DELIVERABLE 2.1

Grant Agreement No.: 872550
Project Acronym: TETRRIS
Project Title: Territorial Responsible Research and Innovation and Smart Specialization

Work package/Deliverable: D2.1 : VALIDATED MAPPING AND ANALYSIS FRAMEWORK

Version: 5.0 / Final

Due Date: 31-10-2020
Submission Date: 05-11-2020
Dissemination level: Public
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Contributors: All partners
Status: Plan, Draft, Working, **Final**, Submitted, Approved (select)

DOCUMENT HISTORY

Version	Date	Author	Description
1.0 / Draft	20.10.2020	Nicholas Martin et al. (Fh ISI)	Initial draft for partners
2.0	21.10.2020	YAG, VTT, TEC	Reviews and comments
3.0 / Revised Draft	22.10.2020	Nicholas Martin et al. (Fh ISI)	Revised draft for partners
4.0	26.10.2020	YAG, VTT	Reviews and comments
5.0 / Final	04.11.2020	Nicholas Martin et al. (Fh ISI)	Final version for submission

ACKNOWLEDGEMENT

LEGAL DISCLAIMER

EXECUTIVE SUMMARY

This document is Deliverable 2.1 of the TetRRIS project, funded by the European Commission under its Horizon 2020 Research and innovation program (H2020) Science with and for Society Call 14. The document sets out the core theoretical framework of the TetRRIS project. The core objective of TetRRIS is to to support four European pilot territories in integrating Responsible Research and Innovation (RRI) practices into their local/regional innovation systems and development approaches. To do so, TetRRIS draws on concepts from the literatures on Regional Innovation Systems (RIS) and Responsible Research and Innovation (RRI/RI). This Deliverable identifies and summarises the key concepts of these literatures relevant to the TetRRIS Project, and discusses both the relevance of RRI for regional innovation and development, and possible obstacles to integrating RRI into regional projects and structures. The Deliverable moreover includes a "Mapping Tool", an extended set of questions which scholars and practitioners can use to analyse the structures and workings of a given territory's innovation system and approaches and local innovation and development projects, both to understand their structures, processes and goals, and to identify to what extent RRI is already being de facto practiced in these projects and systems, and where particular needs, challenges and problems exist on the part of the practitioners that RRI might help them address.

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1 Introduction

The aims of *Project TetRRIS – Territorial Responsible Research and Innovation and Smart Specialisation* are to support four European pilot territories in integrating Responsible Research and Innovation (RRI) practices into their local/regional ("territorial") innovation systems and development approaches; to promote mutual learning and interaction between the pilots (and, where possible, other European projects and regions); and to develop tools, good practices and policy recommendations that can be used to integrate RRI into regional development in other European territories.

The first step in this endeavor is to understand better how each pilot territory's innovation and development "system" is currently configured: who the main actors are, what structures they work through, and what the innovation/development aims and activities are that they are currently pursuing. Building on this, we next seek to understand which dimensions of responsible research and innovation are most relevant to the innovation/development activities and projects of the local actors, to what extent RRI-like practices are already occurring in these projects (albeit perhaps under another name – so-called "de-facto RRI"), and what the entry and leverage points are through which RRI thought and practice may be (further) introduced to these actors and integrated into their work. A particular focus is on identifying what challenges and problems the actors may be confronting in their work that RRI could help solve – how RRI practice can make a positive contribution to their work rather than appearing as a further (albeit, "soft") compliance hurdle they need to jump through.

This Deliverable introduces the theoretical framework for this work, and provides project partners with a practical tool to "map" their territories' innovation/development systems and activities, and identify relevant RRI dimensions. To do so, it draws on two main bodies of scholarly work; those on regional innovation systems and on RRI, respectively.

One challenge for *TetRRIS* is that academic theories and policy debates over RRI and regional innovation/development have historically focused on different policy arenas, institutions and types of actors. RRI discourse (and research projects) have mostly been about national- or EU-level science and technology policy, funding schemes, and major research performing and funding organisations. Conversely regional innovation has been more concerned with economic development at subnational (municipal and provincial) levels, and with the interplay between policy makers, entrepreneurs, education and research organisations, financial institutions as well as organised labour at local and regional levels. The Deliverable therefore tries to identify the relevance and benefits, but also the possible challenges, of integrating RRI into regional work.

The Deliverable is organised as follows. Sections 2 and 3 introduce the concepts of regional innovation systems and of RRI, respectively. Section 4 then examines the benefits and challenges of integrating RRI into regional work in more depth. Section 5 proposes a "mapping tool", concretely a set of two questionnaires, to help *TetRRIS*

partners analyse and "map" the innovation/development systems of their territories and the activities carried out therein, and identify how RRI can be relevant to these.

First however a note on terminology and concepts.

Territory / Region / Locality. Following the terminology of the text of Call funding *TetRRIS* (SwafS-14-2019) the project is concerned with *territories*, defined as subnational geographical units that have some economic, political and/or socio-cultural coherence, but without necessarily corresponding to pre-existing political-administrative units such as a particular municipality or federal state/province (though they may do). Relatedly, "territories" in the sense of *TetRRIS* can be both towns, cities, municipalities or districts (i.e., the lowest levels of government in most European states, often called "localities" in regional-development discourse) or larger regions or federal states (the intermediate level of governance in many European states, between the municipality and the nation-state, often called "regions"). For sake of linguistic variation and because *TetRRIS* pilot territories include both municipalities and provinces, this document will use "territory", "region" and "locality" interchangeably; where a specific administrative level is referred to, this will be indicated.

Innovation / Development. The word "innovation" is commonly used to refer to new products, processes or organisational forms (OECD 2005, 2018). In particular in RRI discourse, the concern is often with radical (and perhaps risky) new-to-the-world technologies. Governance of these processes (i.e., funding, hard and soft rule-setting, oversight) usually resides at national or European levels. Policy makers and institutions at regional and local levels mostly have little role in this. While local entrepreneurs, technologists and researchers may be innovating radical new technologies and maintain close relations with national and European governance structures, local policy makers are most likely to appear in the innovation process in a different way: as trying to facilitate beneficial local framework conditions for the innovators (the concern of local economic development), or as *users* deploying the new technology to solve their own local governance challenges (e.g. modernising the transportation system), something again likely to be closely connected to local economic and infrastructural development agendas.

Governance of new technologies – the concern of RRI – in the local context is thus likely to mainly mean *governance of their deployment* or clever *tinkering with local framework conditions* to encourage innovators to choose particular technology trajectories. Especially the latter is likely to induce a very soft steering mechanism[1] in the local context. As most local/regional authorities' have limited scope to offer substantial incentives in terms of and most relevant regulatory powers are outside of their remit they

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[1] "Soft" governance refers to steering mechanisms that are non-binding, voluntary and informal, such as persuasion and provision of information, guidelines and good practices. Non-compliance is not (formally) sanctioned and there is no (formal) enforcement mechanism. (In practice, there may of course be informal and indirect sanctions such as a loss of social capital, good will, etc.). "Hard" governance mechanisms refer to legally-binding obligations, usually encased in legislation or executive orders of some sort that are formally enforcement. (Maggetti 2015, Knodt et al. 2020).
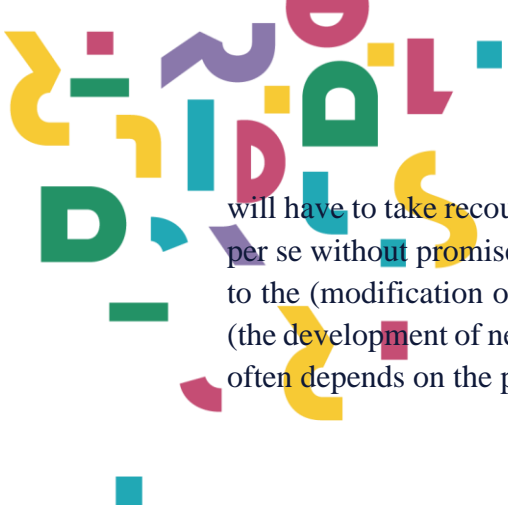
will have to take recourse to less formal governance mechanisms that are nonetheless not per se without promise. The *deployment* of innovative solutions is likely to closely relate to the (modification of) social practices and thus to *service as well as social innovation* (the development of new social practices) since effective deployment of new technologies often depends on the parallel growth of new practices and usage patterns.

2 An Introduction to the Concept of Regional Innovation Systems

The concept of regional innovation systems was conceived in the early to mid-1990s by Cooke (1992), in parallel to considerations on innovation systems at the national level (Lundvall, 1992). Based on the observation that a country's dynamics of economic development and competitiveness cannot be explained by its stock and investments of capital and labour alone (Freeman, 1987), the new, systemic approach focuses on the central role of institutions, actors and linkages for economic growth (Edquist, 1997).

2.1   Motivation and Approach

Building on earlier literature on innovation as an interactive, complex and cumulative knowledge and learning process driven by technology as much as market demand, systems of innovation models emphasise the variety of interactions between idea and market-ready solution (Asheim et al. 2016). They translate to the level of country what earlier literature had identified at the level of the firm: recursive steps, the involvement of diverse actors, and the fact that needs of society and regulation matter as much as the opportunities theoretically provided by technological advances (cf. Figure 1). According to Edquist (1997), innovation systems comprise "all important economic, social, political, organizational and other factors that influence the development, diffusion, and use of innovations." (Edquist 1997: 14). From a pragmatic standpoint, the approach thus highlights that innovation depends not only on general framework conditions and inputs, but also on the diversity of human interactions in which knowledge is generated, processed, and translated into concrete solutions. Hence, a main focus of all innovation system approaches primarily is on institutions, i.e. the "common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals (Edquist and Johnson 1997: 46).

Figure 1: Combined or coupled innovation model
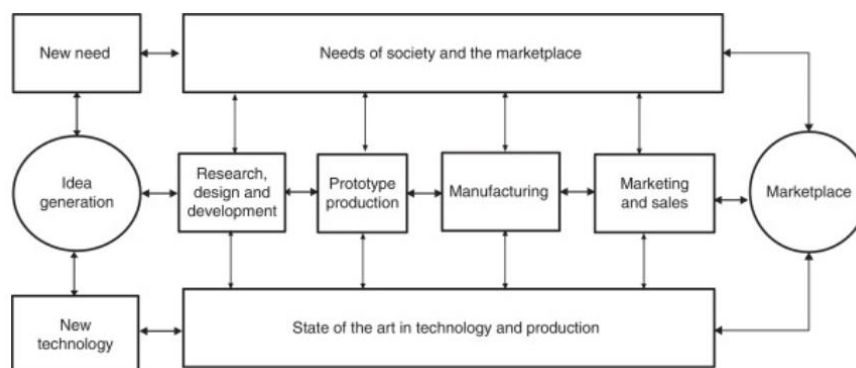
Source: Rothwell (1994)

In that sense, most studies on innovation system are empirical rather than abstract or conceptual in nature. At least, major parts of the literature focus on elaborating on the

role of individual actors and the exchanges between them – rather than on abstract logics of (sub-)systemic interaction. By referring to "systems", however, the approach underlines that it does not promote simple mapping, but focuses on organisations and individuals ("actors") as assuming functions, i.e. tasks and roles, in a defined context ("sub-system") (cf. Figure 2). Put differently, they are the drivers of activity in knowledge generation, knowledge diffusion and innovation governance. Geographical proximity within a particular territory facilitates knowledge sharing as well as economic and social interactions between public and private agents, which is why the regional level is of major importance to engender and diffuse innovation (Asheim et al. 2011)

Figure 2: Standard Overview of a regional innovation system with functional subsystems
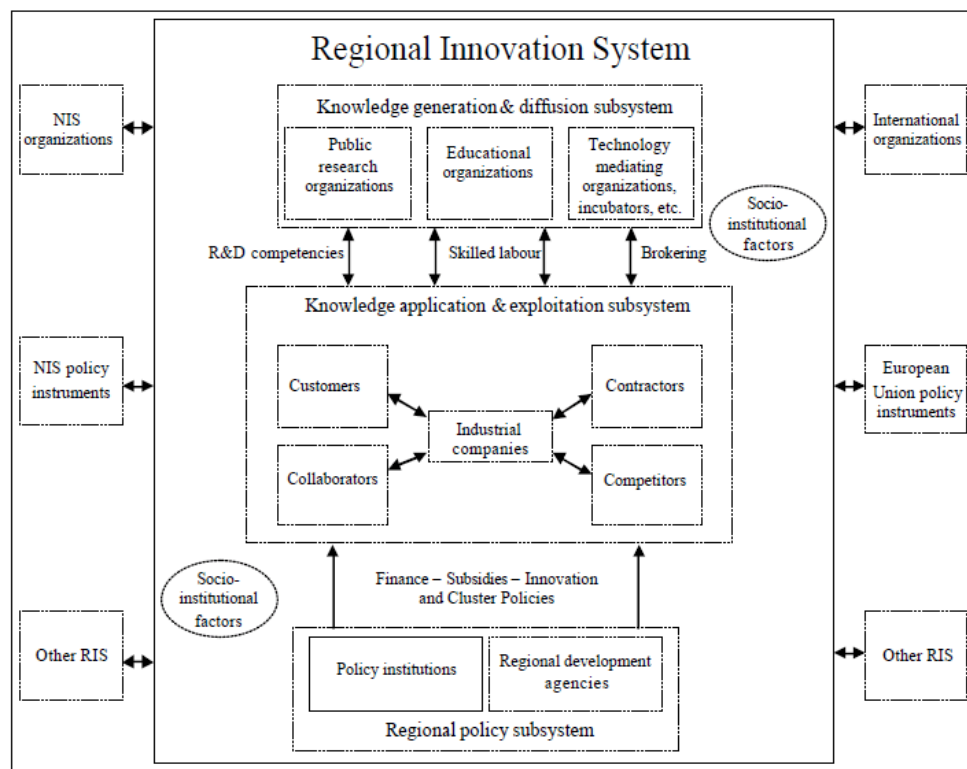
Source: Wintjes (2016) adapted from Tödtling and Trippl (2005) and Trippl and Tödtling (2010)

To illustrate how the Regional Innovation System model has informed and structured our thinking about regional processes of innovation, three main perspectives can be highlighted as central elements that have developed over time:

- Acknowledgement of Diversity
- Permeable Boundaries
- Conceptual Inclusiveness

2.2   Acknowledgement of Diversity

As has been commonly acknowledged, regions differ from each other in relation to their innovation potential – primarily in quantitative but also in qualitative terms.

For example, many regions are dominated by SMEs with limited resources for and interest in R&D activities. This is true especially of regions peripheral to the main economic centers. In these regions, innovation is typically small-scale and incremental in nature, disconnected from activities in the science sector and mainly occurs through application of existing knowledge or through new combinations of knowledge (Asheim & Coenen 2005). Furthermore, many peripheral regions are characterised by a weak presence of capable actors altogether and/or are dominated by selected traditional industries (e.g. in mining or artificially created industrial bases). In these, institutional thinness has been considered as the most important barrier to innovation (Doloreux 2003; Isaksen 2001). It implies that various institutions relevant for knowledge-based development (such as dynamic networks and relevant policies) are scarce, as is the density of actors itself including knowledge suppliers, educational institutions, as well as specialised service providers (Tödtling & Trippl 2005).

In consequence, different regions may be characterised by quite different sets of organisations driving local innovation processes as well as by different institutional arrangements that regulate, enable or hinder their progress. As a result, even the goals and ambitions that local stakeholder are pursuing by conducting innovative activities may differ substantially. Quite often, the innovation processes that are common in, even characteristic for one region (such as cutting-edge, science- and technology-driven activities) are rare and uncharacteristic of the kinds of innovation dominantly occuring in other regions (where innovation may be more about creative adaptation and/or user-driven improvement of what already exists). How developed and formalised the innovation process is, is also likely to vary considerably. In one region, it might be fairly common for firms to have a fairly structured, routinised innovation process tightly integrated into other business functions (e.g., production) and employ staff with defined innovation-related responsibilities (e.g., CTOs or even Chief Innovation Officers). In other regions, innovation may occur as a much more haphazard, irregular process as firms (or individual employees) somewhat randomly "luck into" a good idea.

Against that background, the regional innovation systems approach maintains as central that not only the processual arrangement of innovation activities may locally differ, but also the very objective and purpose of these activities as such. In short, innovation processes in one region need by no means be the same – or even very similar to – those in another and must hence not be considered as a phenomenon measureable on a one-dimensional scale (Pelkonen and Nieminen 2015).

2.3   Permeable Boundaries

A closer analogy to traditional systems theory is that innovation systems are considered as clearly delineated from their environment. From at least an analytical perspective, it "must be possible to identify the boundaries of the system" (Edquist, 2001) which means that the region (or "territory") under analysis should be clearly delineated. However, that does not imply that the analysis should exclude extra-regional dimensions. While, some early literature on regional innovation systems took a focused approach in that sense, it

has long been acknowledged that regional innovation systems are not only hubs (Markusen, 1996) connected through "global pipelines" (Bathelt et al., 2004) but stand in a context of multi-scalar levels of regulation and relations between actors (Asheim and Coenen, 2006). Moreover, it is precisely these interdependencies and intersections between innovation systems that are crucial for the competiveness in the knowledge economy (Asheim et al. 2016). Against this background, Binz and Truffer (2017) developed the global innovation systems framework, which stresses the transnational character of innovation processes and technology development, characterized by international linkages and couplings of regional and national innovation systems (cf. Figure 3). Of particular importance is that the spatial configuration of innovation systems depends on the dominant innovation mode as well as the economic system of valuation. A stronger global orientation can be expected with increasing product standardisation and science- and technology-driven modes of knowledge generation, while the local dimension is gaining importance with more customized products relying on incremental learning and tacit knowledge. Today, putting the focus on a regional system mostly intends to focus the perspective on impacts and outcomes rather than to artificially limit perspectives on triggering and moderating factors (Asheim et al., 2016).

Figure 3: Different Kinds of network configurations in regional innovation systems
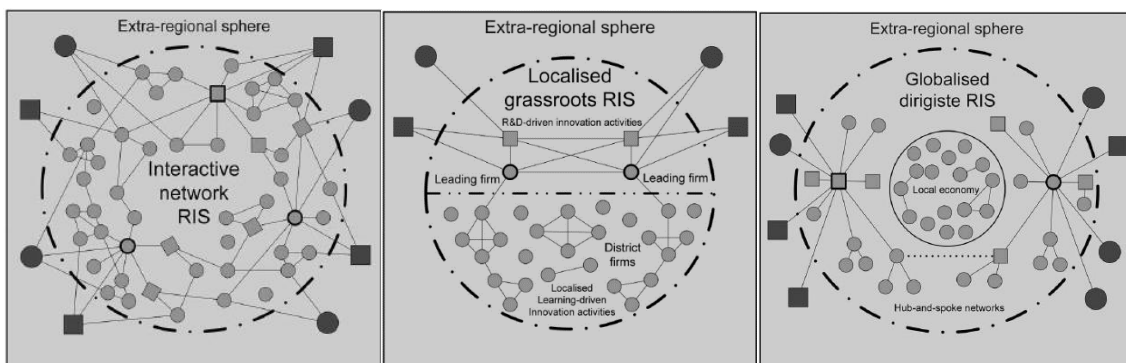
Source: Stuck et al. (2015)

2.4   Conceptual Inclusiveness

Over time, much innovation system research had developed a tendency towards deploying schematic heuristics. While a key motivation for the development of the approach was to introduce diversity into economic thinking, at least some strands of subsequent analysis had developed a tendency of repeating a "standardised" approach distinguishing between common sets of actors (firms, universities, intermediaries, ...) as well as relations (flows of money, codified knowledge, people, ...). While the idea of policy and government as an important, autonomous actor (Kuhlmann and Arnold, 2001) had been implicitly present from the beginning in large parts of the regional innovation system literature starting from Cooke, 1992, this was not always sufficiently pursued subsequently. While different forms of external relations and diversity within the business sector was increasingly acknowledged (Stuck et al., 2015), policy-relevant actors and

relations beyond those immediately relevant for funding and regulations often remained unconsidered.

In the socio-economic context of the 1990s and early 2000s, this omission was not immediately problematic, as long as policy goals and research questions remained focused on the traditional economic – i.e. oftentimes manufacturing – domains (cf. Figure 4). More recently, however, user innovation, social innovation, and collaborative innovation has come to play a more prominent role (cf. Chesbrough, 2003 and Figure 5). In a world of increasingly reflexive and open science and innovation modes, many additional actors have come to influence processes of idea generation, technological development, the piloting of first solutions and the provision of feedback on established ones. Under these framework conditions, the established model of regional innovation systems must be considered simplistic as it underemphasises the role of a number of further actors with increasing relevance for the processes of knowledge generation, solution development and user uptake (Warnke et al., 2016) (cf. Figure 6). This is relevant to the question of integrating RRI into regional innovation systems and practice for, as we shall see below, an important strand of RRI thinking is to seek to involve a broad range of actors in research and innovation processes, in particular actors not traditionally part of these processes (e.g. citizens, civil society organisations, etc.).

Figure 4: Classic System of Innovation Heuristic by Kuhlmann and Arnold
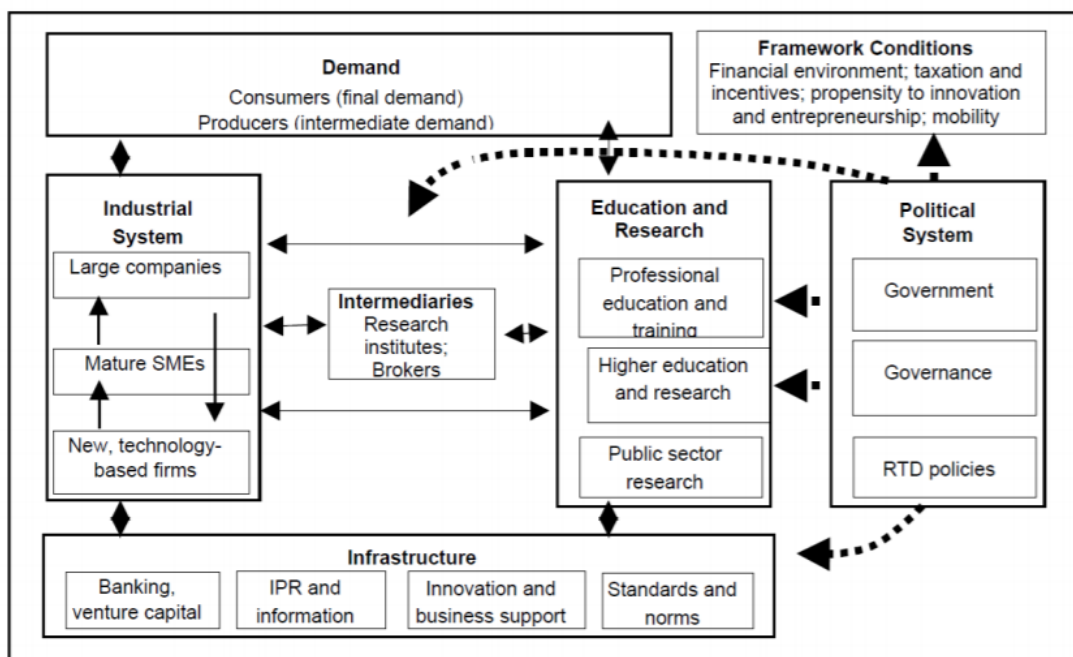
Source: Kuhlmann and Arnold (2001)

Figure 5: The Open Innovation Model
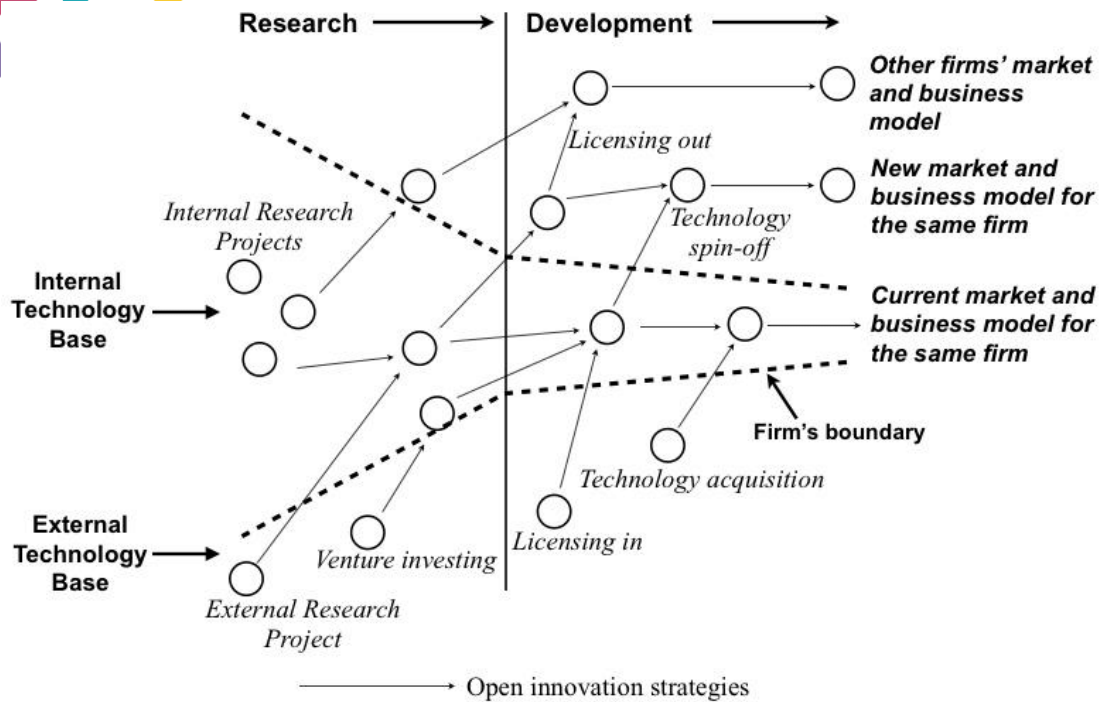
Source: Adapted from Chesbrough (2003) in Rezende Ramos (2014)

Indeed, the past two decades have seen the gradual emergence of new actors in all major functional domains of the innovation system, in most cases assuming various functions in parallel (cf. Figures 6 – 8). Hence, the initial idea of the innovation-systems approach, to try to separate the innovation system into clearly delimited functional domains, has been called into question. For our subsequent considerations with a view to regional RRI this implies that there will rarely be a specific RRI subsystem in which specific, dedicated actors can be identified. More commonly, RRI will – if it is practiced – be part of the de facto practices between diverse, multitasking actors connected by personal and organisational networks. Following on from the recent debate on mission-oriented innovation systems (Hekkert et al. 2020), which underlines the importance of transformative innovation policy to address societal challenges, questions of RRI increasingly coming into focus as they explicitly emphasize societal benefits beyond sole economic well-being.

That said, while the concerns underlying RRI – a more normatively or "mission"-oriented and reflexive innovation policy and practice; more systematic inclusion of novel and non-traditional actors in innovation processes – have come to be increasingly integrated into national- and EU-level policy approaches, most regional strategies have so far remained conservative and focused on the more traditional goal of economic growth (Kroll 2015). While a strong theoretical case can be made that integrating RRI ideas into regional policy could improve this (Uyarra et al. 2019; Fitjar et al. 2019), this endeavour also faces clear challenges. Given their usually very practically-focused work, the actors involved in regional development are likely to have a comparatively large cognitive distance to the often rather abstract language of RRI. Moreover, as noted before, the notion of RRI was first formulated to apply to national and EU science and technology policy – not regional

work. It is therefore necessary to operationalise RRI in ways that can be usefully applied to regional work. The next section attempts this.

Figure 6: New actors in different functional spheres of the innovation system
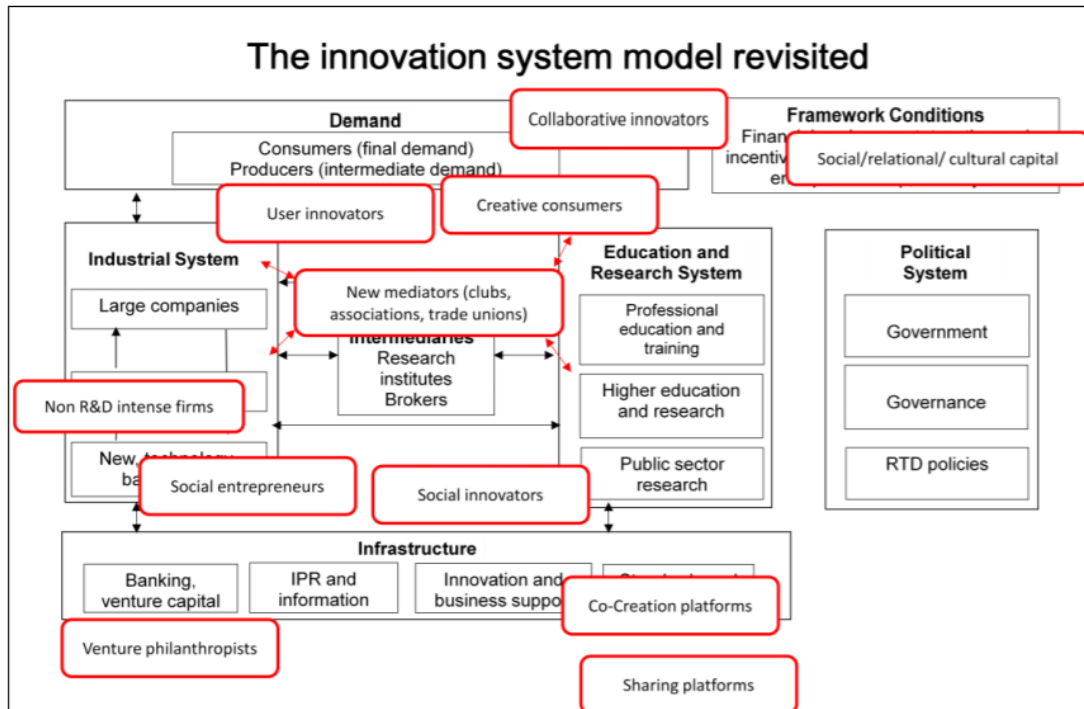
Source: Warnke et al. (2016)

Figure 7: New actors in different functional spheres of the innovation system
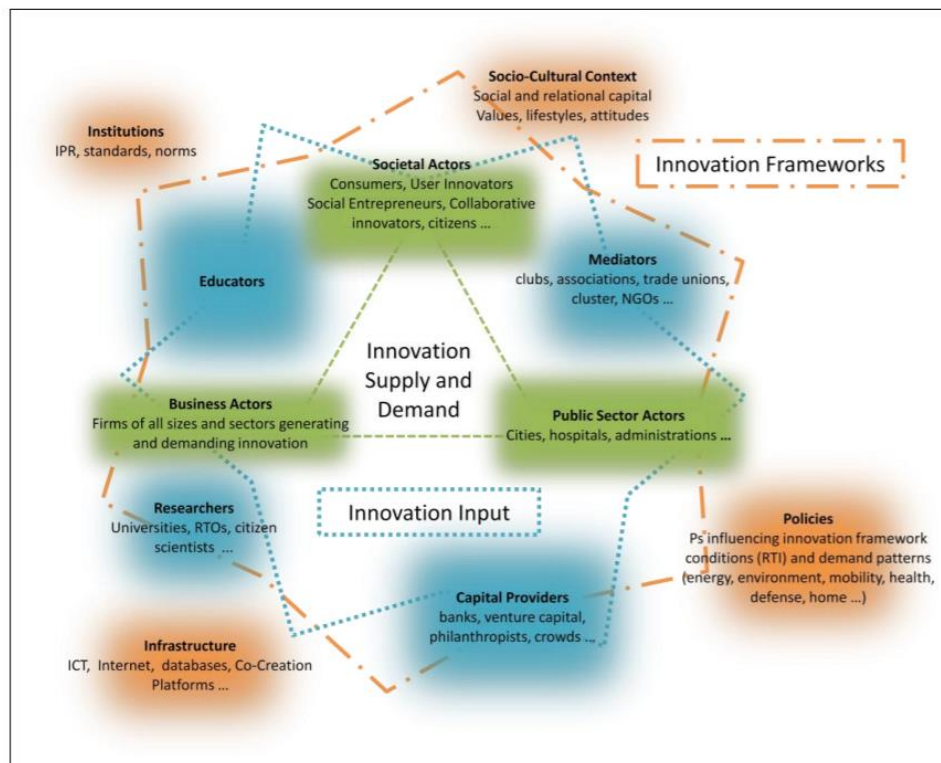
Source: Warnke et al. (2016)

3   Responsible Research and Innovation

3.1   Background and Definitions

Independently of the evolving theories of regional (subnational) innovation systems chronicled above, scholars and practitioners involved in debates about – implicitly, national and supra-national – science and technology policy have called for changes in how research and innovation (R&I) activities take place and are situated in society. Firstly, they have emphasised the need for R&I practitioners (i.e., scientists, technologists and entrepreneurs, but also funders and policy makers) to more systematically align their activities with broader societal needs and values (as expressed for instance in the societal "grand challenges" guiding the European Commission's Horizon 2020 program, the Sustainable Development Goals or the 2009 Lund Declaration), so that science, technology and innovation may better serve society.

Secondly and relatedly, they have called for R&I to become reflexive. This means that practitioners should give deeper and more systematic attention to the wider consequences and effects their R&I outputs may have on society and environment, including unintended and unexpected consequences. As part of this, R&I practitioners should also give greater attention to the values and power structures inscribed into how they practice R&I – to which questions are (not) asked, and which groups (not) consulted over research agendas and processes (Owen et al. 2013; Stirling 2008). After all, how R&I is practiced, and who is involved, is likely in turn to influence the nature of its outputs – concretely, what technologies are (not) developed, how they are (not) designed and deployed, and what effects they might have in society.

Accordingly, scholars and practitioners have underscored the importance that R&I processes be made more open and inclusive. Ideally, all societal stakeholders should be engaged in the R&I process, including not just traditional R&I actors like (predominantly male) senior researchers, entrepreneurs, policy makers and funders, but also citizens, civil society organisations, and groups traditionally underrepresented in R&I, such as women, ethnic minorities and people from disadvantaged socio-economic backgrounds (Wilsdon and Willis, 2004; Guston 2011). Over the past decade, this ambition and policy approach

has been commonly discussed in terms of "Responsible Research and Innovation" (RRI) or "Responsible Innovation" (RI).[2]

The by now voluminous literature on RRI has spawned a number of partially-overlapping definitions of the concept and efforts to further concretise it. Probably the most-cited definition is that by Rene von Schomberg (2013). "Responsible Research and Innovation", for von Schomberg (2013), is

> *A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).*

A pithier definition is offered by Jack Stilgoe, Richard Owen and Phil Macnaghten (Stilgoe et al. 2013), for whom

> *Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present.*

Building upon the ideas of von Schomburg and others, the European Commission (n.d. a) sums up RRI as

> *An approach [to R&I] that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation.*

3.2   Grand Challenges and RRI "Dimensions" or "Keys"

To make these rather abstract definitions more concrete and practically usable, theorists and policy makers have sought to operationalise RRI in terms of certain substantive and processual goals. Two broad thrusts can be distinguished in this regard, one substantive, the other more processual, though there are also mixed approaches. In particular the European Commission construes RRI in ways that mix processual and substantive elements.

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2 The terms "RRI" and "RI" are often used synonymously, but in fact emerged from two somewhat distinct (albeit closely, though not fully, overlapping) discourses. At heart of the distinction is that while "RI" emerged as a bottom-up, academic-driven discourse, "RRI" was from the beginning a more policy-driven discourse that emerged out of the European Commission, aspects of whose further evolution were then heavily shaped by the Commission and in particular the political-institutional logics of the Horizon 2020 Framework Programme. Our understanding of "RRI" draws on both discourses – which, after all, continue to be closely linked, with many scholars using the two terms interchangeably and drawing liberally on both discourses. Indeed, it is likely that many continue to regard them as a single discourse. For a detailed reconstruction and comparison of the two discourses see Owen and Pansera (2019).

3.2.1 Substantive understandings of Responsible Research and Innovation

Substantively, reference is often made to the idea of societal "grand challenges" and/or the UN Sustainable Development Goals. "Responsible" R&I then is R&I geared to achieving these challenges/goals, by producing innovation outcomes (new technologies, social and policy or governance practices, etc.) that practicably contribute to achieving these goals, as opposed to contributing to some other objective (e.g. innovating zero-carbon energy technologies rather than improving online ad-targeting).

In this regard, the (R)RI discourse is part of a larger "mission-" or demand/needs-oriented turn in innovation policy (Mazzucato 2018). Whereas historically innovation policy was mainly seen as part of economic and industrial policy, serving the goal of economic and employment growth as well as tax revenues, the objective of innovation policy in this new understanding is seen as the achievement of broader societal transformations (concretely: the "grand challenges" and Sustainable Development Goals). From being the primary objective, growth, jobs and taxes are relegated to the status of a (highly desirable) by-product of the mission-oriented innovation policy and process.

These substantive concerns underlie, at least implicitly, also most of the more processually-oriented interpretations of RRI, such as those described below. In other words, the concern with getting R&I processes and practitioners to refocus their work on solving the big challenges of our times, instead of optimising for some narrow economic objective, is fundamental to the (R)RI discourse and one of its driving (if often implicit) concerns. That said, somewhat ironically the (R)RI discourse to date has not focused its theory-building energies on these questions over the substantive orientation of (national, supra-national or regional) innovation systems. Instead, work on RRI has sofar mostly focused on processual aspects. Indeed it would be fair to say that RRI, at least in its standard construals, is above all a process-oriented theory, setting normative goals ("dimensions", "keys") for how R&I should be conducted more than to what substantive end it is practiced (beyond the general idea that R&I should serve the attainment of grand challenges, etc.). From the perspective of TetRRIS this may have both benefits and drawbacks. On the one hand, substantive goals (e.g. sustainability) may be easier to communicate to local practitioners than processual goals (e.g. reflexivity), On the other hand, processual approaches may be more likely to apply in diverse settings and contexts, and are more amenable to the fundamentally bottom-up, user-/practitioner-driven approach of TetRRIS that allows for diverse, locally and contextually-based definitions of responsibility and of substantive end-goals to emerge.

Of course, the processual and the substantive approaches to RRI do not preclude each other. On the contrary, substantively-focused work (e.g. on sustainability) may be at its most effective when enriched by the processual dimensions discussed in the next section. After all, even innovation work oriented towards sustainability can be conducted in either a reflexive or a non-reflexive manner, and ex ante, it seems likely that it will be more effective if conducted reflexively.

3.2.2 Processual Understandings of RRI: Stilgoe et al.'s Four Dimensions[3]

Probably the most influential statement operationalising RRI in terms of processual goals is that by the UK academics Jack Stilgoe, Richard Owen and Phil Macnaghten. They define four "dimensions" of RRI; viz. anticipation, reflexivity, inclusion and responsiveness (Stilgoe et al. 2013). "Responsible" R&I, in this telling, then is R&I conducted in such a way as to systematically integrate these dimensions into its practice. They developed these dimensions as an overarching framework for RRI in cooperation with (and on behalf of) the UK Engineering and Physical Sciences Research Council, which has since taken them up as its "official" definition of RRI.4 In the process, Stilgoe et al. were also able to practically implement and try out these dimensions in the context of a larger UK research project into geoengineering (the SPICE project).

3.2.2.1 Anticipation

At its core, anticipation involves systematically thinking through an innovation's possible direct and more indirect impacts and effects. The concern is especially with possible harmful effects, but anticipation can be also fruitfully extended to beneficial effects and consequences, both for society at large (unlooked for usages and benefits) and the innovator (unanticipated market niches).

Anticipation is different from conventional risk assessments and predictions in that it is not, generally, about calculating precise risks and probabilities from known, quantifiable parameters. Rather, engaging in anticipation involves more open-ended deliberation focused in particular on "complexities and uncertainties" and points of ignorance, where no meaningful mathematical calculation is feasible. The aim is to identify the range of possible outcomes, while also distinguishing between "what is known, what is likely, what is plausible and what is possible". It is about asking "what if-questions", and taking contingency seriously.

This explorative aspect of anticipation connects it to the dimension of inclusion, discussed below. Because anticipation is about exploring the "unknown unknowns", including a broad and non-traditional set of voices in the process is likely helpful. Maximising the diversity of perspectives will increase the likelihood of hitherto unrecognised possibilities and effects being identified. Anticipation also relates to the dimension of responsiveness (see further below). After all, the point of identifying potentially problematic outcomes is to be able to take action to respond to them!

Anticipation is likely to be relevant to many regional innovation and development activities. After all, innovation by definition deals with the unknown and the uncertain,

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3 This section is based on Stilgoe et al. 2013, unless otherwise noted

4 Albeit with the dimensions slightly relabelled, as AREA: Anticipate, Reflect, Engage, Act. See https://epsrc.ukri.org/research/framework/

where a complex, unexpected positive and negative consequences can easily occur. "Anticipation" in Stilgoe et al.'s sense is about trying to achieve greater clarity about what these could be, so as to innovate better.

How anticipation is practically enacted will have to vary according to circumstances. A large organisation or project rich in time and financial resources has quite different possibilities than a smaller or more resource-constrained unit. Numerous techniques exist through which anticipation can be practiced, including foresight processes, technology assessment, horizon scanning, scenarios or vision assessments. TetRRIS participants might also find it useful to consult the resources and tools collected online by the RRI-Tools project (https://rri-tools.eu/). In all cases, the tools or techniques chosen most likely will have to be adapted, modified – and quite possibly slimmed down! – to suit the particular circumstances of the actors and projects in which they are to be used.

3.2.2.2   *Reflexivity*

If anticipation is about assessing external consequences of innovations, reflexivity is about the innovator's personal stance, perspective and behavior. It is about clarifying and critically interrogating both one's own cognitive and normative frames, through which one conceptualises and makes sense of the attempted innovation and its possible consequences. This includes one's assumptions, knowledge bases, possible biases, and values, and one's motives (why one is undertaking this innovation). The point is of course to try to determine whether there are viable alternative frames through which to view the innovation – both normatively and cognitively – and whether such alternative frames might lead one to re-evaluate, re-design or in some other way alter the (planned) innovation – including the process and methods by means of which one intends to conduct the innovation.

Again, integrating reflexivity into innovation processes is likely to ultimately lead to better innovations (i.e., more societally and environmentally as well as, in the long term, also commercially more sustainable ones), since "reflexivity" is ultimately about surfacing relevant but hitherto unrecognised information. This has clear relevance also for the regional context. That said, an important challenge to enacting reflexivity in practice is likely to be that R&I practitioners (technologists, entrepreneuers, researchers, other societal or political actors) are often caught in powerful functional and institutional logics that they only very partially control (e.g. market and publication pressures, terms of funding, policy or regulatory mandates set by higher levels of government, citizen demands, …). Critical reflection by itself will rarely neutralise these logics, and in the worst case might even lead to frustration, if the outcome is new insights into how innovation might be done better but also a recognition of limited capacity act on this insight without paying unacceptably high costs. Guiding practitioners to enact reflexivity in some way therefore also requires understanding and sympathy for the constraints they face. Practising reflexivity (and especially acting on its insights) may also require creativity and pragmatism, to identify those responses which are both meaningful (that make a difference) but also feasible within the given constraints.

Techniques and through which reflexivity may be practiced tools that Stilgoe et al. mention include codes of conduct, standards, midstream modulation or ethical technology assessment. However, it may be necessary and possible to develop new approaches. Again, TetRRIS participants are referred to the RRI-Tools project for possible resources.

3.2.2.3   Inclusion

Inclusion is about engaging the wider public in the innovation process (including in deliberation over its direction and objectives; i.e., over what one is seeking to innovate). "The wider public" in this context refers especially to ordinary citizens and interested groups other than traditional established "stakeholders", who may well be involved in some way already. These "non-traditional" groups could for instance be civil society organisations representing human and non-human constituencies (e.g. the environment) potentially affected by the innovation or the innovation process (e.g., through the methods used), in contrast to "traditional" stakeholder groups like organised business, labour or professions.

Inclusion (or participatory governance) of this kind is often already practiced to some extent, both in R&I policy and practice, and in regional development. There is a substantial literature on participation in the governance of R&I (ably summarised in Stilgoe et al. 2013), discussing both its potential benefits but also pitfalls. Among the benefits, the emphasis is most often on securing legitimacy for R&I in a time of waning confidence in experts, as well as the more basic democratic value of public participation in decisions over the collective future, as well as over the deployment of collective resources (in the case of publicly funded R&I). Among technologists, the practical value of involving anticipated (and sometimes, unanticipated) user groups in design decisions is well-established, albeit more often discussed in terms of "open" or "user-driven" innovation than in terms of "inclusion" or "participation".

The pitfalls are both practical and normative. On the practical side, the difficulty of assembling lay citizens with sufficient time, knowledge and motivation to participate meaningfully is well-established. As the political theorist Mark Warren (1996) observes, people want safe food and air travel, but only rarely do they want to participate in slaughter-house inspection or air-traffic control. The structural imbalance between experts and even committed lay people in processes concerned with evaluating and deciding over matters to which scientific expertise is fundamental can lead to sham participations that end up reinforcing technocratic power structures they were supposed to open up. Open innovation can fall prey to users' own biases and limited imagination. As Henry Ford is reputed to have observed, had he asked his customers what they wanted, they would said "faster horses" and urged him start horse-breeding programs.

On the normative side, participatory governance can create tensions with established processes of representative democratic legitimacy. This problem may be particularly acute in regional development, where elected officials are directly involved. If the city government decides one way and a self-constituted collective of "participating" citizens another, then where does the truly legitimate decision lie? The tension is further hightened

by the fact that governments are expected to take into account the interests of future citizens (e.g. children and the unborn; expected new residents who have not moved in yet). Future citizens however can usually not participate in participatory governance initiatives (whether of R&I or development).

All that said, when done well the inclusion of broader publics can provide valuable information otherwise hard to come by, shore up legitimacy of complicated and contested decisions, and help to diffuse potential conflicts around the innovation and deployment of new technologies and social practices. Growing expectations among citizens of being consulted or involved in some way may also mean that governance – especially as it pertains to local or regional development – has to become more inclusive/participatory, or run the risk of destabilising blow-back from enraged citizens.

Numerous participatory methods have been developed, such as multi-stakeholder processes, consensus conferences, citizens' juries, deliberative mapping and polling, focus groups, and the inclusion of lay members in expert bodies. The literature on user-centered design and open innovation too offers diverse methods.

3.2.2.4   *Responsiveness*

The purpose of practicing the above dimensions is to improve the process and outcomes of R&I activities; i.e., to trigger responses to the new insights they produce. That responsiveness actually happens can of course not be guaranteed: whether or not to respond in a meaningful way is ultimately a choice.

One way of increasing the likelihood that R&I practitioners respond meaningfully to new insights can be to institute "stage gates" related to the above dimensions into the R&I process. Stage-gating is a technique originally applied to product development. The development process is organised into a series of defined, usually sequential stages, divided by screening points (gates) where a formal decision whether to proceed to the next stage, revise the prior one, or abandon the project entirely, must be taken. Usually, this decision is tied to the particular output of the squence in question, with decision rules specified in advance (e.g. whether the sequence "market study" identified promising or poor prospects for the planned product). As demonstrated in the SPICE project (discussed in Stilgoe et al.) this technique can be applied to RRI. For instance, an ethics assessment or public consultation can constitute a "stage", with the decision whether to proceed, abandon or revise the innovation (the "gate") tied to the outcome of the assessment/consultation.

3.2.3   The Five Keys of RRI according to the European Commission

In the context of the Eightth ("Horizon 2020") Framework Program, the European Commission has defined RRI in terms of five "keys", which mix processual and substantive elements. These keys are public engagement of lay citizens and stakeholders, open access/open science and open innovation, giving due attention to questions of

gender and ethics in R&I processes, and providing formal and informal science education (EC n.d. a).

3.2.3.1 Public Engagement

This key basically corresponds to the "inclusion" dimension of Stilgoe et al. The Commission describes public engagement as being about "co-creating the future with citizens and civil society organisations" and including "the widest possible diversity of actors" in R&I processes. By way of an example for what public engagement might mean in practice, the Commission mentions iterative "participatory multi-actor dialogues" between "researchers, policy makers, industry and civil society organisations, NGOs, and citizens", and recommends that such engagement be embedded in the R&I process from an early stage so that learnings achieved this way can be directly integrated into the subsequent progress of the R&I project (EC n.d. b).

3.2.3.2 Open Access/Open Science/Open Innovation

In Horizon 2020, this key initially was concerned mainly with making research findings published in journal-article or monograph form available free of charge (open access). The key was subsequently broadened, as a commitment to open science. Open science, in the Commission's understanding, includes additional (and overarching) focii on making underlying research data freely available and encouraging its reuse, and fostering enhanced collaboration among researchers (beyond the traditional research consortium) and between researchers and citizen scientists, especially by making use of new digital tools to share research results, questions and work-in-progress (e.g. blogs, social media, video and podcasts, etc.), but also by trying to shift the aim of (university-/public RPO-based) research practice from publication to knowledge sharing (EC 2016, n.d. c).

In the following Ninth ("Horizon Europe") Framework Program, the "openness" key was further extended to stress open innovation. As the Commission notes, "open innovation" is a broad term encompassing several different nuances and approaches (EC 2016). Generally, it expresses the idea that the innovation process should be opened up to all relevant stakeholders along and across sectors and value chains, with a particular emphasis on drawing end-users into the innovation process. Unlike other RRI Keys and Dimensions, the motive here is mainly utilitarian: innovation is believed to flourish best when knowledge and ideas circulate freely across organisational boundaries. For companies in particular this may involve a change of mindset: in place of an inward-looking focus on conducting and controlling all relevant research, development and design (R,D&D) within the boundaries of the firm, the emphasis shifts to identifying and drawing in useful external R,D&D, and creating value through targeted internal R,D&D activities that seek to complement rather than wholly substitute external efforts.

Open innovation is quite similar to some of the underlying ideas and concerns of Stilgoe et al.'s "anticipation" and "reflexivity" dimensions, and links closely to "inclusion"/"public engagement", too, insofar as it is ultimately about surfacing new

information. This also gives it a clear relevance and connection to issues of regional innovation. Conversely, the "open access"/"open science"-keys are likely to be less relevant to regional concerns, given that they primarily address aspects of the academic scientific research process.

3.2.3.3   Gender

Within Horizon 2020, the gender key assumed two main meanings. Firstly, it related to fostering gender balance in research teams, research decision-making and advisory bodies. Second and more broadly, it meant giving systematic attention to gender dimensions of R&I contents; i.e., taking account of how the needs, behaviours and attitudes of people of different genders may vary, and what consequences these variations might have for research designs and results and for how innovations are (not) used (EC n.d. c).

Both meanings of the gender key can be quite relevant to regional innovation and development. Regional structures, too, should strive for gender balance as a normative goal in itself. The same goes for systematically attending to how needs of female citizens and users may be different.

3.2.3.4   Ethics

In Horizon 2020, the Ethics-Key related primarily to compliance with research ethics and integrity rules and frameworks, in particular those relating to the involvement of human subjects and animals, use of human embryonic stem cells, or privacy and data protection issues, but also fabrication or falsification of data or plagiarism (EC n.d. d).

While ethics are naturally relevant to innovation and development within the pilot territories in a general way, the operationalisation of this key offered by the Commission is, with the partial exception of privacy/data protection, relevant primarily to academic science. TetRRIS partners who want to further explore the ethics key for regional work are referred to the various ethics tools collected by the RRI-Tools project (https://rri-tools.eu/ethics). Interested partners may also want to explore the ethics impact assessment tools developed by the SARTORI and SIENNA projects (https://satoriproject.eu, https://www.sienna-project.eu)

3.2.3.5   Science Education

The Science Education-Key in Horizon 2020 was understood as having several components. For one, it related to efforts to make scientific careers more attractive to you people. For another, it concerned raising the general scientific literacy of the population, as well as involving ordinary citizens more strongly in research through citizen-science projects (EC n.d. e).

The quality of local science education offered the local education and training institutions and students' success therein is likely to be a perennial concern of local governments and businesses focused on the economic competitiveness of their region. In some situations,
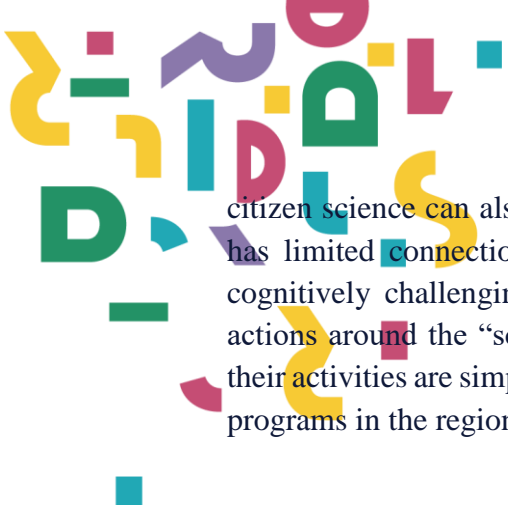
citizen science can also be a useful tool for local researchers. At the same time the key has limited connection to may of the other and, for local practitioners, likely more cognitively challenging aspects of RRI. If TetRRIS partners decide to develop pilot actions around the "science education" key, they may want to be careful to avoid that their activities are simply subsumed into existing, highly utilitarian education and training programs in the region.

4 Integrating RRI into Territories' Innovation Systems and Development Approaches

The foregoing discussion has shown the relevance of the various dimensions of RRI to territories' innovation and development initiatives and approaches. Apart from national research and innovation policies and programmes in a few countries of the EU, the main vehicle for integrating RRI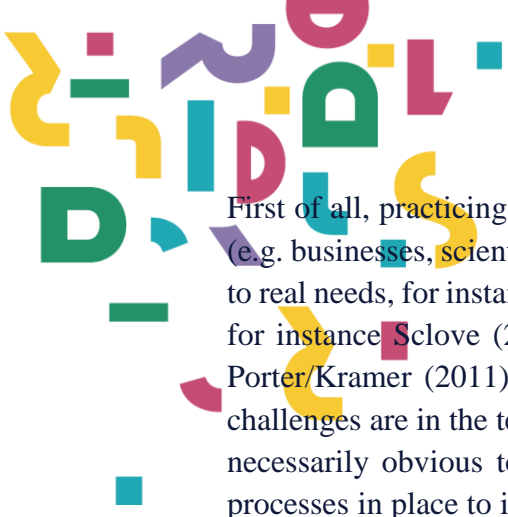 into territorial innovation systems is of course the EU's policy framework, especially the large funding programs like Horizon 2020 or the EU's regional structural policy, particularly concerning the European Regional Development Fund (ERDF). While (with some exceptions) the work programmes in H2020 have mostly not put special emphasis on the regional dimension of innovation, there are nevertheless some important programmes addressing societal challenges, building capacities and developing innovative ways of connecting science to society. Especially the "Science with and for Society" (SwafS) work programme has to be mentioned within this context, which has been one of the main vehicles for mainstreaming RRI in Europe. However, as mentioned above, H2020 as well as SwafS are not primarily "regional programmes". This is problematic insofar as what concretely it measn to be "responsible" or to "respond to societal needs" will necessarily vary across regions.

Conversely, there are several programme lines with the aim to support regional innovation in Europe. The main vehicle here is the European Regional Development Fund or the Smart Specialisation Strategy (S3) as the compulsory element for accessing the financial opportunities provided by ERDF. However, as Fitjar et al. (2019) note, while S3 has some similarities to RRI – especially the empasis on broad stakeholder involvement – there are also substantive differences. S3 is, at its core, about building regional economic competitiveness, and not about cultivating responsibility. While S3 strategies must be "sustainable" and "inclusive", the programme tends to prioritise economic concerns. Stakeholder involvement in S3 thus tends to have a more instrumental objective than in RRI: maximising information flows to facilitate better decisions, rather than maxisiming democratic involvement. However, the fact that RRI has played a limited role in regional initiatives so far does not mean that there is any reason why this has to remain so. On the contrary, as Fitjar et al. (2019) argue, combining the two approaches, of RRI and S3, can drive both growth and build better societies.

Against this background, the following section deepens the discussion carried out in the last section, by first addressing the possible benefits, but also the challenges of systematically integrating RRI into the local innovation and development system.

4.1 Benefits integrating RRI into Regional Innovation Systems

A systematic integration of RRI into the innovation activities and the innovation system of a territory could conceivably yield a range of benefits.

First of all, practicing RRI may help regional policy and individual regional institutions (e.g. businesses, scientific institutions, government agencies) better identify and re-spond to real needs, for instance in the area of the grand challenges or other societal aspects (see for instance Sclove (2016) and his concept of participatory technology assessment or Porter/Kramer (2011) regarding the concept of shared value). What the real societal challenges are in the territory and in what shape or form they articulate themselves is not necessarily obvious to local innovation actors, nor are there necessarily structures or processes in place to identify these needs in a continuous and systematic way. The same goes for possible solutions and local innovation re-sources that may help address these challenges.

Second, RRI can result in better policy and innovation outputs (see for instance Fitjar et al. 2019, and the H2020 "Responsible Industry" project [http://www.responsible-industry.eu]). For instance, by including all relevant stakeholders and taking a more anticipatory/reflexive approach that tries seriously to reckon with the diversity of user/stakeholder needs and perspectives (rather than remaining caught in the innovator's own unexamined and often implicit assumptions) and the potential for wholly unanticipated good and bad impacts and effects to emerge, all the full range of relevant information needed for commercially, environmen-tally and socially sustainable innovations can be more systematically collected and assessed. This approach seems to be particularly relevant for disruptive or risky technologies with a high degree of uncertainty and unknown impacts for citizens or the region as a whole. But it is likely to also be very relevant for innovations or development projects that are to be used by or that affect people with quite different backgrounds and life experiences to the innovators, even if they do not involve particularly disruptive or "risky" technologies. While the overall societal and environmental stakes in the case of failure may be lower, the stakes remain high for the innovators themselves (money, time, reputation, etc.). Anticipatory, inclusive and reflexive innovation strategies can lower the chance of failure, by surfacing more relevant information earlier. Indeed, good practices point to a positive correlation between the degree of the involvement of citizens or interested external experts prior to the launch of R&D&I projects and the later success and acceptance within a broader regional context. Against this background, regulated sand boxes for instance can fulfil the function of both experimenting in the real environment and at the same time gain information on technology acceptance. Thereby, pitfalls, risks and unanticipated negative outcomes can be potentially avoided.

Third, the integration of RRI can contribute to better attention to non-traditional forms of innovations and non-traditional innovators (see for instance Chesbrough et al. 2006, Carayannis et al. 2012). By non-traditional innovators we understand either individual persons/inventors of solutions for daily/regional problems or start-up companies developing new (disruptive) technologies and/or implementing new business concepts. The integration of non-traditional innovators into regional innovation systems can result in mutual and common learning processes, which ultimately contribute to bet-ter outcomes for the territory and the regional innovation system. Generally speaking, the inclusion of different stakeholders or societal groups into the innovation process re-sults

on the one hand in a broadening of the legitimation base, on the other hand con-tributes to innovation as enablers and by providing external expertise and information usually not or too lately considered in the innovation process.

4.2 Challenges of integrating RRI into Regional Innovation Systems

On a practical level, integrating RRI (dimensions) into regional innovation systems can result in several challenges, which have to be taken into account in TetRRIS. As conceptually founded in the previous sections, regional innovation systems tend towards a certain degree of routinized activities – depending on the type of the system (e.g. science driven, production oriented, technology-oriented, dominance of mature industries), the centrality/dominance of different actors in the system, or the degree of regulation or self-organisation. Due to the nature of a system, i.e. strong ties or linkages between the network partners, action typically results in an institutionally stabilized fashion. This includes inherent hindrances when it comes to new activities outside of the commonly agreed routines. RRI and its different dimensions or keys is certainly an example of a new perspective on regional innovation and therefore may result in various likely challenges (see for instance Kuzma/Roberts, 2018, Wittrock et al. 2021):

Challenges rooted in the funding system for projects and in the regional system as such (e.g. no incentives for RRI; no appropriate processes, management tools or driving persons) (Warnke et al. 2016, Wittrock et al. 2021)

RRI is not considered to be an area worth thinking about (from potential project coordinators or the regional management agency); no clear value-add from RRI perceived (e.g. due to its abstract, "academic" terminology, lack of positive prior experiences with RRI) (Ribeiro et al. 2018)

Challenges related to different disciplinary background of acting people (e.g. difficulty of recognising the potential relevance or benefits of RRI) (Wittrock et al. 2021)

One the main challenges of integrating RRI into regional innovation systems can be sys-temic features or hindrances inherent to the respective system itself. Depending on the characteristics of the region and the significance of regional innovation, it may be possible that no incentives for RRI – both on a structural level and regarding individual per-sons as drivers – exist. This assumption is based on the fact that the idea of RRI, including the various operationalising keys/dimensions have emerged as normative concepts from top-down political-academic processes. They did not emerge from bottom-up, practitioner-driven processes, or as practical tools to solve concrete innovation/development-related problems.

Therefore, RRI will likely only be taken up by actors in the territory when it promises to deliver concrete benefits, for instance better societal acceptance of new technologies, innovations or other outputs from practitioners' projects, good experience with regional stakeholder processes, better project results or other long-term goals. On the other hand,

the absence of aspects like (financial) incentives, adequate regional processes or management tools addressing RRI or single persons as "mentors" for RRI may have a negative effect on the current (and future) inclusion of RRI.

Another important aspect or hindrance is related to different disciplinary backgrounds of individual actors leading regional innovation or R&D&I projects. Interdisciplinary project teams can principally be beneficial for the inclusion of RRI, either from within the project consortiums or in the form of external input, for instance provided by the regional innovation agency. However, it remains to be seen in the regional TetRRIS cases whether unilateral projects led by engineers tend to neglect RRI dimension compared to heterogeneous projects teams.

A final challenge relates to the normative and democratic tensions inherent in the idea of inclusion/participation in representative-democratic systems. All variants of RRI place considerable emphasis on the participation/inclusion of citizens in innovation processes and decision-making, mostly treating this as an unproblematic good. However, especially in the regional context the question of who participates (and who does not) can become acute. Subnational territories always stand in relation to and are part of larger polities, whose citizens also have legitimate claims on the direction of regional development/innovation even if they are not currently residing in the territory in question. Industrial and infrastructural development has to take place somewhere. The same goes for new housing or nuclear waste repositories. Representative democratic organs and the larger state structure is organised to take these countervailing claims at least somewhat into account. But that is not necessarily true of participatory processes, unless carefully designed to do so. A challenge for RRI in the regional context is therefore to avoid unwittingly empowering NYMBYism5 – both because this might lead to undesirable outcomes, and because it might erode regional innovation-system actors' willingness to explore and adopt RRI.

The challenges outlined above will be addressed within TetRRIS by not only supporting the regional partners in a more advisory manner, but also empirically and applying adequate methodologies. In this regard, the second deliverable will contain the outcome of the regional mapping exercise (ecosystem mapping) and furthermore will address issues like value constellations, policy discourses and their relationship to RRI. In the medium term, TetRRIS (e.g. in work package 4) will help develop context specific solutions to overcome the challenges, in collaboration with the regional partners. This will be an integral part of the pilot projects and the foreseen qualitative methods of our research. The following section already include several topics outlined above, at least from a conceptual perspective with regard to investigate the respective innovation systems. However, important to note is that the (empirical) concept needs to be kept

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5 „Not In My Back Yard" – unprincipled opposition to development projects or policy measures from local residents motivated by parochial interests (e.g., property prices) who would be quite happy to see the project realised somewhere else – just not in *their* backyard.

flexible and adapted to the regional specifics and thus, takes into consideration the socio-economic context.

5 Integration in Practice: Mapping Territories, Selecting Aspects of RRI, and Adapting Terminology

5.1 General Considerations

How to try to integrate RRI into a territory's innovation and development systems and approaches must be decided in light of the particular circumstances of that territory. The first step must therefore be to "map" the territory's system, to identify who the relevant actors, initiatives and projects are, and what they see as their priorities, problems and concerns. The mapping must also yield an understanding of how the system is configured, how it works and what its larger social-political and cultural context is.

As part of the mapping, TetRRIS partners are advised to try to identify possible connection points between the various aspects and concerns of RRI and the local actors' concerns and priorities. The goal is to find overlaps, where the practice of RRI may make a palpable, positive difference to the local actors, helping them to achieve superior outcomes for their innovation/development endeavours. As part of this, TetRRIS partners are also advised to try to identify which terminology is most useful, locally, to discuss and communicate RRI ideas to local actors. RRI derives and is generally formulated in a professional academic and policy language that is unlikely to be immediately intuitive to local actors. It is therefore likely to be necessary to "translate" the concerns of RRI into language the local actors are more familiar with.

As discussed in Section 3, RRI is a broad concept, encompassing different substantive and processual elements. These often have considerable coherence and even build on each other. Especially Stilgoe et al.'s dimensions can be read as forming a coherent "package", with "anticipation" prompting "reflection" and "inclusion" facilitatating both while they in turn – hopefully – lead to "responsiveness". However, in practice it may be more feasible for TetRRIS partners to ultimately focus on a limited number of RRI aspects (e.g., one substantive goal, like sustainability, and/or a couple of "dimensions" or "keys") rather than all, and (in WPs 3 and 4) develop and implement pilot activities on this more limited number of RRI aspects, rather than on all.

5.2 Using the Mapping Tool

The mapping tool proposed below is to help TetRRIS partners carry out this mapping. The tool consists of two questionnaires.

The first questionnaire focuses more on the macro-level, to help produce a general overview over the territory's innovation system as a whole. The purpose of this questionnaire is to help guide TetRRIS partners' analysis when completing their "mapping reports" (Task 2.2 / Deliverable 2.2). They may complete the questionnaire

themselves, in dialogue with their Regional Partner or other experts, or just use the questions as "background" pointers to help them undertake their analysis in other ways.
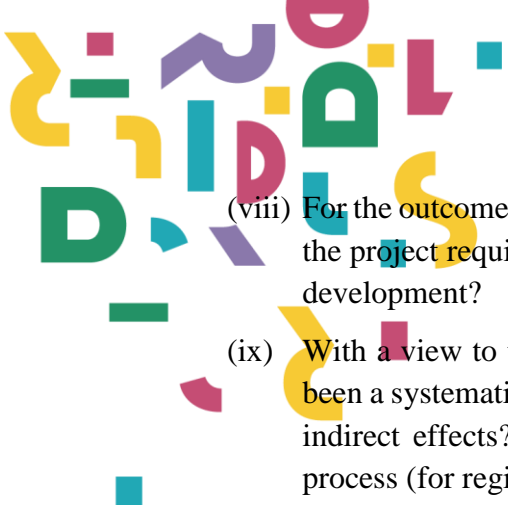
The second questionnaire addresses the project (or company) level, and is to be used to analyse individual innovation projects or initiatives. Its purpose is to help TetRRIS partners understand how the different innovation/development projects of the territory are configured, what level of de-facto RRI may already be occurring in these projects, and especially to identify possible challenges, problems or needs that the local actors have that are relevant to different aspects of RRI. This provides input for the Scoping and Co-Creation activities in WP 3, where pilot RRI activities relevant to the territory and the territory's actors are to be developed, to then be executed in WP 4. Thus, this second questionnaire can be used for interviews or focus groups with local actors, especially local companies or project managers undertaking innovation initiatives.

Both questionnaires consist of a rather long list of questions. TetRRIS partners are not expected to necessarily ask or address every one of these questions in their interviews, focus groups or other mapping activities. Rather, they should use it as a tool box, taking up those lines of questioning they find useful, adding new ones if necessary – while sharing such new questions with the rest of the TetRRIS consortium where feasible – and ignoring those considered irrelevant for local purposes. In particular, partners are also strongly encouraged to modify the language of the questions wherever they think this necessary, so as to best suit the local respondents.

5.3   Mapping Questionnaire 1: The Regional Innovation System

(i)   How is the existing territorial innovation/development system constituted (actors, stakeholders, degree of functionality, special constraints, etc.)? You may want to consider some of the following points:

   a.   Which organisations ('actors') are central for the system? These can include business, public sector, societal actors, education & research, intermediaries, …

   b.   How are tasks ('functions') shared or distributed between actors/orgs?

   c.   What is the industry structure and dominant sectors (e.g. mainly mature industries, new digital industries, energy, agriculture…; strong start-up scene, SMEs, large companies)

   d.   How close are the linkages and relationships between the actors in the system? Are there relatively close links and structures and processes to bring actors together and facilitate exchange between them, or are the actors relatively isolated from each other and maybe even don't know about each others' existence?

e. Are there particularly important relationships to entities (e.g. export markets, companies, institutions) *outside the territory*, that shape the *innovation behavior* of the local actors in important ways?

f. Are there other local stakeholders (or aspects of the local political and societal culture, the local political-societal "landscape") that are perhaps not involved in innovation/development work per se, but impact or shape the behavior of innovation-system actors in the territory in important ways?

(ii) What are the main political-cultural "currents" and attitudes in your territory regarding novel technologies, development and innovation? (Note that multiple, partly corntradictory "subcultures" can co-exist; e.g. a tech-enthusiastic startup scene; a culturally and institutionally influential engineering culture located in major companies and university departments; green movements with techno-sceptical or techno-philiac wings; strong or weak civil-society organisations; entrenched anti-government/anti-authority suspicions in the population; …)

(iii) What is the strategy behind the current structure and performance of the system (funding & financial resources, priorities, focus technologies and innovation, management organisation & staff)?

(iv) Can you structure the different innovation/development projects and initiatives in your territory into different clusters, e.g. projects involving disruptive, novel or "risky" technologies or use cases; projects concerned with public infrastructure; educational projects; "pure R&D" projects without local application/implementation; …? You may want to play around with several different ways of structuring the projects!

(v) Have there been any larger policy/strategy processes in your territory concerned with issues that relate to or operationalise notions of "responsibility"? Examples **could** be **something like** a "Carbon Neutrality by 2035"-goal/process/strategy, a "Demographic Change/'Seniors-friendly Region'"-goal/process/strategy, but also a "Securing Quality Employment during Economic Transition"-goal/process/strategy.

(vi) Have there been any systematic consultative stakeholder processes in the territory? What were the subject(s) of the consultation(s)? Who initiated the consultation(s) and for what purpose? Which groups were included, which not? Which methods (e.g. participatory multi-actor dialogues)? What was the experience with the stakeholder process (main hindrances and possible positive effects assessed in hindsight)?

(vii) Have any of the projects currently (or recently) underway generated tensions with the local population or have there been issues or concerns about technology acceptance? If so, how, and how successfully, was this dealt with? Are there any projects where you anticipate that public acceptance could become an issue? If so, are there any plans for how to address this?

(viii) For the outcome of a given regional project to be widely adopted and accepted, does the project require lobbying activates in the domain of decision making and policy development?

(ix) With a view to the different projects currently implemented or planned, has there been a systematic approach to the possible impacts and effects, including direct and indirect effects? What was your role as a management organisation within this process (for regional partners)?

(x) Did you (the regional partner) as the regional innovation agency or similar body unfold any activities to improve the process and outcomes of the R&I activities in the territory?

(xi) Does your territory's approach to innovation/development include a particular role or focus on sustainability, or other "grand challenges"? If so, what are the formats, how is it done? What are the results and general experience? Do you as the regional agency take on a special role within this process, where appropriate in cooperation with the local universities or non-university research institutes?

(xii) Is there a specific role for open innovation/open science/open access in your territory's approach to innovation/development? If so, what are the formats, how is it done? What are the results and general experience? Do you as the regional agency take on a special role within this process, where appropriate in cooperation with the local universities or non-university research institutes?

(xiii) Will the research and innovation results be actively communicated within the research network (stakeholders) during the regional project(s)?

(xiv) Is specific attention given to diversity issues (for example gender, but also class, ethnicity, etc.) issues in your territory's approach to innovation/development? If so, what gender issues? How are they attended to, and what have the results/experiences been? "Diversity issues" could for example relate to equal representation in executive and advisory bodies, to systematic consideration of female or other perspectives in planning and strategy processes, or to the possibly distinct needs or usage patterns of different genders and social groups.

(xv) Does the territory have organisational arrangements to progressively eliminate barriers impeding women's and different ethnic groups' advancement to top positions and to identify and eliminate factors inducing women (or minority groups) to drop out of innovation activities?

(xvi) Does your territory apply risk identification and risk management strategies to adjust the course of your project(s)?

(xvii) Does the territory actively and continuously include values and normative principles (health, safety, security, privacy, accountability, etc.) in its research, and technological design?

(xviii) Considering the regional determinants of innovation and particularly the individual actors and current projects, what are your ideas regarding how different

RRI Dimensions/Keys might be integrated into regional innovation? Under which circumstances? Are there particular Keys/Dimensions that seem especially relevant to your territory?

(xix) What are your first ideas for pilot actions in your region and underlying dialogue processes and stakeholder relations?

(xx) What are the development/innovation priorities of the actors in the pilot; which projects or initiatives that might be relevant for the later WPs of TetRRIs are taking place, have recently been completed or are planned?

(xxi) Which RRI dimensions may be especially relevant to these initiatives/projects --- how may TetRRIs activities be of interest/made relevant to the local actors: what problems can we solve with/for them?

(xxii) To what extent de facto RRI activities are (or have been) taking place in this context and how they have been framed?

5.4 Mapping Questionnaire 2: (Technology) projects currently implemented or planned

(i) Can you briefly describe the priorities or the main content/research questions of the project?

(ii) Is the aim to develop a commercially-viable product/service (or prototype thereof), to implement an experimental proof-of-concept-type system, to conduct basic or applied research, or to implement a public-sector system or solution (e.g. new infrastructural systems)? Or something else?

(iii) Who leads/owns the project --- a private company, a university/public research organisation, or a public sector agency (or a combination of these)? Who funds it?

(iv) Which is/was the role of the regional innovation agency within the process of the acquisition and current implementation? Which other (regional) partners are involved?

(v) What impact (beyond perhaps company profit) are you hoping for with the project? Are there particular social, environmental or other impacts you hope to produce? What (if any) larger societal or regional problem/challenge are you hoping to help solve through the project? Also, what was the genesis of the project, what led to it?

(vi) More broadly, how do you think about "social or environmental responsibility" in your innovation/development work? What does responsibility mean to you, and how does it concretely influence or shape your work?

(vii) Are societal values (privacy, safety, health, security, data ownership, etc.) actively included in the design process of your regional projects?

(viii) How did you analyse who the users or beneficiaries of the project/project output might be, and how they were likely to use / benefit from the project, what need of

their's the project addressed? Would greater clarity about who the likely and possible users/beneficiaries are and what their needs are/how they might benefit from the project be helpful for your work? How helpful, on a scale 1 – 5? (1 = not very useful; 5 = extremely useful)

(ix)   Did you involve anticipated users in the project and the innovation process in some way (e.g. market research, focus groups, co-design activities)? What was the experience with that? Would increasing user involvement in the project be helpful? How helpful, on a scale 1 – 5?

(x)   Do you use a systematic approach (specified how, when and why) from the beginning within your project to include various stakeholder viewpoints on a wide set of values (technical, social, ethical, legal, etc.)? this can be: (1) include input of end users / customers in the design and development process (2) or from possible non-users / indirect stakeholders (3) or from suppliers (materials and/or knowledge) (4) or from funders / investors (5) or from civil society groups / NGOs (6) or from policy makers How helpful, on a scale 1 – 5?

(xi)   Do you regularly organize group deliberation (employee engagement, trainings, discussions, etc.) on societal / social / public / policy aspects of your regional innovation activities?

(xii) Did you try to involve other groups and stakeholders (beyond the users) in the project or innovation process or try to collect responses and insights from them; e.g. from other companies, researchers, civil society groups, …? If yes, how did you do that (what formats) and what were you trying to achieve? Did it work? What are/were the main hindrances/challenges? Would (further) involving stakeholders *beyond the users* be helpful? Scale 1 – 5.

(xiii) Have you sought to systematically educate outside stakeholders or ordinary citizens about the project, or in some other way tried to systematically contribute to raising the scientific literacy in the population? If so, what was your motivation and context for doing so, and what were the results and your experience? Is this something you would be interested in or that would strike you as helpful for your work? be helpful? Scale 1 – 5.

(xiv) Have "Open Innovation" or "Open Science" approaches influenced your project in some other way? Would you like to learn more about applying Open Innovation principles, would this be helpful? Scale 1 – 5.

(xv)   Within this project, IP in the form of patent applications (from our side) or acquiring licenses (from others) do play a large role? Is the confidentiality of methods and results an issue within this research and development project?

(xvi) Have you considered whether different groups (e.g. women and men, people of different ethnic or class backgrounds, etc.) may use, benefit or be impacted by the project/innovation in different ways? Have diversity-related questions or activities been included in the project in some other way? With what results? Would further exploring these questions be helpful? How helpful? Scale 1 – 5.

(xvii) Is your project "disruptive" or does it involve (what some people consider) "risk technologies"? In what ways and for whom is it disruptive?

(xviii) Are you concerned about popular acceptance of your project/technology/innovation, or of aspects of it? Have there been issues with concerns or even protests from stakeholders, civil society organisations or the general public? If so, did that surprise you? How did you try to deal with that? Was it successful? Would learning more about how to work with technologies that face public acceptance challenges be helpful for you? How helpful, Scale 1 – 5?

(xix) Did you go through a systematic process concerning aspects like (regional) impacts or technology assessment as such, including possible negative impacts? Did you have to do a Data Protection Impact Assessment for the project? Would learning more about how to conduct impact, technology or data protection assessments be helpful? Scale 1 – 5.

(xx) How open is the research frame of your project — is there flexibility for feedback/new information to prompt changes to the project, e.g. redesigning the innovation or even considering new, alternative solutions? Have you structured the project so as to include room to periodically re-evaluate the solution and/or design choices? If so, how is that working? Would learning about how to build greater flexibility for iteration into project structures and project management be helpful? Scale, 1 – 10.

(xxi) What was/is the role of the regional innovation agency regarding aspects like technology risk assessment, impact assessment, systematic stakeholder inclusion process, public understanding of the research activities/acceptance, open science or gender mainstreaming?

(xxii) Do you adopt a learning approach to adapt your innovation according to the viewpoints and ideas of other stakeholders?

(xxiii) Looking at your current projects with the region or addressing regional challenges, what did you learn concerning the above mentioned dimensions of RRI?

(xxiv) What would you improve next time and why?

(xxv) Which RRI dimensions may be especially relevant to your current initiatives/projects - how may TetRRIs activities be of interest/made relevant to you and your project partners - and the local actors: what problems can we solve with/for them?
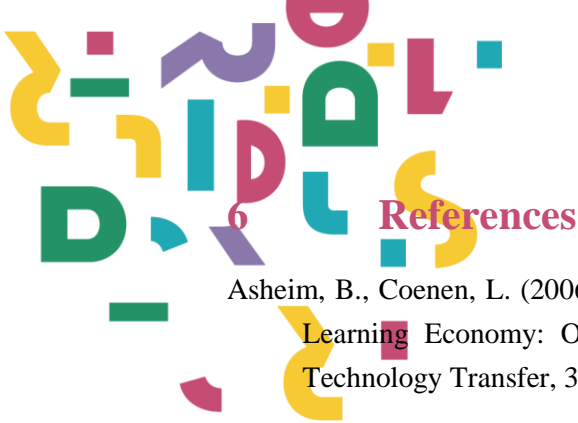
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