECD *(Source: Lindner et al., 2024a; based on Gassler et al., 2006, Daimer et al., 2012 and Breitinger et al., 2021.)*

In addition to the briefly outlined paradigmatic shifts in STI-policy in the OECD, which obviously also include the EU member states, several specific European developments seem to be relevant for the contextualisation of RRI and ORRI. Of these, two partly interrelated aspects appear to be particularly important: (1) the European dynamics of the STI-policy field and (2) attempts to respond to the crisis of legitimacy of European institutions.

STI as a policy field at the European level slowly emerged in the 1960s. Policy objectives in these early years of European science and technology policy concentrated on developing joint European research infrastructures and facilitating researcher mobility (Biegelbauer and Weber, 2018). An important step forward in firmly establishing STI-policy at the European level was the start of the first Framework Programme (FP) in 1984. To date, the EU has implemented a total of nine FPs, and each new programme enjoyed a significant budget growth compared to the previous one, making STI-policy the second largest Europeanised policy area already in the 1990s (European Commission, 2015). While the thematic profiles of the respective FPs changed over time, Biegelbauer and Weber (2018) show that the dominant and overarching driver for the STI-policy area was the fear of Europe falling behind technologically and economically compared to its main competitors.

In fact, Biegelbauer and Weber (2018) and Weber et al. (2023) demonstrate that the interpretation that Europe needs to catch-up in science and technology to secure economic competitiveness was and continues to be the "master frame" of European STI-policy since its early conception until today. Arguably, other influential policy rationales in European STI-policy, such as the frame of the "European paradox", according to which European performance is particularly weak in terms of bringing science-based knowledge into markets, essentially build on the master frame "Europe as a laggard in science and technology" (Biegelbauer and Weber, 2018). In principle, this interpretation also at least partly holds for the policy paradigm addressing grand societal challenges. While this most recent paradigm in STI-policy deviates from the master frame by focussing on societal and environmental needs, it at the same time echoes key aspects of the "Europe as laggard in science and technology" rationale as it assumes that generating solutions for societal and environmental challenges also serves the objective of improving international competitiveness (Lindner et al., 2024b).

Politically salient side effects of the intensifying European integration over the past decades were recurring phases of concern about a possibly growing democratic deficit and a related crisis of legitimacy of the EU. These concerns were fuelled by recurring Eurobarometer survey findings indicating declining popular support for European institutions (Kies and Nanz, 2013) and particularly by the results of referenda in numerous member states on European treaties (mainly on the Maastricht Treaty in 1993 and the Constitutional Treaty in 2005). In view of these developments, improved participation of citizens and civil society organisations in European decision-making was increasingly seen as a promising approach to address the low levels of legitimacy of European institutions (Lindner et al., 2016). This alleged "participatory turn" of EU governance (Saurruger, 2010) was reflected in the European Commission's influential White Paper on Governance (Commission of the European Communities, 2001), which proposed to open European decision-making processes for societal participation. This general participatory turn of European governance also influenced the EU's STI-policy. In 2002, the European Commission adopted the Science and Society Action Plan (European Commission, 2002), calling for active involvement of citizens in science as well as in science policy. This policy ambition was soon translated into the new funding line "Science and Society" within FP6 (2003-2006), and further strengthened with the "Science in Society" funding line of FP7 (2007-2013). For the time being, attempts to better align science and society reached a highpoint with the 8th FP Horizon Europe (2014-2020) (Griessler et al., 2023). In the context of the funding line Science with and for Society (SwafS), RRI was broadly rolled out through significant funding and enjoyed the status of a cross-cutting issue for the whole of Horizon 2020 (European Commission, 2020). In the current FP Horizon Europe however, the

institutional and financial backing for the explicated concept of RRI dropped and partly shifted to the EC's specific understanding of open science.

From a bird's eye perspective, the brief outline of the broader shifts in the STI-policy landscape and of the STI-related developments at EU level by and large seem to have provided rather favourable context conditions for a reform- and transformation-oriented concept such as RRI. The dedicated call of the most recent STI-policy paradigm to direct research and innovation actively towards addressing pressing societal challenges is in close normative proximity to the RRI ambition of better aligning research and innovation with societal needs and values. Likewise, one would expect that the EU's "participatory turn" provided sufficient political backing for public engagement in STI (policy), as it was always strongly promoted by RRI. Yet, it can be concluded that these favourable conditions seem to have contributed to a window of opportunity for the rise of RRI but were not sufficient to effectively institutionalise and thus firmly establish this policy concept at EU level.

Arguably, the policy frame "Europe as laggard in science and innovation" continues to dominate European STI-policy thinking – despite the emergence of the grand challenges paradigm. What is more, for the most part a rather irritating mutual ignorance of the policy discourses promoting the grand challenges paradigm on the one hand and the RRI concept on the other indicates that potential strategic connections and joint perspectives have so far not been actively sought and woven together by the respective proponents.[15] The insights generated by the literature review conducted in Work Package 1 of the REINFORCING project (see Chapter 5.3), also support this observation, as only very few academic articles dealing with transformative innovation policies and/or missions explicitly include RRI perspectives. Given the often-far-reaching changes of innovation ecosystems, modes of production and consumption, and behavioural patterns aimed at by transformative policies, and the uncertainty of how these changes might play out concretely due to the high degree of complexity associated with any transformation, more, not less, anticipation, reflexivity and participation are needed when pursuing policies addressing grand societal challenges. Thus, for the future it will be extremely important to actively seek to integrate RRI perspectives in transformative (innovation)policies, thereby increasing the likelihood of achieving societally robust and desired impacts and reducing the probability of unintended consequences of such transformations.

[15] For more in-depth discussions of the reasons for the relative decline of ORRI in European STI-policy, see e.g., Daimer et al., 2023; Griessler et al., 2023; Novitzky et al., 2020; Owen et al., 2021b; Strand and Spaapen, 2021; Völker et al., 2024.

4.2 Open science & innovation

Defining Open Science and Innovation: An ongoing process

Open Science is not just a modern buzzword. It is a concept deeply rooted in the tradition of scientific openness that has evolved over time to meet global demands (Burgelman, J. C., Pascu, C. et al., 2019). Open science at its core, is about transforming how research is conducted, shared, and utilised. Open science transcends the mere openness of data and publications, fostering a culture where relevant knowledge actors, including citizens and scientists, collaborate in the co-production of knowledge (Von Schomberg, 2020).

Open science encompasses various facets, often referred to interchangeably as open scholarship or open research. Von Schomberg (2020) defines it as the early sharing of knowledge and data in the research process, a collaboration that extends beyond traditional academic boundaries (Burgelman, J. C., Pascu, C. et al., 2019). Open Science can be seen as revolutionising the research landscape, ushering in sociocultural and technological changes (Vicente-Saez & Martinez-Fuentes, 2018). It is not just a change in how research is done; it is about creating a new ecosystem of knowledge sharing and development. Tools like open data platforms and open peer review methods are just the beginning of this trend (Vicente-Saez & Martinez-Fuentes, 2018).

Regarding Open Innovation, the European Commission, in its vision of the Open Innovation, Open Science, Open to the World (3Os), has adopted Henry Chesbrough definition for Open Innovation as the "use of purposive inflows and outflows of knowledge to accelerate internal innovation". Open innovation focuses on opening the innovation process to all active players and other experts in other fields (Chesbrough, 2003; cf Chesborough et al. 2006). The main purpose is to open the innovation process so that knowledge can flow freely and be transformed into products and services that create new markets, fostering a stronger entrepreneurship culture (3Os Vision).

The concept of Open Innovation (OI) has been continuously evolving and has been defined in numerous ways through academic journal articles, books aimed at practitioners, and business case studies (cf. Kuan 2020). McGahan and colleagues (2021) observed that as Open Innovation has developed over time, it has become more complex. Resulting in the concept covering a wide spectrum, including both the process of innovation, such as seen with open-source software, and the outcomes of such processes, like drugs developed externally by pharmaceutical companies and then brought to market (cf. Chesbrough et al 2024). Currently there is a vast literature on open innovation and its various dimensions, of which a good collection is provided by the recent Handbook of Open innovation (Chesbrough et al 2024). Thus, the relationship between Open Science and Open

Innovation can be seen in how Open Innovation fosters a new structure within the ecosystem by linking businesses, universities, and governments. This is complemented by Open Science, which disseminates theoretical and practical knowledge, thereby supporting the Open Innovation framework (Ottonicar et al. 2020).

Recently, Robinson et al. (2020) have also highlighted the critical role of co-creation in bridging open innovation with RRI. Co-creation, a process involving various stakeholders in innovation, is seen to foster innovation that is more closely aligned with societal needs and values. This approach has not only been beneficial in enhancing stakeholder involvement and harnessing diverse expertise and perspectives but also holds the potential for generating innovative solutions that are responsible, inclusive, and socially driven (Robinson et al. 2020).

Benefits of Open Science and Innovation

One key benefit of open science is that it makes research more efficient in several ways (Nielsen, 2011)**.** First, it makes more knowledge available to everyone, which can reduce costs and increase the chances of research success and reuse. Consequently, this approach can lead to the democratisation of science (Arza & Fressoli, 2018). Second, it encourages different kinds of experts to work together, boosting creativity and collective intelligence. Furthermore, when scientists in the same field work together smoothly, it speeds up the process of sharing and evaluating different ideas and findings, enhancing the collective intelligence (Nielsen, 2011). By sharing both the results and the work in progress of scientific research, we create a bigger pool of knowledge everyone can use. This helps avoid repeating the same work unnecessarily and lets researchers build on each other's work to find new answers and solutions more efficiently. Plus, open science allows re-using existing data, leading to new discoveries (Arza & Fressoli, 2018). Open data also means that important research findings can be checked and used by others, moving science forward, as noted by Hartshorne and Schachner (2012).

Open science makes scientific knowledge more accessible and understandable to more people, which is another form of science democratisation (Arza & Fressoli, 2018). It lowers the barriers to accessing and re-using the vast amount of knowledge out there, not just for scientists but for everyone, including NGOs, CSOs, businesses, and the general public. This widespread access leads to a more informed society and encourages new learning processes, according to Gregson, Brownlee, Playforth, and Bimbe (2015). Some open science initiatives, like citizen science projects, even let non-scientists help create scientific knowledge. This kind of participation can lead to new questions, skills, and even new forms of science created by everyday people (Arza & Fressoli, 2018). Thus, it can also be viewed

as a science democratising force, promoting broader societal participation in producing knowledge (Arza & Fressoli, 2018).

Lastly, open science is great for addressing societal needs more directly. It increases the visibility of local issues and encourages community involvement in science, which can help steer research towards solving relevant problems (Stodden, 2010). When the community contributes, they bring their unique perspectives and experiences, enriching the research process and its outcomes. The open sharing of scientific resources prevents private companies from taking control of them, making it easier and cheaper to find solutions to community problems (Arza & Fressoli, 2018). Lastly, open access and licences, like Creative Commons, remove barriers, making it simpler to turn scientific discoveries into real-world solutions (Arza & Fressoli, 2018).

However, there is yet little understanding on mechanisms and conditions that link open science practices with potential benefits. There is no guarantee that opening up some scientific practices or outputs in some way would univocally trigger knowledge democratisation, research efficiency, and social responsiveness.

Open innovation, in turn, have been seeing offering several related direct benefits for firms including e.g.(Kuan 2020; Chesbrough et al 2024):

- By engaging with external entities, firms can tap into a wider pool of ideas and technologies, leading to more diverse and potentially groundbreaking innovations.
- Collaborating with outside partners can reduce the costs associated with research and development, as well as spread the financial risk.
- Access to external knowledge and resources can accelerate the development process, enabling firms to bring products and services to market more quickly.
- Firms that effectively manage open innovation can outpace competitors by leveraging external contributions and reaching new markets.

Shaping Open Science and Innovation: The European Commission's Visionary Impact

Since the first science journal in 1665, scientists have published research for recognition rather than financial gain (Das & Dutta, 2020). The rise of the internet and increasing journal costs sparked the open access movement, addressing the global access crisis in scientific literature (Das & Dutta, 2020). Today, the open science movement thrives, featuring thousands of open access journals and repositories, changing how scientific knowledge is shared.

In response to this shift, the Europe Commission took action. Working hand in hand with key scientific stakeholders, the EC developed a holistic policy to embed open science in European institutions[16] (Brinken et al., 2019; Burgelman, J. C., Pascu, C. et al., 2019). Initiatives like the Open Access pilot in the Seventh Framework Programme and the Horizon 2020 and HORIZON Europe Open Access Mandate show the EU's dedication. The introduction of "Plan S"[17] in 2018, as Brinken et al. (2019) and Burgelman, J. C., Pascu, C. et al. (2019) highlight, was a game changer, setting Open Access as the standard by 2021. The plan includes requirements for Intellectual Property Rights retention, open licences, immediate open access, and further requirements for repositories and OA venues (Burgelman, J. C., Pascu, C. et al., 2019).

The European Commission's strategy, as Burgelman et al. (2019) emphasise, went beyond mere open access. They are embedding Open science practices in certain Horizon Europe work programs, depending on the needs of scientific fields (Burgelman et al., 2019). When compared with H2020, RRI was a prominent driver, embedding responsible, equitable, and fair innovation principles into various projects and programs. However, as Horizon Europe emerges, it integrates RRI as an overarching principle without a dedicated funding program (Robinson et al. 2020). This includes funding for innovative practices like early sharing of research results or extending beyond just publications and data. The Commission is even exploring rewarding researchers who engage in open science practices, possibly using new metrics like data citation (Burgelman et al., 2019).

These efforts and developments render Horizon Europe the first global public research funding programme to include open science in its evaluation criteria of excellence (Burgelman et al., 2019). Research proposals must now describe how they will implement open science practices, while adhering to the FAIR principles of responsible data management. This shift, along with significant funding for research that involves co-creation with citizens and society in developing and implementing projects is groundbreaking (Owen et al., 2021b). Robinson et al. (2020) argues that, particularly through co-creation, the implementation of the 3Os policy in Horizon Europe has the chance to leverage and reframe many insights from RRI's past activities.

[16] For instance the Open Science Policy Platform established by the European Commission that highlight existing OA requirements, monitoring, and sanctioning, https://ec.europa.eu/research/openscience/index.cfm?pg=openscience-policy-platform

[17] https://www.coalition-s.org/addendum-to-the-coalition-s-guidance-on-the-implementation-of-plan-s/principles-and-implementation/

This approach by the EC has inspired other funders and institutions globally. It has become a model for other open science approaches and policies (Brinken et al., 2019; Burgelman et al., 2019), such as a call by the National Academies of Sciences, Engineering, and Medicine for "open science by design" in 2018, the Australian research data infrastructure initiative, the G7 Open Science Working Group, the OECD work on Enhanced Access to Data and Models (OECD, 2006) and Business models for sustainable research data repositories (OECD, 2017), and the African Research Cloud (ARC), and UNESCO.

Challenges in the Evolution of Open Science

As the scientific research landscape evolves towards greater openness and collaboration, the transition to open science faces a spectrum of challenges that need addressing. These include practical, technical, cultural, environmental, and financial implementation hurdles, emphasising the need for systemic changes in how research is conducted, shared, and evaluated in the era of open science. The list of challenges includes amongst other:

1. **Practical implementation concerns:** The question of how to include citizens and publics in open science raises practical challenges in its execution (Owen et al., 2021b).

2. **Data sharing complications:** Burgelman et al. (2019) emphasise the critical role of open data in the research life cycle, highlighting it as essential for reproducibility and scientific advancement. Open data not only accelerates research by enabling data reuse and validation of findings, but also enhances research impact and addresses global challenges. Burgelman et al. (2019) highlight that despite the interdisciplinary benefits of sharing data and creating new (meta) knowledge (Evans & Foster, 2011; Fischer & Zigmond, 2010), data sharing faces hurdles such as a lack of formal recognition and researchers concerns over jeopardising their publishing impacts (Costas et al., 2013; Scheliga & Friesike, 2014). Burgelman et al. (2019) also highlight that although the Horizon Europe open data default policy emphasises FAIR principles (findable, accessible, interoperable, and re-usable), it also aims to balance openness with protection and privacy concerns. In that sense, responsible data management plans (DMP) will become mandatory and using trusted or certified repositories and infrastructures like the European Open Science Cloud (EOSC) will be required for research data in some Horizon Europe work programs (Burgelman et al., 2019). Additionally, in certain research domains, Open Science may present compatibility challenges due to data protection laws, data sensitivity, and ethical considerations (e.g., research involving vulnerable groups) (Ryan et al., 2023).

3. **Competitive Science Dynamics:** The culture of competitive science often hinders data sharing, impacting the reliability and reproducibility of research (Von Schomberg, 2020).

4. **Skill Gaps in Open Science:** There is a growing need for building open science skills among researchers. EU Projects like FOSTER aim to build these capacities, e.g. on its platform the project provides a range of online courses and resources to learn about key Open Science topics (Brinken et al., 2019).

5. **Licensing and publications issues**: challenges include licensing complexities, additional costs for subscription and publishing, and the underrepresentation of Open Access journals in major scientific databases (Das & Dutta, 2020; Ryan et al., 2023).

6. **Changing reward and incentive systems:** Shifting the scientific community's focus from traditional publication metrics to rewarding open science practices remains a major challenge (Burgelman et al., 2019). Notably, funding agencies can play a pivotal role in incentivizing the adoption of open science principles (Ryan et al., 2023)

7. **Lack of institutional support**: It is worth acknowledging that measures are currently being undertaken in this regard, as evidenced by the SuPER-MoRRI survey outcomes. This survey gauged the perspectives of European researchers regarding their primary motivations for embracing open science practices. Notably, nearly half of the respondents (43%) indicated that their institutions do not provide incentives or recognition for engagement in open science activities. This underscores the crucial role that institutional support plays in fostering open science (Ryan et al., 2023).

8. **Coordination and infrastructure limitations:** The lack of coordinated actions among repositories and the need for a federated infrastructure based on fair principles are significant to unlock the potential of data analysis and integration (European Commission, 2018).

9. **Financial considerations**: the cost implications of implementing open science, especially in data hosting and maintenance, present a financial challenge. In addition, there is a high opportunity cost of not adopting FAIR research data which is estimated around €10.2 bn for the EU Scientific system (Burgelman et al., 2019)

10. **Open Innovation barriers**: Open innovation faces several challenges, including balancing collaboration with competition, handling intellectual property rights, and addressing variations in education and infrastructure (McGahan et al., 2021).

11. **Environmental impact:** The digital infrastructure enabling open science has significant environmental implications, requiring ethical and social responsibility considerations (Samuel & Lucivero, 2020).

12. **Evolution of research evaluation:** The current focus on publication metrics is increasingly misaligned with the collaborative nature of modern science, necessitating a shift towards valuing knowledge sharing and data-intensive collaboration (Von Schomberg, 2020).

Regarding more specifically open innovation, it is challenging to integrate these efforts into the overall innovation strategy as some companies treat open innovation as a separate unit, which can lead to missed synergies. Therefore, building an efficient process for managing external ideas is essential. Furthermore, managing IP issues is a significant challenge. Organisations must navigate IP rights when collaborating with external partners to avoid conflicts. Therefore, clear agreements and terms are essential to protect both parties' interests. (von Dyck 2015; Kylliäinen 2018 cf. Chesbrough et al 2024)

4.3 Societal engagement

Societal engagement has been frequently emphasised in contemporary economic, cultural, social, educational, and ecological policies. Research on this topic has provided support for the development and implementation of various practices to plan, execute and evaluate societally important actions. There is an ongoing and acknowledged need for Europe to build more cohesive and inclusive societies where citizens are not seen as objects and passive recipients of policy interventions, but rather as active participants of the society (Ateca-Amestoy et al., 2019). The engagement of citizens, local communities and civil society is considered a key element of the European Research Area to achieve greater societal impact and increased trust in science (European Commission Directorate-General for Research and Innovation, Kania, & Bucksch, 2020). To achieve this, policy makers, funders and leaders of R&I institutions are expected to agree on recommendations, principles and good practices for incentivizing and rewarding citizen participation. The Commission, on its part, aims to continuously support these intentions by organising with Member States and other stakeholders Europe-wide citizen science campaigns with the intention to stimulate citizens' contribution to knowledge production with means such as crowdsourcing platforms or pan-European hackathons.. The Commission, together with Member States, also plans to develop best practices to open science and innovation to citizens, especially the youth (ibid.), and has recently launched code of practice on citizen engagement for knowledge valorisation (European Commission, 2024) and mutual learning exercise on Public Engagement in R&I (European Commission Directorate-General for Research and Innovation, 2024). The corporate world can also play an important part in

this, by contributing to the communities where they operate and sell. For example, companies could develop and implement some form of "community involvement strategies" that could take into consideration the current state and needs of local communities and other relevant societal actors (Lakin & Scheubel, 2017), or they could form mutual symbiotic relationships with customers in creating value through co-innovation processes (Lafuente, 2023; Takahashi & Takahashi 2023; Roberts et al 2021). All these ambitions and activities would enhance communication and collaboration between the actors in the European research and innovation ecosystem, including citizens.

Steen and Nauta (2020) point out that societal engagement is a complex phenomenon that can bring along numerous advantages (legitimacy, alignment, collaboration, and clarity), but also possible disadvantages (effort, complexity, slowdown, expectations, and reputation). They suggest that there are at least two modes of societal engagement, depending on the nature of the relationship between subjects:

a) An organisation may adopt an outside-in orientation, promoting legitimacy and strategy alignment, communicating with the society about its needs but still working on its own. This approach is limited as the different actors in the system remain separate in their functioning. However, it will allow rich dialogue and mutual understanding, with better chances for the organisation to be aligned with societal needs.

b) An organisation may, additionally to legitimacy and strategy alignment, embrace collaboration and clarity – if it shares vision and defines common goals with the society. Together the organisation and civil society organisations can collaboratively work towards the fulfilment of shared goals thus shifting the locus of innovation towards societal needs. In other words, organisations and the society are able to have mutual goals towards which they will strive together.

The same authors also propose a set of recommendations for organising societal engagement effectively, stressing the importance of the quality of the interactions between and among the organisations involved:

- When decisions have not yet been made;
- When the sponsoring body is willing to listen;
- When a diverse array of stakeholders or members of the public is involved;
- When the issue being debated was framed with public or stakeholder input;
- When the interactions are an integral part of the R&D process.

Along the same line, specific requirements and respective challenges for societal engagement should be noted. In this regard, five distinct dimensions have proved to be

central in an analysis of the discourse on societal engagement under RRI (Bauer, Bogner, & Fuchs, 2021). The first, "the purposes of societal engagement", suggests that it is important to understand the motivation for this approach, where competing rationales such as normative, instrumental, substantial, and constructive rationales can be identified. Second, "the actor groups that should become engaged" as a dimension points out that not only all frequently mentioned actors (policymakers, researchers, industry actors, funding agencies, stakeholders and the public) have a role to play in R&I processes, but those additional underrepresented actors – Civil Society Organisations and unorganised publics (such as citizens, consumers, users) – need to be engaged as well. "Aspect of timing" is the third important dimension, which deals with the moments in which societal actors should be involved in R&I processes; sometimes public debates and societal engagement come too late, as the technology is already developed and implemented, which leads to suboptimal reactive engagement; in other cases, members of society are contacted too early in the technology development process thus being unable to envision potential implications. "Engagement formats and procedures", as the fourth dimension, provides an extensive repertoire for dialogic interactions between all actors, spanning from public outreach and dialogue events to societal consultations and public participation in research. The fifth dimension, "the framing of science, technology and innovation in engagement processes", describes what the social engagement is about – what are the issues that frame the dialogue (risk and safety, privacy and precaution, justice, welfare standards for marginalised groups, politics of exclusion, etc.), and whether these issues should be the focal point, or if the "frame" itself is harmful and limiting for societal engagement.

Engagement and dialogue with society are at the core of so-called democratisation of science. While the traditional view emphasised a strict division of labour between scientists and the public, the democratisation of science challenges this by recognizing that science is not value-free, and that the public may and should have a role in defining scientific research and its targets. Thus, advocates for democratisation argue that science should not be solely controlled by experts. Instead, the public should actively participate in shaping scientific research and its impact on society. This involvement helps ensure that science is aligned with societal needs and values. It is argued that by involving a broader range of perspectives, democratisation can lead to more relevant and effective scientific results and impacts. It is argued that democratisation can enhance the quality of research, foster innovation, and address pressing societal challenges. Furthermore, democratisation seeks to prevent the political misuse of scientific knowledge or "politicisation of science". For these purposes it emphasises transparency, accountability, and ethical considerations. Currently democratisation of science is an ongoing dialogue, and various perspectives contribute to shaping its implementation and impact. (Kurtumulus, 2024; Koller 2023.)

At the same time, from a more critical point of view, it can be also claimed that democratisation of science is not all the way positive development and there are challenges to reap the benefits and minimise the potential negative effects. For instance, while democratisation aims to empower citizens, it can also be exploited for advancing specific political interests in the society. Individuals or interest groups might manipulate scientific processes to advance their own agendas and thus undermine the integrity of it. Therefore, it should be legitimate for scientists not to follow the values of the public if they are in contradiction with the values of science, for instance. Furthermore, citizens may lack the necessary expertise to make informed decisions. Inadequate understanding of complex scientific issues could lead to misguided choices. Striking a balance between public participation and maintaining scientific autonomy may be challenging as the traditional view of science as a self-governing enterprise clash with the democratisation ideas. (Kurtumulus, 2024; Schroeder 2022.) On the other hand, it has been suggested that the real obstacles to the democratisation of science follow from social and economic inequalities and lack of commitment to expert authority (Kleinman 1998).

4.4 Digital agenda & AI

To present a concrete example of responsibility and ethics issues, REINFORCING addresses the development, diffusion, and use of artificial intelligence (AI). AI is used as an overall term to describe a mix of computational methods and technologies or systems that function in an intelligent fashion (Stone et al., 2016). The European Commission (AI HLEG 2019) describes AI as either software and hardware systems that through data acquisition reason and process information to decide the most suitable action for achieving a given goal or undertaking programmed actions. AI processes include learning, reasoning, and self-correction (Gillath et al., 2021).

AI is creating a positive impact for example through information processing capabilities (Wirtz & Müller, 2019). For example, in health and social care, AI in independent living offers service integration using IoTs sensory and signal devices (Kankanhalli et al., 2019) and links to health, security, and transport services. Positive effects can include better gathering, storing, and processing of data, decision-making advantages, higher speed and lower cost of services, new service models or integrated models (for example robotics surgery, more accurate medical diagnoses), evidence-based policy support, security and surveillance and easy user involvement (Kinder et al., 2023).

However, AI innovations also give rise to a multitude of challenges and ethical dilemmas spanning various policy domains, encompassing social, technological, data, privacy, economic, political, legal, organisational, managerial, and ethical spheres (Dwivedi et al., 2019). Various concerns regarding AI usage have been identified, such as issues about

access and control, biases in data selection, and the complexity of seeking remedies (Kinder et al., 2023). For example, misinterpretations of facial expressions of people of colour by facial recognition systems (Eubanks, 2017) was evident in 2021 when Facebook AI labelled black people as 'primates' (BBC, 2021). Degeling and Berendt (2018) point to a 35% failure rate of facial recognition for women of colour and Brindle (2018) to inappropriate database choices. In the Netherlands, tax authority services included a xenophobic algorithm based on racial profiling (Amnesty International, 2021). Similarly, in the US public services have had wrongful benefit denials (O'Neil, 2016; Eubanks, 2017), with similar concerns evident in the United Kingdom, including contract cancellations (The Guardian, 2019). After evaluating four international cases of AI deployment for accountability, predictability, consistency, and equality, Zalnieriute et al. (2019) identified 150 positive and 570 negative points.

Boulanin et al. (2020) describe that these risks may derive from (a) the way AI technology is developed (design-induced risks), (b) diffused (diffusion-induced risks), (c) used (risk of misuse), or (d) a combination of these factors. Design-induced risks stem from decisions, whether deliberate or inadvertent, undertaken during the development phase. These decisions directly impact the transparency, comprehensibility, explication, and dependability of AI systems. Diffusion-induced risks emerge from the availability and accessibility of the technology itself or the knowledge required to create it. Finally, the risk of misuse where AI technologies are used on purpose or by accident with limited distinction capacities and without human oversight to create harm.

Boulanin et al. (2020), Stahl (2022) and Brundane (2018) argue that RRI presents an avenue to integrate ethical and social awareness into the innovation ecosystems related to AI. We utilise Brundane's (2018) approach where RRI as a technology governance approach can be implemented through the following instruments:

1. Ad hoc or permanent groups, such as ethical review boards comprised of relevant stakeholders from diverse organisations or disciplines, such as the social and natural sciences, can convene to discuss or oversee the favourable and unfavourable consequences of innovation.
2. Frameworks and principles that establish the minimum standards for research and innovation outcomes that may pose legal, ethical, or safety concerns. Standards of conduct are designed to encourage responsible behaviour among pertinent stakeholders in research, academia, private enterprises, and governmental bodies.
3. Industry standards that delineate the fundamental levels of safety necessary for the advancement and testing of evolving technologies, ensuring adaptability and responsiveness to changes.

4. Approaches for evaluating the impact and forecasting of technology, including methods such as expert elicitation (involving interdisciplinary expert discussions), scenario planning, and formal modelling.
5. Targeted capacity-building and training initiatives focused on Responsible Research and Innovation (RRI), ethics, and the societal ramifications of science and technology.

To address the first and second instrument, numerous expert bodies such as the High-Level Expert Group on Artificial Intelligence (AI HLEG) exist at EU level and public and civil organisations have issued guidelines for the ethical design of AI, including those from the AI4People (Floridi et al., 2018), and the European Commission's AI HLEG (2019). Fjeld et al. (2020) and Jobin et al. (2019) have mapped the AI landscape and ethical principles from ethical guideline documents globally. Both papers analysed guidelines created by governmental and intergovernmental, multi-stakeholder and civil society organisations. Fjeld et al. (2020) also include private sector approaches. A comparison of findings is presented in Table 1.

Principles (Fjeld et al. 2020) N=36	**Definition**	**Principles Jobin et al. 2019) N=84**	**Definition**
Privacy	Privacy, Control over Use of Data, Consent, Privacy by Design, Recommendation for Data, Protection Laws, Ability to Restrict Processing, Right to Rectification, Right to Erasure	Transparency (73/84)	Explainability, interpretability, acts of communication disclosure, dialog, participation, principles of democracy
Accountability & responsibility	Accountability, Recommendation for New Regulations, Impact Assessment, Evaluation and Auditing Requirement, Verifiability and Replicability, Liability and Legal Responsibility, Ability to Appeal, Environmental Responsibility, Creation of a Monitoring Body, Remedy for Automated Decision	Justice and fairness (68/84)	Fairness, prevention, monitoring or mitigation unwanted bias, discrimination, respect for diversity, inclusion, equality, possibility to appeal or challenge decisions, the right to redress and remedy, fair access to AI, AI impacts on labor market, democratic and societal issues.
Safety & Security	Security, Safety and Reliability, Predictability, Security by Design	Non-maleficence (60/84)	General safety and security, avoidance of foreseeable and unintentional harm e.g. cyberwarfare and malicious hacking, harm as discrimination / violations of privacy / bodily harm, loss of trust or skills, radical individualism, outpacing regulatory measures.
Transparency & explainability	Explainability, Transparency, Open Source Data and Algorithms, Notification when Interacting with an AI, Notification when AI Makes a Decision about an Individual, Regular Reporting, Requirement, Right to Information, Open Procurement (for Government)	Responsibility (60/84)	Integrity, responsibility and legal liability, remedy, potential harm avoidance, promoting diversity, ethics in STEM education
Fairness & non-discrimination	Non-discrimination and the Prevention of Bias, Fairness, Inclusiveness in Design, Inclusiveness in Impact, Representative and High-Quality Data, Equality	Privacy (47/84)	Data protection and security, freedom, trust, differential privacy, privacy by design, data minimization, access control, awareness, regulation and legal compliance.
Human control of technology	Human Control of Technology, Human Review of Automated Decision, Ability to Opt out of Automated Decision	Beneficence (41/84)	Promotion of human well-being, peace, happiness, the creation of socio-economic opportunities, economic prosperity,

			benefits for customers/environment/humanity
Professional responsibility	Multistakeholder Collaboration, Responsible Design, Consideration of Long-Term Effects, Accuracy, Scientific Integrity	Freedom & Autonomy (34/84)	Freedom of expression, informational self-determination, 'privacy-protecting user controls', empowerment, autonomy
Promotion of human values	Leveraged to Benefit Society, Human Values and Human Flourishing, Access to Technology	Trust (28/84)	Trustworthy AI research and technology / AI developers and organizations / design principles / customer trust, guideline for AI transparency
		Sustainability (14/84)	AI for protecting environment, contribution to fairer and more equal societies, promoting peace
		Dignity (13/84)	Human rights, avoiding harm, forced acceptance, automated classification, unknown human-AI interaction
		Solidarity (6/84)	Implications of AI for the labor market

Table 2. Comparison of Fjeld et al. (2020) and Jobin et al. (2019) principles in ethical guidelines.

The third instrument of industry standards currently stem from the just accepted EU AI Act and Corporate Sustainability Due Diligence Directive (CSDDD), and existing standards and legislation such as data privacy and security (GDPR), Corporate Sustainability Reporting Directive (CSRD) and human rights legislation and national legislations on e.g., on digital services and labour standards. Addressing these challenges necessitates answering questions regarding who, how, where, and when the positive or negative impacts of AI innovations will be felt (Floridi et al., 2018). What is technically feasible may not always be desirable or beneficial; thus, how do we evaluate the utility and ethical desirability of AI innovation? The challenge is that technical standards emerge faster than standards governing usage and user protection. Not so many intercontinental standards exist except the importance of the EU's GDPR (2020) insistence on impact assessments including the nature of human interventions in decisions (article-35). Standards still tail-end technologies and created business models, which makes it hard to ethically protect citizens.

The last two instruments focus more on building capacities and actionable tools to utilise not only in conducting the previously mentioned requirements but also in seeking to transform the design and development processes culture of AI technologies to be more responsible and address these ethical issues which is also at the heart of the REINFORCING project. Developing emerging technology governance to address these principles "relies on enabling inclusive governance modalities that enhance the social sustainability of AI deployment" (Sigfrids et al., 2023). Current research on AI highlights that socially responsible AI development and deployment necessitates the involvement of a range of stakeholders from different specialisms involving representatives from research, academia,

the private sector, government, and civil society (Hickok, 2020; Rossi, 2018; Koskimies et al., 2022). Responsible implementation mechanisms to support trustworthy AI can only be achieved using holistic and multidisciplinary frameworks, ensuring the shared identification, and resolving of issues. Thus, *inclusiveness*, meaning active horizontal and vertical stakeholder and civil society engagement, is seen as crucial in all phases of the responsible AI development and deployment process (Koskimies & Kinder, 2022; Sigfrids et al., 2023).

5 GAPS IN THE IMPLEMENTATION OF ORRI

5.1 Introduction

In the preceding chapters we have reviewed the existing literature on ORRI implementation and institutionalisation conducted mostly in Europe in various projects and other contexts. Many of the provided insights are linked to various drivers and barriers, conditions, and contexts, as well as the successes and failures of ORRI implementation in Europe. The chapters have also touched upon the issue of gaps in ORRI implementation. These gaps include for example the difficulties in applying the broad and diverse umbrella concept of ORRI into practical organisational contexts, practices, and cultures. This chapter will dive deeper into the issue of ORRI implementation gaps by distilling key insights from the literature review and adding recent insights gained through workshops as well individual interviews with key experts.

5.2 Methods

In REINFORCING, WP1 aims at identifying existing and functioning ORRI practices which have proven sustainable in the sense of institutional embedding in a broad range of contexts. In Task 1.1 of WP1, relevant publications, projects, etc. were collected and analysed to provide an appraisal of existing ORRI knowledge and to identify current gaps in implementation. The gap analysis is based on three different data sources: 1) an extensive literature review, 2) expert interviews conducted as part of a hybrid workshop, and 3) additional individual interviews with representatives of relevant ORRI -related projects conducted by the REINFORCING partners participating in WP1.

The literature review was conducted in a collaborative manner based on the ORRI review framework (chapter 2). The main topics and building blocks of the framework were assigned to individual partners who each conducted an in-depth review of at least ten relevant sources on the topic. Based on bespoke review templates, partners captured the main aspects of each publication and conducted an initial analysis of relevant gaps in the literature with respect to their assigned topic. Partners summarised findings and presented them at internal project meetings for discussion and comparison.

On 19th of October 2023, WP 1 partners conducted seven (7) semi-structured expert interviews that lasted approximately 30 minutes each and discussed the current state of the art of ORRI with the interviewees. Main topics addressed included current responsibility and sustainability initiatives in Europe from a broad perspective and major deficiencies or gaps in implementing the initiatives for example thematically or in terms of policies, organisations, regions and territories. The seven expert participants represented the

following groups: 1) local government, 2) science and research, and 3) the European Commission.

Between March 2023 and January 2024, WP1 project partners conducted individual thematic interviews (N=12). The main purpose was to extract operationally relevant knowledge on RRI research and practice from one-on-one discussions with key project/thought/activity leaders in the field, representing twelve different international research projects (some completed, some ongoing). Interviews focused on key (preliminary) outcomes, including but not limited to concrete measures, models, methods, and tools.

REINFORCING Task 1.1 Appraisal and Task 1.2 ORRI Gaps both draw on the results of the literature review, the project review, and the interviews. The following sections report on the outcomes of the gap analysis.

5.3 Workshop findings - Expert interviews

This chapter introduces the findings from seven semi-structured expert interviews clustered according to general themes to highlight the identified challenges and gaps. The perspective of this chapter is on the individual researchers and practitioners whereas the literature review focuses more on the perspective of organisations and territories.

Evolution of RRI and understanding across disciplines

Interviewees highlighted that RRI has played a significant role in EU policy debates, particularly in research assessment reforms. However, it was pointed out that RRI has reached its "peak" in policy discussions due to the evolving research and policy landscape. This entails recognizing the terminological change/fluidity of the concept of RRI encompassing research of citizen science, trust, openness, and social value anticipation, responsiveness, and inclusivity. Promoting an understanding of the issues around the concept of RRI beyond specific terms involves creating a map of de facto rri practices and a map of discourses related to, inspired by, or inspiring RRI research and practice. While the shift away from the RRI label is acknowledged, its fundamental principles endure, albeit sometimes fragmented across different initiatives and discussions.

The interviewees emphasise the translation of the different RRI concepts into diverse communities and scientific domains, proposing the establishment of RRI Labs enabling organisational and institutional experimentation with RRI principles in practice, including translation to local contexts and languages. Implemented at organisational, network or consortial level, such Labs could aid in demystifying RRI and enhancing its applicability. However, challenges persist in bridging the gap between research, politics, and the public,

necessitating clearer communication and engagement strategies. To take up these suggestions, RRI should be better connected to public concerns, utilising participatory methods, and ensuring accessibility in funding and impact creation. Ultimately, the aim is to align science with societal needs and enhance public understanding and involvement in research processes.

RRI for society with society – civil society engagement and democracy

In European RRI projects, a lack of understanding of local needs has caused structural issues. Implementing RRI for Society with Society goes beyond mere lip service and traditional top-down policy approaches. This means that researchers and innovators should work more closely with local policymakers to create a systemic and regional understanding of societal and environmental practices. To do so, a shift towards specific challenges, problems and needs in local or regional contexts is required. The aim is to drive transformative actions toward more desirable futures, which would entail changes in research policy, funding structures, and research management that facilitate more meaningful engagement with societal challenges. More specifically, the academic constraints such as the focus on publications rather than addressing local challenges are seen as an obstacle to building shared understanding. To put RRI into practice, a radical collaboration between researchers, companies, civil society, and policymakers is essential. The need to interact, ask people about their needs, and avoid reinventing solutions is stressed.

The interviewees emphasised that RRI should be pursued from a democratic perspective, aiming to strengthen democracy and trust, both in science and policy. This can be achieved by working with actors at the local level to identify and address their real problems by allocating resources, and encouraging researchers and innovators to address local or regional challenges and needs as the starting point for their work to promote relevance and impact. A strong focus is put on involving civil society and promoting "true collaboration" among researchers and innovators, civil society, and public administration. This approach positions science and innovation as an enabler, mediator, and facilitator for the co-creation of viable options and solutions to societal challenges - and RRI as a tool to strengthen the democratic pursuit of such endeavours.

The importance of public and citizen engagement in R&I was also emphasised by the interviewees. Challenges in sustainability, including the tension in the rapid transition, engagement practices, and the need for a participatory approach, are noted. To increase participation, interviews suggest the implementation of climate panels, studying lived experiences, and recognizing individuals as actively engaged participants rather than passive users.

European level governance and policy dissemination – bursting the RRI bubble

RRI is widely seen as a topic that intersects various fields. However, discussions around it often remain confined and do not reach a broader audience. Interviewees argued that the RRI community hasn't effectively communicated its efforts to policymakers and other stakeholders. The interview partners also underline a gap between the RRI community, the so-called "RRI bubble," and other scientific disciplines, policymakers, and stakeholders. While the academic outputs of this community are evident, there's a perception of a delay in policy uptake. Therefore, the interviewees place a strong emphasis on the need for better dissemination and translation of RRI concepts into easily understandable language to bridge this gap in interactions. In addition, different timescales between policy and academia and the perception of RRI as a cross-cutting issue without dedicated support are seen as an issue.

Interviewees encourage discussion about how RRI can be implemented in research policy, particularly in the definition of missions. This involves integrating RRI principles into the strategic goals and missions of research initiatives. The discussions highlight the need for governance at the European level to oversee and guide RRI initiatives and the allocation of RRI funding. The European Parliament is identified as a crucial agent in pushing forward RRI and related discussions. However, a loss of support for RRI at the European level has been identified. Concrete suggestions include advocating for RRI in the upcoming FP10, contacting Members of the European Parliament (MEPs) and Members of Parliament (MPs), and focusing on issues related to science scepticism. The importance of lobbying, explaining RRI, and making it transparent is emphasised.

Institutionalisation of RRI practices and capacity building

Concerns are raised about the continuum of RRI interventions, as many initiatives tend to lose momentum once the project ends. There is a call for the institutionalisation of RRI to increase its transformative effects, ensuring that its principles are embedded in the organisation’s research and policy practices. However, challenges include issues related to national interests at the European level, diversity in institutional capacities, and the transformative effects researchers can have.

The central question is how to effectively engage internal and external stakeholders and design research responsibly. Democratisation of science, involving citizens in scientific processes, is a significant challenge, requiring capacity building and education. This requires mutual learning over one-sided education and open science is viewed as essential for transparency, but the establishment of trust among stakeholders is a complex task.

For the academic community, the rise of ESG reporting (disclosure of environmental, social and governance impacts) is identified as a force compelling sustainability consideration in project proposals and during the project. To address this need, organisations need to allocate resources to new approaches integrating governance, ethics, and sustainability. CEO commitment and organisational support for RRI institutionalisation are highlighted, with integration into ethics committees, responsibility programs, and sustainability strategies seen as strategic moves. Key principles include respect and diversity, emphasising research that includes citizens as equal partners. RRI is contextual, particularly relevant to emerging technologies, and involves ethical approaches to deploying novel technologies. Advocacy for mutual learning spaces to address generational issues and foster open discussions on RRI challenges is important. The conversation underscores the ongoing need for dialogue, education, and a commitment to responsible practices in research and addressing possible divide and polarised opinions influencing RRI acceptance and understanding.

5.4 Individual RRI project interviews

In addition to expert interviews in a group setting, WP1 partners conducted twelve individual interviews with representatives of recently finished or currently ongoing EU-projects that either focus on RRI in general or on specific aspects or dimensions of RRI. The selection was made so that various aspects, which are relevant for the REINFORCING would be covered, including territorial aspects, ecosystems, organisations, engagement, research and innovation processes, examples of specific implementation contexts in terms of innovation and technology, as well as institutionalisation. The following section provides a summary of the key insights from each interview.

DigiTeRRI ("Responsible Research and Innovation Approach for Transitioning the Traditional Industry Regions into Digitalised Industry Territories"; 2020-2022; GA no. 873010), a project involving stakeholders from industry, research, government, and civil society in Austria, France, and Sweden, focuses on implementing ORRI in digitalization. Co-creation workshops were conducted in each territory to develop roadmaps, involving representatives from government, universities, business clusters, and specific industries. The project organised web meetings to discuss and raise awareness about ORRI, digitalization, and their implications for the territories. DigiTeRRI included the quadruple helix stakeholders in each of the territories: government (county/municipality), universities, business clusters. The consortium developed the workshops, starting with the question on how digitalization is done (in companies) and aiming to update it with a regional focus. The workshops had research, education, industry, and SMEs stakeholders, together with government representatives and NGOs in each region. Key best practices

identified include government involvement for support and regulation, addressing important topics like gender, open access, integrity, and ethics, and implementing actions through a roadmap. Main barriers in the project included challenges in engaging NGOs, explaining RRI to stakeholders, and managing expectations, particularly with a business mindset. Novel approaches were not identified in the project. The project faced challenges in explaining the benefits of participation, managing government expectations, and addressing the environmental and societal impacts of rapidly advancing technology. Despite these challenges, immediate positive effects were observed, with several countries already incorporating RRI principles into their calls. The project highlighted the need to consider the environmental footprint and societal effects of emerging technologies to ensure their trustworthiness and benefit for all.

The "Building Self-Sustaining Research and Innovation Ecosystems in Europe through Responsible Research and Innovation" project (**SeeRRI**; 2019-2021; GA no. 824588) aimed to integrate RRI principles into regional Smart Specialisation policies, fostering collaboration in research and innovation with a responsible mindset. Objectives included establishing self-sustaining R&I ecosystems, implementing new working methods at the organisational level, sharing best practices, engaging stakeholders meaningfully, and contributing to MORRI indicators and SDGs. Triple helix stakeholders (academia, industry, government) were included, but having representatives in the consortium boosted their participation. Best practices involved stakeholder engagement to get people involved and workshops for building innovation ecosystems. Specific topics, like coastal development in Norway, required careful stakeholder management. A specific practice was to develop a common future (foresight) while focusing on what can be done now and how risks can be transformed into opportunities. Challenges included SME participation due to resource constraints, leading to a lack of diversity. Well-prepared workshops were crucial, and methodologies like stakeholder engagement, roadmaps, and foresight were employed, though the challenge was in translating them into action. The results of the project were included in the regional development plans which amplified the long-lasting impact. Similarly, as in DigiTeRRI, the impact on the environment and societal effects, especially in the context of rapidly advancing technology, was recognized as the next frontier in RRI. Ensuring the trustworthiness and benefits of emergent technologies for all, while avoiding polarisation, emerged as a challenge in the project.

The **MARIE** project, ("Mainstreaming Responsible Innovation into Regional Strategies and Funding") funded by INTERREG Europe (2017-2021), aimed to develop European Regional Development Fund (ERDF) instruments with a focus on RRI. Initially, the project centred on ERDF, but as RRI gained traction and AI themes emerged, an AI-focused pilot was created to develop RRI-informed criteria for funding. The project successfully

institutionalised RRI-informed funding criteria, utilised in three funding rounds, demonstrating its importance. However, as the EU's funding frame changed for the 2021-2028 period, the project's criteria couldn't be continued, reflecting challenges in aligning with EU mandates. Several other challenges were identified, including difficulties for applicants in answering RRI-related questions, timing in a sense that during Marie project in 2017, themes such as inclusivity, ethics, risks, and impact assessments were more difficult to introduce than today and resource constraints in a way that RRI knowledge is on one person in the organisation, and a lack of knowledge among applicants and funders. Interaction with the Co-Change project, in the form of knowledge exchange with a private funding organisation in Vienna provided insights into different thematic bodies influencing funding decisions. However, adapting private funding models to public organisations posed challenges. The We Make Transition program continued RRI work from the Marie project, particularly in citizen engagement. Concerns were raised about the EU's criteria being more of a compliance exercise than a driver for understanding RRI issues. Internally the Council of Tampere region has different bodies such as the environmental board, but they don't necessarily steer the funding. To enhance RRI themes, discussions should extend beyond funding frames and incorporate broader contexts, such as the Sustainable Development Goals (SDGs). While recognizing the imperfections in the EU's funding framework, funding organisations must emphasise its importance. However, evaluating funded projects against RRI criteria remains limited, and there is a need for administrative officials to mandate supervision and make RRI a more effective steering mechanism.

The **NextGenProteins** project ("Bioconversion of Underutilised Resources into Next Generation Proteins for Food and Feed"; 2019-2023; GA no. 862704) aimed to explore alternative proteins and assess their societal acceptability with RRI approaches. However, RRI activities were confined to one task, limiting their impact on the project. The RRI-framework was developed early but had limited reach. The RRI-framework implementation included interviews with work package (WP) leaders, synthesising RRI-related sources, awareness-raising through webinars, applying the Thinking Tool in WPs, and analysing the implementation process via surveys. The project involved consumers, food industry agencies, research organisations, policy actors, and start-ups. Barriers to RRI implementation included the project's natural science and business -oriented focus, which manifested in the disinterestedness and uncomfortableness of some researchers vis-à-vis RRI. The generic nature of the Thinking Tool also posed challenges. The dual role of RRI advocates in assessing social acceptance while supporting the project was a challenge. The implementation of RRI was task-specific, lacking broader influence across work packages. The framework did not guide stakeholder engagement activities comprehensively. A prevalent gap in RRI practice is the weak "upstream" implementation in research and innovation (R&I) activities. RRI is often seen as a cosmetic add-on rather than influencing

decision-making early in project preparation. Proper implementation requires resources and cross-cutting commitment, often lacking. The next frontier for RRI is its integration into commercial and industrial activities beyond the EU project context.

The main aim of the **FoTRRIs** project ("Fostering a Transition towards Responsible Research and Innovation Systems"; 2015-2018; GA no. 665906) was to develop and validate a method supporting the transformation of research and innovation practices, specifically in sustainability transitions. Adopting a co-creation approach, the project engaged various stakeholder groups, including policymakers, research entities, businesses (primarily small and new businesses), and civil society organisations. The primary output was the "FoTRRIS Cookbook" detailing Responsible Research and Innovation (RRI) practices. The project conducted five experiments, termed RRI competence cells, across different European regions. Stakeholders were invited to develop RRI competencies collectively. Despite participants having some prior knowledge of RRI, the co-creative design allowed them to test and internalise key skills, emphasising transdisciplinarity, participatory methods, and RRI dimensions like gender. Challenges included unequal power distribution among participants, somewhat mitigated within the project's context but resurfacing afterward. Political dynamics influenced the uptake of project results, with institutional changes dependent on specific "windows of opportunity" in political debates. It was important to translate the immediate benefits to participants, and resource availability played a crucial role, with diverse stakeholder groups having varying levels of resourcefulness. Post-project, there was scepticism about the effectiveness of the cookbook without active support for uptake and institutionalisation. Despite challenges, many participants continued applying the learned methods, indicating a positive impact. One research partner reported heightened awareness of social justice in transition processes, leading to a significant shift in their approach to designing research projects and stakeholder engagement processes.

The **FRANCIS** project ("Frugal innovation by Citizens for Citizens"; 2021-2024; GA no. 101006220) focused on developing frugal innovations through open innovation challenges involving citizens, scientists, and industry, with a particular emphasis on marginalised and vulnerable groups. Key outcomes include low-tech, cost-efficient prototypes meeting citizens' needs. Stakeholders include citizens, especially marginalised groups, civil society organisations (CSOs), businesses (from startups to corporations), science, and policy/public bodies. The project centres on two frugal, citizen-led innovation challenges. For the preparation of engagement activities, the project employed the creation of "personas'' representing different citizen types, validated by CSO representatives. Marketing activities, including games, were used to inform stakeholders about frugal innovation and recruit participants. The recruited citizens were supported using ideation

methods such as fast prototyping. Barriers encountered included cultural differences and the varying socio-economic backgrounds of participants. Important enablers included exchanging ideas with CSO representatives before engaging citizens, demonstrating respect and appreciation, and employing ideation and design thinking methods. Institutionalised learnings likely include raised awareness of socio-economic differences and the need to involve participants with lower formal education and marginalised groups. Concerns were raised about RRI becoming a tick-box exercise or perceived as an additional burden rather than an opportunity for learning and generating new ideas, similarly as risks raised in the MARIE project. The practical side revealed the challenges and demands of citizen engagement, highlighting that many research partners were not adequately prepared for these requirements.

The "Embedding RRI in Western Balkan Countries: Enhancement of Self-Sustaining R&I Ecosystems" project (**WBC-RRI.NET**; 2021–2024) is part of the H2020-SwafS-2018-2020 programme with grant agreement No. 101006279. It aims to boost R&I in the Western Balkan Countries (WBCs) by adopting a sustainable development framework based on RRI principles at the local level in five Western Balkan (WB) R&I ecosystems; four on the regional level and one on the country level. The key stakeholders involved in the project represent the entire quadruple helix and include regional authorities, regional development agencies; programme authorities; policy makers; the business community; the academic sector and citizens. For each territory, challenges, main activities and expected changes were mapped with reference to Smart Specialisation Strategy (S3) and/or regional policies. These workshops resulted in future scenarios to address the major barriers encountered in RRI implementation (e.g. political and economic instability; decreasing cooperation with international partners, brain drain and the slow implementation of S3 strategies). Although this region lags in implementing formal RRI related projects and policies, it appears that there are numerous local initiatives in the Western Balkan Countries related to de-facto RRI which undoubtedly deserve to be spread and highlighted. For that purpose, WBC-RRI.NET has launched a continuous call for submission of good practices in RRI, from and for the Western Balkans with a focus on Gender Equality and Ethics in Research and Innovation, Public Engagement and Science Education, Open Science and Open Access. A total of 32 good practices were submitted and three winners were announced. By recognizing and promoting good practices in RRI, WBC-RRI.NET hopes to increase the impact of these actions and inspire more stakeholders to join the cause. Through collaboration and shared knowledge, the Western Balkans can continue to make strides in RRI.

The "Co-Create change on research funding and performing project" (**Co-Change**, 2020–2023; GA no. 873112) supported the implementation of institutional change among

research and innovation actors through constituting change labs in the organisations of project consortium partners. These change labs instigated experimentation and improvements in the areas of research ethics, open science, stakeholder engagement, science education, gender equality and/or sustainability. Several tools and practices for responsible research and innovation were developed during the project life span. The key stakeholders involved included researchers, policy makers, citizens, and businesses. The Scientific Institute for Food Technologies in Novi Sad (FINS) was a linked third party, aiding in facilitating cross-lab interchange between project partner Faculty of Agriculture's (PFNS) and other involved labs. FINS established a new Gender Equality Plan of the Institute and developed a new Research Ethics Codex of the Institute. The main challenge was the high level of bureaucratic burdens – excessively complicated administrative procedures required for any kind of institutional change. It took a lot of time and effort to start and finish internal procedures required for a change to happen. At the same time, the created changes will likely be sustainable and long-lasting, as they were institutionalised and formalised in both FINS and PFNS. The high participation of staff and external stakeholders ensure a sense of ownership and acceptance of these institutional improvements. Also, several requirements at the national and EU levels warrant implementation of these changes. To foster institutional change towards RRI, RRI and its perception need to change from a forced top-down requirement to an internal need of researchers to get in contact with society. The next frontier is to interweave responsibility with daily research practices.

The "REconciling sCience, Innovation and Precaution through the Engagement of Stakeholders"project (**RECIPES**; 2019 – 2022; GA no. 824665) aimed to develop hands-on guidance for the practical application of the precautionary principle in the governance of innovation processes, in a co-creative process involving research policy, industry and society (represented by environmental NGOs). Based on an extensive literature review, the project was able to show that the precautionary principle is not at odds with innovation but can rather help to stir innovation in a societally desirable direction. Nine in-depth case study reports on various topics and a cross-cutting analysis helped to develop guidance for policy makers on how to implement the precautionary principle in practice. A major barrier to RRI implementation, in the sense of applying the precautionary principle in the face of significant uncertainty, include the strong industry and policy interests regarding technological innovation, economic and technological competitiveness, and the creation of jobs and revenue. The final guidance developed by the project was well received by the EC and the EFSA (European Food Safety Authority). However, already in the next major case in question, the use of glyphosate in agriculture, the guidance and the precautionary principle were not followed. Instead, policy followed the interest of business and industry and prolonged the licence for use for another 10 years despite growing evidence for negative health effects. Thus, RRI should aim to improve participatory processes,

transparency, and decision-making on the governance of technological innovation, showing who is involved for what reason, what evidence is considered and how, and which side in the debate is given the benefit of the doubt in the final ruling.

The ERC-funded "GeoEngineering and NegatIve Emissions pathways in Europe" project (**GENIE**; 2021–2027; GA no. 951542) aims to evaluate and expand the solution space to address climate change by looking at a range of geoengineering technologies. However, GENIE is not an engineering project. Instead, it conducts qualitative research on and with relevant stakeholder groups and is concerned with the ethics of technology development and deployment and develops recommendations and governance principles for rendering technology development and deployment more inclusive, reflexive, and anticipatory. In other words, the project studies a range of RRI concerns and approaches in practice, focusing on more than 20 technology options. Regarding research goals, the consortium seeks to study the implications of different technology designs and implementation strategies, to discuss these with a range of stakeholder groups (upstream engagement/participation/deliberation) and to advise on governance principles. Regarding research design, the consortium seeks to capture the full diversity of perspectives (for, against, ambivalent) and to pay close attention to representativeness, including representativeness of Global South, of youth, and of indigenous groups to include people who have never been asked these questions before. Thereby, the research design also addresses the RRI-themes of public engagement and science education.

The "Constructing Healthcare Environments through Responsible Research Innovation and Entrepreneurship Strategies" project (**CHERRIES**, 2020-2023, GA no. 872873) focused on technological innovation in the healthcare sector in various regions (Murcia (ES), Örebro (SE) and Cyprus (CY)). It aimed to address healthcare challenges through technology and community engagement, tailoring solutions to each region's specific needs. The varied stakeholders in the CHERRIES project included regional healthcare systems, regional governments, social care organisations, universities, multiple sclerosis associations, solution providers, public health entities, private hospitals, and technology providers. Community engagement started with the definition of problems by means of an open call for needs. The complexity of the field proved to be the main challenge to implementing RRI, requiring significant organisational and institutional changes. The lack of institutional support also played a role and some healthcare systems lacked processes for organisational and institutional change, hindering the integration of RRI principles into practice. Additionally, tailoring engagement and implementation strategies to local contexts proved to be a good practice and economic incentives played a significant role in shaping stakeholder engagement. Notable lasting changes included the setup of an innovation unit at the participating hospital in Cyprus and a continuing partnership between various

entities, including regional governments, private hospitals, and social care organisations beyond the timespan of the project.

The "Territorial RRI fostering Innovative Climate Action" project (**TeRRIFICA**, 2019-2022, GA no. 824489) addressed local issues related to climate change adaptation on a very practical level. The main goals of the project were to engage citizens, collect data on local climate change impacts, and develop practical solutions for local contexts, such as climate change shelters and regreening activities, in collaboration with stakeholders. Data based on these efforts were collected on a crowd mapping website and used to inform regional climate change adaptation plans. The involvement of citizens and public representatives at various levels (e.g. city administration, local teams, extended local teams and a local advisory board) proved to be invaluable for continuous engagement throughout and beyond the project. A multitude of co-creative multi-stakeholder approaches, backed by partners outside the project consortium, were designed to ensure alignment with local needs. Due to challenges such as the COVID-19 pandemic and a lack of funding to provide economic remuneration for participation, the project relied on creative strategies for engagement, including promotional activities, citizen science and public relations campaigns. In the interview, the project representative suggests that research organisations increasingly recognize the benefits and importance of engaging with stakeholders and the wider community. Potential enablers may include funding programs that require engagement activities. This marks a shift in the research landscape towards valuing engagement to enhance research outcomes and societal impact. However, the interviewee also acknowledges several barriers to RRI and public engagement, such as the discrepancy between RRI funding requirements and the actual implementation of such plans in real-life research practices. Despite increased attention to these topics, there remains a lack of clarity and consensus about the meaning of RRI in view of related concepts. Often, RRI activities focus solely on Open Access and data management, neglecting the crucial aspect of public engagement. This indicates a need for greater awareness and education on the importance of citizen involvement in science, research, and innovation.

5.5 Discussion and conclusion

This section distils and discusses the gaps identified in the literature and project reviews as well as the expert interviews to identify the main issues that need addressing for, in and through RRI research. To address the central concern of the REINFORCING project, the section focuses on the glaring gap of RRI implementation upon which hinges the pending shift of research and innovation systems towards an alignment with societal needs and concerns.

Gaps in RRI-implementation in research policy

Having emerged in the context of research policy, large gaps remain between RRI conceptualization, operationalization, and implementation. Already over a decade ago, Weber and Rohracher (2012) attested the RRI discourse a focus on design and framing instead of on strategies for effective implementation within and across diverse institutional and organisational contexts. Meanwhile, a plethora of projects, especially in the EU-context, have developed tools and methods for RRI implementation and monitoring, conducted best practice analyses and devised recommendations. At the same time, a significant systemic shift away from research and innovation primarily directed at economic competition and growth that would be geared towards social needs and societal concerns, as acclaimed by RRI proponents, is still underway and has yet to occur - even though we have a number of responsibility emphasising initiatives and processes on-going, including e.g. transformative innovation policy, mission orientation in policy-making and various initiatives for and by companies to adopt socially and environmentally sustainable practices crystallised e.g. in the idea of purpose-driven firms. However, such a desired shift of research and innovation systems is challenging, if RRI goals and principles are (seemingly) at odds with objectives regarded of higher value, importance, or urgency.

Following a noticeable rise of related concepts in policy discourse such as open science, diversity and inclusion, gender equality, citizen science, participation, and engagement, it has been suggested that RRI principles continue to flourish although the RRI label features less prominently. In this regard, the phenomenon of the "RRI bubble", consisting of a productive research community largely funded through the European Union, which has been identified as problematic, seems to have burst. A map of discourses related to, inspired by, or inspiring RRI research and practice as well as a comprehensive catalogue of RRI practices would help to better understand the current research and policy landscape and the position and standing of RRI within it. In addition, such a mapping exercise would help to identify concepts related to or even borne out of RRI discourse which have already gained traction and taken root in other social spheres. In this regard, a recent comprehensive review of responsible innovation scholarship offers one promising point of departure (Fisher et al. 2024).

A key question emerging from the literature and project reviews as well as the expert interviews concerns the possibility of implementing RRI in research policy, particularly in the identification and formulation of missions. Taking a participatory approach to the very definition of missions and funding programs would render research funding more responsive to societal concerns. Moreover, the advancing institutionalisation of ethics requirements and the increased focus on participation and public engagement highlight the importance of framework conditions conducive to establishing and institutionalising desired

practices and approaches. In short, to close the gap of RRI implementation in research policy, RRI principles would need to be both practised and preached by public funding agencies from the local to the regional level.

Gaps in RRI implementation in research (organisations)

RRI encompasses but also extends far beyond research ethics and scientific codes of conduct. In fact, RRI demands a lot from scientists in terms of inter- and transdisciplinary communication, collaboration, and knowledge integration. This explains why much capacity building has focused on research practices at individual, organisational and project level. In this regard, the SwafS projects funded under Horizon 2020 clearly indicate the significant impact of funding requirements on institutional changes. One successful strategy to institutionalise RRI-driven collaboration in a research landscape organised in projects has been the establishment of research infrastructures at project level bringing together a variety of stakeholders to collaboratively define and address a shared need or concern. As a next step to move beyond small-scale, contextualised settings, would be to devise a more comprehensive, adaptable approach. In this regard, the concept of the RRI Lab has been suggested as a methodology and setting to design, test, and improve RRI-driven R&I processes. Crucially, such Labs would open the entire research process from problem definition and methodological approach to implementation and evaluation to multi-stakeholder deliberation and collaboration.

Such fundamental changes to the set-up of research processes and projects would in turn require a change in research funding structures and scientific reward systems. An alternative, RRI-driven research approach positions science as an enabler, mediator, and facilitator, and RRI as a tool to do so. Resources and cross-cutting commitments are needed for the successful implementation of RRI approaches into project and organisational contexts, yet they are frequently absent. Scientists would need the time and funding as well as the incentives to work on challenges co-defined with external stakeholders. Crucially, the institutionalisation of RRI through both top-down requirements (by research funders) and bottom-up initiatives (by research organisations) would increase its impact and transformative effects. As ESG reporting (the disclosure of environmental, social and governance impacts) appears to strengthen the consideration of sustainability issues in project proposals and during project implementation, a similar reporting requirement for RRI principles would likely contribute to the implementation and institutionalisation of RRI in research (organisations). In addition, extended reporting requirements would help addressing the identified gap between promise and practice of participation and engagement.

Gaps in RRI implementation in business and industry (organisations)

Institutional entrepreneurship and Deep Institutionalization have emerged as relevant and complementary perspectives to better understand and advance the institutionalisation of RRI-practices in business organisations. Whereas universities and research organisations have ethics committees and other forums to review and address issues related to RRI, this is less common for businesses. Recognizing that institutional changes take time, launching experiments for RRI-driven organisational changes, collecting experiences, and identifying best practice strategies emerge as relevant focus for REINFORCING and its cascading grants. In this regard, SMEs could receive special attention as they frequently lack the resources to engage in experimentation and organisational change towards RRI practices.

At the same time, taking significant strides towards responsibility and sustainability is difficult if not impossible in a capitalist, techno-economic system (Rodríguez et al., 2020). As noted above, one of the biggest challenges remaining is the tension between the institutionalisation of RRI and maximising economic profit. Thus, there is great demand for concrete examples demonstrating how investing in RI would be economically profitable. Building on insights gained and strategies developed in the EU-project PRISMA (Piloting Responsible research and innovation in Industry: a roadmap for transformative technologies, 2016-2019), the concept of Corporate Responsible Innovation could be established as bearer of organisational changes towards RRI similar to those inspired and driven by the by now well established and institutionalised notion of Corporate Social Responsibility. A key to success in this regard is a focus on practical guidance on how to establish and enact RRI rather than simply reporting on it as a "tick-the-box exercise". Amongst other, this would require translating RRI jargon into the conceptual repertoires in business and industry, identifying successful examples in practice and devising codes for conduct, certification schemes and standard setting approaches.

Gaps in RRI implementation in territories

The main gaps regarding the implementation of RRI in territories relate to a lack of operationalization and quantitative indicators enabling the tracking and evaluation of transformation processes towards the establishment of RRI at a local, national, or regional level. Attempts to advance RRI through Regional Innovation Strategies for Smart Specialization (RIS3) or to develop European Regional Development Fund (ERDF) instruments with a focus on RRI give reason to believe that such a "piggyback strategy" is conducive to operationalizing RRI notions and embedding RRI practice.

Comparing RRI activities in different regions, the Western Balkans have joined the movement comparatively late. Although developments are slow and scattered, the increasing and continuous involvement of regional actors have contributed greatly to

capacity building and steps towards open science and participation in this region and elsewhere. At the same time, close collaboration between research organisations and policymakers at the local, national, and regional level has emerged as a sine qua non for bursting the "RRI bubble" and creating a systemic understanding of and approach to RRI in territories.

Gaps in RRI implementation in society

Since the heart of RRI consists of the ambition to render research and innovation (systems) more democratic, RRI methods and tools can contribute to strengthening democracy and trust, both in science and policy. Crucially, this requires moving beyond tokenistic tick-the-box exercises of public outreach and towards devising methods, tools, and institutions for "public in reach" in the form of open and public upstream participation and deliberation. Rendering technology development and deployment more inclusive, reflexive, and anticipatory thus requires earmarking significant funds for SSH research with a decidedly broad and global perspective. A good practice example in case is the GENIE project (GA no. 951542) which aims to evaluate and expand the solution space to address climate change by looking at a range of geoengineering technologies and to tackle the "WEIRD bias", a focus on Western, Educated, Industrialised, Rich Democracies, by including, elevating, and empowering the voices of marginalised or vulnerable communities.

To build on advances made in the context of SwafS research programs, the establishment of more systemic approaches to the governance of research and innovation and hence the institutionalisation of RRI beyond project boundaries has emerged as the next frontier. Initial conceptual and methodological steps towards establishing RRI at different scale levels of innovation ecosystems have been taken. Further research and experimentation are needed to strengthen science-society interaction and collaboration in a systematic and democratic manner by means of suitable policy and institutional framework conditions. Points of consideration include how to render research and innovation systems more reflexive and open in the evaluation and establishment of technology portfolios addressing current challenges. This includes more symmetry and transparency in anticipation, decision-making and risk assessment as well as novel formats and fora such as citizen panels. Recognizing and approaching citizens as engaged participants instead of passive users emerged as a first, crucial step to take both in theory and practice. The democratisation of science, involving citizens in scientific processes, poses a significant challenge, requiring capacity building and education. RRI can serve as a conceptual tool and as a methodological approach for learning and generating new ideas and to co-design innovations addressing collective needs and concerns.

In conclusion: a need for the directed, reflexive, critical governance of research and innovation

While health and well-being, social cohesion and a good life for all living creatures, present and future, have been defined and widely recognized societally desirable goals (e.g. in form of the SDGs), current decision-making is more centrally concerned with technology and economics. In addition, innovation practices revolve around engineering problems and solutions with a bias towards challenges particularly faced by the Global North. Thus, a key challenge for RRI organisation is to help achieve systemic changes needed in society towards responsibility, sustainability, and transparency by acting as mediator, enabler, facilitator, and institutional entrepreneur. To this end, the required and desired fundamentally democratic and open research and innovation systems may emerge from creating open research infrastructures, enabling communities, inspiring researchers, and transforming academia. Adding to the challenge is the distributed and thus shared responsibility and capacity for establishing a democratic, participatory, deliberative, and anticipatory approach to governing research and innovation (systems) among all actors in the quintuple helix: society, policy, business and industry, science, and environment.

Since system inertia and complexity represent major obstacles to achieving a transformation towards open science based on RRI principles, RRI organisations need to (be able to) resist simplistic, managerial approaches. Instead, collaborative experimentation for change in and across different social spheres, scientific fields and policy domains emerges as the current key challenge and task for RRI research and practice.

6 ORRI TAXONOMY

The REINFORCING project aims to consolidate past knowledge of RRI projects and ongoing initiatives around ORRI initiatives, as well as expanding and deepening the understanding of the gaps identified in the literature. For doing so, the REINFORCING project aims *"to become the ORRI central point of knowledge and expertise that supports territories and institutions in fostering Fair Transitions governance by aligning with societal values, needs and expectations"* (REINFORCING GA, p104).

Becoming the "ORRI central point of knowledge and expertise" demands a significant "stocktaking exercise" that can gather and uptake the diversity and significant number of resources, instruments and tools developed during the last years not only within the EC, but also in the international community that has grown around ORRI. In this regard, the development of the REINFORCING platform is a primary infrastructure for giving visibility to these numerous resources, but also to keep contributing to the generation and classification of them.

In this regard, this D1.1 constitutes the first step to *"conduct a thorough review to identify blind spots and gaps, interacting with key RRI researchers and practice actors and analysing all tools collected in the RRI Tools platform which has acted as a living repository of RRI resources, so as to come up with a new taxonomy and guidelines for meaningful implementation of ORRI initiatives"* (REINFORCING GA, p106).

The taxonomy that is being exposed in this deliverable aims to provide a useful, simple, and efficient categorization that will help to position the REINFORCING platform as a One-Stop Source across ERA. To that aim, this deliverable will feed the theoretical basis of the development of the REINFORCING platform for upgrading the structure of the RRI Tools platform[18]. The RRI Tools have played a major role in the diffusion of the concept on the virtual space and now it congregates more than 1600 tools, resources, projects, and references of interest. Transferring that collection of resources and upgrading its structure the REINFORCING OSS can be a challenging task, but also a risky one.

In this sense, different specific meetings have been held during the project lifespan for addressing specifically these issues. A first session was organised during the second general meeting at Tampere (Finland) in the VTT premises, during the 19th and 20th of October of 2023. In that meeting several issues arise in relation to the design of the REINFORCING OSS. Discussions pivoted around several main issues (among others):

[18] https://ORRI-tools.eu/

- **Potential users:** who can be a platform user? Which kinds of users can emerge? What are their needs? How can we involve them into the development of the platform?
- **Context sensitivity:** How can we address different contexts such as territorial and organisational ones? Can we aim to go further than these two dimensions? Do we need specific tools for the Balkans? Should we pay attention to individuals or to organisations in these contexts?
- **Categorization and collection of resources:** How are we going to collect new resources? How are we going to successfully transfer the old ones? Which categories can fit better to our purposes? What kind of tools are the most important for ORRI practitioners?

Following that physical meeting, another specific session was held during the organisation of the SuperMoRRI final event that was held at Brussels (Belgium), during the 30th of November and the 1st of December of 2023. In this event, another session was hold with some members of the REINFORCING consortium, as well as with participants in the final event to advance in the conceptualization of the REINFORCING OSS. In this occasion, the debate was structured into three rounds that emphasised the need of addressing these prior blocks, sharing with new participants in the debate the tentative structure of the REINFORCING OSS (action dimension, individual/organisational level, ecosystem/territorial level). The discussion with participants pivoted around different issues:

- **Sustainability:** How to maintain the interest of existing users of RRI Tools into a new platform? How to maintain the interest of users after the project ends? There is also a need to consider multilevel perspectives in the development of sustainability to understand its systemic nature.
- **Categorization and collection of resources:** How will these old resources be linked with the new platform? RRI Tools is a repository, but their categories can be problematic (i.e. diversity, inclusiveness and social justice have different meanings but also share commonalities). RRI Tools can be useful for REINFORCING applicants. Categories should focus on the process level, not product level. It will be also important to provide human filtering in the existing resources of RRI Tools for verifying they are still valuable/should be continued into the REINFORCING platform.
- **Interfaces:** Participants also proposed the use of AI or chatbots for accompanying users and helping them to look for the right information in the REINFORCING

platform. Some of the terms suggested as categories are contested and political – they come with values and requirements. Should the platform make these explicit?

Following these two physical meetings, several virtual sessions have been held in early 2024, trying to address these questions and moving forward with the conceptualization of the REINFORCING OSS. At this point it is also important to stress that most participants in this process have favoured a "continuity approach" and they have declared their intention "to not reinvent the wheel". The spirit behind these discussions and conceptualizations has been mainly focused about providing a useful tool for ORRI applicants, as well as addressing the gaps identified by the REINFORCING research team. Lastly, an emphasis in the context has been also encouraged, mainly from the organisational domain and ecosystem perspective. These are some of the reasons that are behind the current tentative structure of the taxonomy (see Table 3) which resembles quite similar to the six normative keys developed by the EC and the RRI Tools platform. But besides this tentative structure, the REINFORCING platform aims to embrace the organisational and ecosystem domains, which were not commonly addressed by the prior platform.

For instance, in the current RRI Tools website (see figure 4), the inspiring practices category[19] could benefit from the significant contributions that REINFORCING aims to fund during its lifespan. This will help to provide visibility to the numerous institutional changes associated with ORRI that will be funded in the project and improve this aspect of the current categorization of resources. Other aspects that can benefit from the REINFORCING project include the territorial dimension of the adoption and diffusion of ORRI which does not possess a high visibility on the current RRI Tools platform, as well as the organisational perspective (see figure 5.). These two themes do not have a high visibility in the platform and the empirical evidence that we have gathered during the development of this deliverable emphasises how the contextualization and operationalization of RRI practices demands to pay particular attention to these two dimensions (territories and organisations).

[19] https://ORRI-tools.eu/search-engine#keywords=@filterOption=40103@order=@page=1

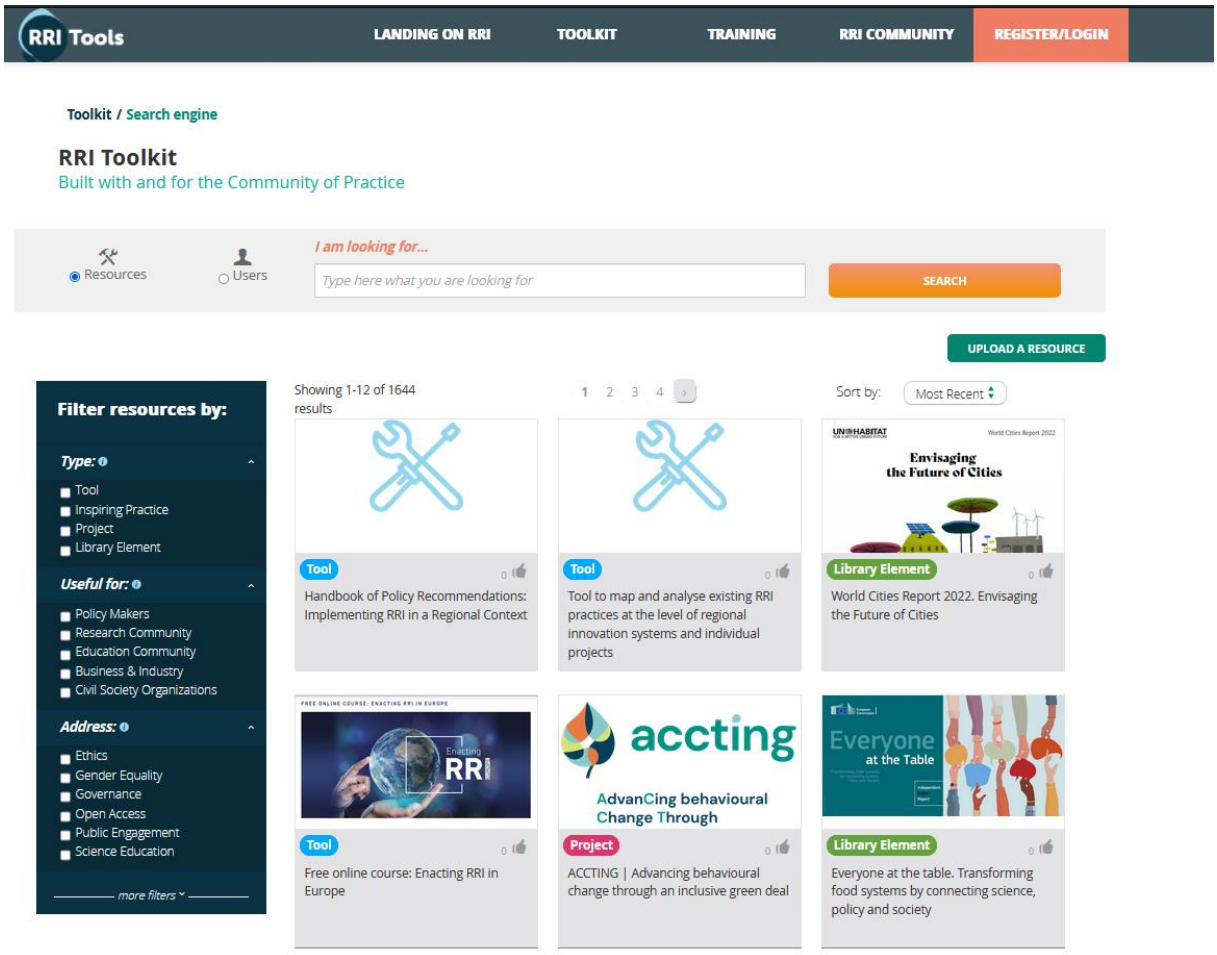

Figure 4. RRI Tools search engine

Technical considerations

Apart from these initial considerations that have started to emerge at different meetings of the REINFORCING consortium, the REINFORCING platform will be also empowered by other deliverables that will help to its design and development. In this sense, WP3 will also contribute to the setting up of the platform and specially through Task 3.1 in which a dedicated task force where different partners are taking part will help to transition from the conceptualization of the platform to its development.

This task force has been iterating around the potential structure that can be developed for the REINFORCING OSS. However, and at the same time, it is also important to remember potential technical considerations that can constrain these conceptualizations.

REINFORCING

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Taxonomy for OSS

	Action level	
Action dimension / categories (keywords)	**Individual/organisational level**	**Ecosystem/territorial level**
Sustainability	Tools/material/library	Tools/material/library
Public engagement	Tools/material/library	Tools/material/library
Diversity and inclusiveness	Tools/material/library	Tools/material/library
Ethics	Tools/material/library	Tools/material/library
Research integrity	Tools/material/library	Tools/material/library
Governance	Tools/material/library	Tools/material/library
Open access/science	Tools/material/library	Tools/material/library
etc.	Tools/material/library	Tools/material/library

Table 3. Tentative taxonomy principles for the REINFORCING OSS

Definition & functionality

Besides these processes, the objective of this deliverable is also to fix and to define the concept of taxonomy and how it will be used from now on in the REINFORCING project. In this regard, taxonomy can be understood as several and different things. It can be an organisation principle for the literature review that has been conducted in this deliverable.

Following the Merriam-Webster Thesaurus we observe that taxonomy has two meanings. The first one as *"the study of the general principles of scientific classification (systematics)"* and the second one as *"orderly classification of plants and animals according to their presumed natural relationships (classification)"*[20]. A very similar definition is provided by the Cambridge Dictionary which at the same time emphasises its scientific character*: "a system for naming and organising things, especially plants and animals, into groups that share similar qualities".*[21]

In our project, we will employ the term taxonomy as the structuring principle for the information in the OSS. This taxonomy will act as a guiding principle for the categorization of the resources that will be transferred by the RRI Tools to the REINFORCING OSS, but also to the new ones developed by the REINFORCING project. The taxonomy will also help

[20] https://www.meORRIam-webster.com/dictionary/taxonomy

[21] https://dictionary.cambridge.org/dictionary/english/taxonomy

potential users of the platform to find the right information that they are looking for through an appropriate path that can adapt to them. In this regard, major efforts will be allocated to the visualisation and presentation of ORRI resources for offering an attractive and easy to use platform that can maximise its reach and impact. The materials that aim to be gathered by the REINFORCING platform will incorporate a variety of tools and resources identified as critical information. The resources will be avoiding RRI jargon that can be difficult to grasp by a non-familiarized user.

7 CONCLUDING REMARKS

Because of numerous ORRI related issues, dimensions, and approaches an exhaustive summary of them in short form would be impossible. Instead, we emphasise three general cross-cutting aspects and dimensions that characterise the collected data and its analysis.

Systemic nature of ORRI. The targets and various related practical dimensions in the implementation of ORRI interact and intertwine with each other, form relations as well as complex feedback loops. Various ORRI dimensions are also connected to each other. Furthermore, they have, besides direct and intentional impacts, also indirect and unintended impacts in their implementation context. Thus, ORRI underscores the interconnectedness of research and innovation with broader societal systems and the importance of taking a holistic, inclusive, and forward-thinking approach to addressing complex societal challenges and promoting responsible and sustainable development. For instance, if you consider applying open science or innovation, you need to think about the engagement of various stakeholder groups and citizens, which, in turn, most likely, brings you to their social and environmental challenges, and how to address them in your specific territorial and organisational context. Subsequently, one must also think about the future impacts of the potential solutions, which raises the need for anticipation and related practices. Moreover, likely these processes are taking place with an aim to create new permanent (institutionalised) practices, which is usually a complex, multi-dimensional and systemic effort even in the context of a single organisation. Thus, while it is analytically useful to discuss these aspects as separate entities, in practice, they are connected to each other in various ways. The inherent uncertainty and complexity of the systems emphasises flexible, adaptive approaches to ORRI. This includes continuous reflective learning, as well as the ability to adjust strategies and interventions in response to changing contexts and emerging challenges.

Contextuality of ORRI. As the systemic nature of ORRI already suggests, context matters. By this we mean that none of the dimensions of ORRI cannot be analysed or implemented in isolation from its social context, in which it is interpreted and adjusted to local or organisational practices. Thus, implementing ORRI in a university or research institute might be different from the context of a private company as the targets, the organisation of actions and organisational cultures differ from each other. Similarly, in territorial or country contexts, regulations, organisations, cultures, and administrational procedures differ from each other. Ethical, social, and environmental considerations must therefore be understood and addressed within the specific social contexts in which activities take place. More specifically this means, for instance, that organisations implementing ORRI need to contextualise the responsibility and sustainability related targets in their

specific context and use the language of practitioners in their business or innovation ecosystem to reach a joint understanding of the challenges at hand and on that basis develop solutions that are contextually meaningful and desirable. By understanding the specific socio-economic contexts, organisations may also improve the participation opportunities for various social groups.

Practice orientation of ORRI. By this we mean at least two issues. First, actions need to be connected to on-going practical considerations and practices in each specific social context. Usually, organisations and people are interested in and live their daily lives with very practical challenges and operations, which stem from their operational environment, daily routines, and operations. Thus, ORRI might be too abstract a concept for a person interested in gender equality or sustainability reporting. The question is usually, how do I do this in practice. This does not exclude the role and importance of theoretical understanding, but emphasises the role and significance of de facto rri, referring to the practical implementation of ORRI principles and practices without explicit or formal recognition of being aligned with the ORRI framework. Practice orientation increases relevance to real-world challenges as it emphasises the integration of responsible practices into existing processes. Second, we need practical tools and approaches by which we can effectively address responsibility related challenges. Structured approaches, and methodologies help identify, assess, and address ORRI related challenges. There are a number of different guidelines, and practical tools available in various platforms to be utilised in the implementation of ORRI. We also need benchmarks and examples of successful implementations, practical experimenting with ORRI-driven organisational changes, and collecting experiences of successful strategies.

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ANNEX 1

List of reviewed EU-funded and nationally funded projects on relevant tools and approaches.

Project Name (Acronym)	**Link:**
BigPicnic	https://cordis.europa.eu/project/id/710780
EQUAL-IST	https://cordis.europa.eu/project/id/710549
FIT4RRI	https://cordis.europa.eu/project/id/741477
GONANO	https://cordis.europa.eu/project/id/768622
GRACE	https://cordis.europa.eu/project/id/883341
GRRIP	https://cordis.europa.eu/project/id/820283
I AM RRI	https://cordis.europa.eu/project/id/788361
JERRI	https://cordis.europa.eu/project/id/709747
LIV.IN	https://cordis.europa.eu/project/id/787991
NewHoRRIzon	https://cordis.europa.eu/project/id/741402
NUCLEUS	https://cordis.europa.eu/project/id/664932
ORION	https://cordis.europa.eu/project/id/741527
PRISMA	https://cordis.europa.eu/project/id/IST-1999-29088
REELER	https://cordis.europa.eu/project/id/731726
RICONFIGURE	https://cordis.europa.eu/project/id/788047
RRI PRACTICE	https://cordis.europa.eu/project/id/709637
RRI TOOLS	https://cordis.europa.eu/project/id/612393
SISCODE	https://cordis.europa.eu/project/id/788217
SMART-Map	https://cordis.europa.eu/project/id/710500
STARBIOS 2	https://cordis.europa.eu/project/id/709517
SUPER_MoRRI	https://cordis.europa.eu/project/id/824671
RESPONSIBLE INDUSTRY	https://cordis.europa.eu/project/id/609817
LIV:IN	https://cordis.europa.eu/project/id/787991/de

Co-Change	https://cordis.europa.eu/project/id/873112
TechEthos	https://cordis.europa.eu/project/id/101006249
CREATE-IoT	https://cordis.europa.eu/project/id/732929
QUEST	https://cordis.europa.eu/project/id/824634
Ethics of Coding	https://cordis.europa.eu/project/id/732407/de
DSI4EU/DSISCALE	https://cordis.europa.eu/project/id/780473
CALIPER	https://cordis.europa.eu/project/id/873134
CASPER	https://cordis.europa.eu/project/id/872113
CANDID	https://cordis.europa.eu/project/id/732561
EFFORTI	https://cordis.europa.eu/project/id/710470
ENERI	https://cordis.europa.eu/project/id/710184
FaRInn	https://keep.eu/projects/9893/Facilitating-Responsible-Inn-EN/
FoTRRIs	https://cordis.europa.eu/project/id/665906
FRANCIS	https://cordis.europa.eu/project/id/101006220
IANUS	https://cordis.europa.eu/project/id/101058158
InSPIRES	https://cordis.europa.eu/project/id/741677/factsheet
SUPER_MoRRI	https://cordis.europa.eu/project/id/824671
NANO2ALL	https://cordis.europa.eu/project/id/685931/factsheet
NANODIODE	https://cordis.europa.eu/project/id/608891/factsheet
PATGOV	https://cordis.europa.eu/project/id/799203/factsheet
PlantHUB	https://cordis.europa.eu/project/id/722338/factsheet
ProteinFactory	https://cordis.europa.eu/project/id/642836
QuantOCancer	https://cordis.europa.eu/project/id/810653/factsheet
RES-AGORA	https://cordis.europa.eu/project/id/321427
Shared Green Deal	https://cordis.europa.eu/project/id/101036640
SYN-ENERGENE	https://cordis.europa.eu/project/id/321488/factsheet
TRANSCEND	https://cordis.europa.eu/project/id/101073913
U4IoT	https://cordis.europa.eu/project/id/732078

V4InnovatE	https://www.v4innovate.de/
CHIC	https://cordis.europa.eu/project/id/760891
CoM_n_Play-Science	https://cordis.europa.eu/project/id/787476
E-Tandem	https://cordis.europa.eu/project/id/101083700
EMBRACE	https://cordis.europa.eu/project/id/101034471
ON-MERIT	https://cordis.europa.eu/project/id/824612
JUST2CE	https://cordis.europa.eu/project/id/101003491
FORGING	https://cordis.europa.eu/project/id/101070200
MySMARTLife	https://cordis.europa.eu/project/id/731297
GREEN-WIN	https://cordis.europa.eu/project/id/642018
NEXTFOOD	https://cordis.europa.eu/project/id/771738
USER-CHI	https://cordis.europa.eu/project/id/875187
EnTIRE	https://cordis.europa.eu/project/id/7417822
GRECO	https://cordis.europa.eu/project/id/787289
BEOPEN	https://cordis.europa.eu/project/id/824323
e-Sides	https://cordis.europa.eu/project/id/731873
ENGAGE	https://cordis.europa.eu/project/id/612269/factsheet/de
ENJOI	https://cordis.europa.eu/project/id/101006407
EnRRICH	https://cordis.europa.eu/project/id/665759
EURAXESS TOP IV	https://cordis.europa.eu/project/id/786133
FANDANGO	https://cordis.europa.eu/project/id/780355
IRRESISTIBLE	https://cordis.europa.eu/project/id/612367/factsheet
MARINA	https://cordis.europa.eu/project/id/710566
NEWSERA	https://cordis.europa.eu/project/id/873125
OSOS	https://cordis.europa.eu/project/id/741572
PERFORM	https://cordis.europa.eu/project/id/665826
RESET	https://cordis.europa.eu/project/id/101006560
RESPONSIBILITY	https://cordis.europa.eu/project/id/321489/factsheet

RRI-ICT Forum	https://cordis.europa.eu/project/id/644200/factsheet
SCILIFE	https://cordis.europa.eu/project/id/723006/factsheet
SPEAR	https://cordis.europa.eu/project/id/824544
SUPER-G	https://cordis.europa.eu/project/id/774124
ECS	https://cordis.europa.eu/project/id/101058509
TRUE	https://cordis.europa.eu/project/id/727973
RETHINK	https://cordis.europa.eu/project/id/824573
D-STIR	http://www.interreg-danube.eu/approved-projects/d-stir
INCENTIVE	https://cordis.europa.eu/project/id/101005330
POLICY ANSWERS	https://cordis.europa.eu/project/id/101058873
DRG4Food	https://cordis.europa.eu/project/id/101086523
SocKETs	https://cordis.europa.eu/project/id/958277
Hypatia	https://cordis.europa.eu/project/id/665566
FemPower	https://fempower.ee.auth.gr/
NCP_WIDERA.NET	https://cordis.europa.eu/project/id/101055286
COS4CLOUD	https://cordis.europa.eu/project/id/863463
SALL	https://cordis.europa.eu/project/id/871794
EuroScitizen	http://www.euroscitizen.eu/
CHANGE	https://cordis.europa.eu/project/id/787177
CSI-COP	https://cordis.europa.eu/project/id/873169
AnticipatoryLedgers	https://cordis.europa.eu/project/id/793059
CreaTures	https://cordis.europa.eu/project/id/870759
DCODE	https://cordis.europa.eu/project/id/955990
EFP	Information on Cordis homepage not available/not found
ENERGIZING FUTURES	Information on Cordis homepage not available/not found
EPINET	Information on Cordis homepage not available/not found
EPOCH	Information on Cordis homepage not available/not found

EST-FRame	https://cordis.europa.eu/project/id/288981
FEDORA	https://cordis.europa.eu/project/id/872841
FLAGSHIP	
GCOF	https://cordis.europa.eu/project/id/643439/factsheet
GECKO	https://cordis.europa.eu/project/id/955422
GENIE	https://cordis.europa.eu/project/id/951542
MILESECURE-2050	https://cordis.europa.eu/project/id/320169
MOSAIC	https://cordis.europa.eu/project/id/101006382
orbit-RRI.org	https://orbit-RRI.org/
PACT	https://cordis.europa.eu/project/id/285635
PARRISE	https://cordis.europa.eu/project/id/612438
PE2020	https://cordis.europa.eu/project/id/611826
PRO-RES	https://cordis.europa.eu/project/id/788352/factsheet
PROGRESS	https://cordis.europa.eu/project/id/321400
RECIPE	Information on Cordis homepage not available/not found
TECHNOLIFE	https://cordis.europa.eu/project/id/230381
ALLINTERACT	https://cordis.europa.eu/project/id/872396
Printeger	https://cordis.europa.eu/project/id/665926
GENDER TIME	https://cordis.europa.eu/project/id/321491/
RECODE	https://cordis.europa.eu/project/id/321463/
SAGE	https://cordis.europa.eu/project/id/710534
STAGES	Information on Cordis homepage not available/not found
GENOVATE	https://cordis.europa.eu/project/id/321378
SECCON	Information on Cordis homepage not available/not found
CASI	https://cordis.europa.eu/project/id/612113
ACT	https://cordis.europa.eu/project/id/788204
Gender-SMART	https://cordis.europa.eu/project/id/824546
CHERRIES	https://cordis.europa.eu/project/id/872873

CSRC	https://cordis.europa.eu/project/id/763594
DigiTeRRI	https://cordis.europa.eu/project/id/873010
WBC-RRI.NET	https://cordis.europa.eu/project/id/101006279
Gaming Horizons	https://cordis.europa.eu/project/id/732332
IPM-4-Citrus	https://cordis.europa.eu/project/id/734921/factsheet
IRENE	https://cordis.europa.eu/project/id/722935/factsheet/es
MadridERN2016-2017	https://cordis.europa.eu/project/id/721631
NERRI	https://cordis.europa.eu/project/id/321464/factsheet
OPENRESEARCHERS	https://cordis.europa.eu/project/id/722930/factsheet
PEPPER	https://cordis.europa.eu/project/id/796520/factsheet
PIER	https://cordis.europa.eu/project/id/632084
PROGRESSIVE	https://cordis.europa.eu/project/id/727802
RRI-LEADERS	https://cordis.europa.eu/project/id/101006439
SeeRRI	https://cordis.europa.eu/project/id/824588
SiS.net3	https://cordis.europa.eu/project/id/857769
TeRRIFICA	https://cordis.europa.eu/project/id/824489
TeRRItoria	https://cordis.europa.eu/project/id/824565
TetRRIS	https://cordis.europa.eu/project/id/872550
TRANSFORM	https://cordis.europa.eu/project/id/872687
ValueChange	https://www.delftdesignforvalues.nl/portfolio/design-for-changing-values/
RIPEET	https://cordis.europa.eu/project/id/101006295
RRI2SCALE	https://cordis.europa.eu/project/id/872526
Biofrontiers	https://www.theicct.org/publications/biofrontiers-responsible-innovation-tomorrows-liquid-fuels
TARGET	https://cordis.europa.eu/project/id/653350
I-CONSENT	https://cordis.europa.eu/project/id/741856/
Bodega	https://cordis.europa.eu/project/id/653676

COMPASS	https://cordis.europa.eu/project/id/710543
Elements of AI	https://www.elementsofai.com/
ETAIROS	https://etairos.fi/en/etairos-en/
ETHNA	https://cordis.europa.eu/project/id/872360
FIT4FOOD2030	https://fit4food2030.eu/
FOSTER Plus	https://cordis.europa.eu/project/id/741839
GEDII	https://cordis.europa.eu/project/id/665851
GenderSTI	https://cordis.europa.eu/project/id/872427
GREAT	https://cordis.europa.eu/project/id/321480/reporting
GreenSCENT	https://cordis.europa.eu/project/id/101036480
HEIRRI	https://cordis.europa.eu/project/id/666004
Human Brain Project (HBP)	https://cordis.europa.eu/project/id/604102
INBOTS	https://cordis.europa.eu/project/id/780073
INTEGRITY	https://cordis.europa.eu/project/id/824586
LeTSGEP	https://cordis.europa.eu/project/id/873072
MARIE	https://projects2014-2020.interregeurope.eu/marie/
MARVEL	https://cordis.europa.eu/project/id/957337
NextGenProteins	https://cordis.europa.eu/project/id/862704
PROSO	https://cordis.europa.eu/project/id/665947
QuantERA	https://cordis.europa.eu/project/id/731473
Refolution	https://cordis.europa.eu/project/id/101096780
REPAIR	https://cordis.europa.eu/project/id/688920
RESBIOS	https://cordis.europa.eu/project/id/872146
ROBUST	https://cordis.europa.eu/project/id/727988
ROSIE	https://cordis.europa.eu/project/id/101006430
RRING	https://cordis.europa.eu/project/id/788503
SATORI	https://cordis.europa.eu/project/id/612231

SHERPA	https://cordis.europa.eu/project/id/786641
SIENNA	https://cordis.europa.eu/project/id/741716
SPARKS	https://cordis.europa.eu/project/id/665825
TIME4CS	https://cordis.europa.eu/project/id/101006201
ACTION	https://cordis.europa.eu/project/id/824603
CIMULACT	https://cordis.europa.eu/project/id/665948
CoAct	https://cordis.europa.eu/project/id/873048
CS-track	https://cordis.europa.eu/project/id/872522
DITOs	https://cordis.europa.eu/project/id/709443
EnviroCitizen	https://cordis.europa.eu/project/id/872557
EU-Citizen.Science	https://cordis.europa.eu/project/id/824580
WeCount	https://cordis.europa.eu/project/id/872743
RRIstart	https://cordis.europa.eu/project/id/101005937

ANNEX 2: LITERATURE REVIEW TEMPLATE

Basic information					**Document category & no.:** (from excel)			
Reviewer's name								
1. Bibliographical information (author/s, year, title, editor/s, journal/book, volume, publisher, place of publication, pages, DOI)								
2. Abstract (copy and paste)								
3. Main focus (multiple entries possible)	**RRI / RI**	o	Citizen participation	o	Science literacy	o	Gender equality	o
	Open access	o	R&I governance and ethics	o	Other	o		
	Sustainabaility	o	Social	o	Environmental	o	Economic	o
	Organization		Strategic level		Practices		Other	
	Policy		European		National		Regional	

	Anticipatory governance		Institutionalization		Other			
Comments								

4. Main perspective **(multiple entries possible)**	Theoretical, conceptual	o	Methodological	o	Policy oriented	o	Practical/guidance	o
	Other	o	Comments:					

5. Type of document	Scientific article	o	Book chapter	o	Book	o	Report	o
	Project deliverable	o	Policy/ strategy document	o	Other	o		

6. System level (if applicable)	Global	o	European	o	National	o	Sub-national/regional	o
Comments:								

7 Country or territorial or organizational focus (if applicable, please specify/name)	

Guiding questions for review
- please add page numbers where appropriate -

8. How is the main focus/problem(s)/research question(s) (see above number 3.) characterized (please, shortly)?

9.1 What main definitions are used? **(e.g. sustainability, governance, institutionalization)**	

9.2 What empirical data (if applicable) is used?	
9.3 To which concepts, theories, approaches, schools of thought, communities (scientific or practice) in the area of research and innovation does the literature relate or make reference to? (e.g., STS, constructive TA, anticipatory governance, foresight, deliberative democracy, …)	
9.4. What are the main conclusions/arguments?	
Comments	
10. Practical learnings	
10.1 Which approaches, instruments, tools etc. are discussed (if any) to facilitate the uptake of responsible or sustainable practices?	
10.2 What are the main challenges, problems, barriers, potential drawbacks etc. for the uptake and how could they be addressed?	

10.3 3 What evidence is presented to support the claims, solutions etc.?	
Comments	

11. Critical and missing points (e.g. is something missing, gaps?)	