Communicating to agency practitioners that 'doing RRI' is imperative: a problem-focussed conceptual framework tested and evaluated in the workshop setting

Ulrich Schoisswohl, independent researcher, Vienna, Austria, European Union
Ulrich Schoisswohl[1], expert for RRI and knowledge & technology transfer, Austrian Research Promotion Agency

ABSTRACT

Communicating the concrete changes RRI means to bring about is a challenge. Conveying that it is indeed imperative that we start doing RRI is a challenge even more so. To close this gap this paper presents a 'problem-focussed conceptual framework' useable for conveying to agency practitioners the realization that doing RRI is imperative. The provided conceptual framework is composed of five explanatory and one systematic account. Practical reasoning underlying the design of the conceptual framework and the results from testing and evaluating the conceptual framework in the workshop setting are provided and reflected upon.

KEYWORDS

Responsible Research and Innovation; wicked problems; conceptual framework for RRI communication; ecosystems; doing RRI as imperative

Introduction

Educated as an astrophysicist, engineer and mediator I've been listening to contributions on Responsible Research and Innovation (RRI) for the past five years and for the greater part of the past two years I've been trying to find a conceptual framework for communicating the imperative of doing RRI to my agency colleagues, others in public administration and my friends and family. Until very recently I pretty much failed. While the ambition of RRI as such was very well received amongst my dialogue partners I did not manage to convey the imperative of actually doing RRI to any of them. The reason, as I found, was that I was focussing too much on informing about different RRI definitions and RRI concepts instead of providing them with a profound understanding of the underlying issues RRI is trying to (re)solve and add what has been learned about these underlying issues on a theoretical level so far. Henceforth I call these underlying issues 'RRI issues' or 'RRI-like issues' and approaches to (re)solve these issues 'RRI approaches' and 'RRI-like approaches'.

The piece you are now reading will provide you with (a) the problem-focussed conceptual framework I am using to convey the imperative for doing RRI in research and innovation funding[2], (b) the practical reasoning underlying the construction of the presented conceptual framework and (c) an evaluation of the performance of the presented conceptual framework in a workshop setting with 15 agency practitioners.

Notes on methodology: employing a post-technocratic approach

Method-wise I want to point out that this is a draft white paper and that I pursue a post-technocratic approach to the creation of understanding (Rutter 2009). I am explicitly not making a claim to formal knowledge but to practical knowledge based on practical reasoning (Fenstermacher 1994). The presented conceptual framework is hence a practice-based conceptual framework which is still in need of further clarification and formalisation. Also, it is entirely intended for the use of communicating the imperative for doing RRI. It is by no means a claim to a new standard model of RRI or an attempt at unifying the diversity of RRI into 'the one concept'.

[1] Email: ulrich.schoisswohl@ffg.at
[2] Please note that I have not yet had the chance to test and evaluate this conceptual framework in science funding.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Practical reasoning underlying the design of the problem-focussed conceptual framework for conveying the imperative of doing RRI

Reviewing and reflecting on a multitude of conversations with agency colleagues and others in public administration, I have come to the conclusion that a consistent conceptual framework for conveying the imperative of doing RRI to dialogue partners from very different walks of life and educational backgrounds, needs to comply with at least the following six requirements.

[R1 requirement]: the content-context-connect requirement

RRI as such is basically unheard of by everyone I talked to, be it my agency colleagues, those I talked to in public administration, my friends or my family. Hence, a conceptual framework needs to provide a clear and easily understandable argument of what RRI aims to bring about (content requirement) as much as what problem it is for (contextual requirement). To be taken up by agency practitioners the conceptual framework needs to enable them to identify already ongoing 'de facto RRI' as well as 'RRI-like activities' and re-contextualize them from within the new problem-focussed conceptual framework (connect requirement).

[R2 requirement]: the simplicity requirement

Agency practitioners work in highly interconnected network-like settings. These settings are highly multi-disciplinary and stretch to a broad range of rather diverse stakeholders. Communicating the imperative to do RRI to agency practitioners hence calls for a conceptual framework based on generally understandable language, notions and concepts. Terminology prevalent in STEM[3] and SSH[4] communities often does not comply with this criteria of general understandability.

[R3 requirement]: the complexity requirement

It is my understanding that RRI aims at addressing issues in which a high degree of social complexity is intertwined with a high degree of technological complexity (for the argument see below). Now, it is my experience that a great many practitioners with an educational background in STEM hold a misinformed imagination of what constitutes social complexity, while a good deal of the practitioners with an educational background in SSH share a misinformed imagination of what makes technological complexity. A plausible reason for misinformed imagination might be that education in STEM focusses on issues of technological complexity while education in SSH focusses on issues of social complexity. To my surprise I found that graduates from spatial planning studies don't seem to suffer to the same extent from misinformed imagination of either social or technological complexity. The obvious reasons are discussed in the 'R4 requirement'. A conceptual framework suitable for agency practitioners hence has to make obvious that there are different types of complexity, enable them to reimagine social and technological complexity and the interrelatedness of both types of complexity in 'RRI issues' and 'RRI-like issues'.

[R4 requirement]: the flexibility requirement

RRI is of different degrees of novelty for different audiences. Some academic and non-academic communities are extensively studying and dealing with 'RRI-like issues' already since the late 70s and early 80s (e.g. Schon; 1973). These communities are profoundly rooted in traditions of working with 'RRI-like approaches'. In addition there have been a number of 'RRI-like approaches' around for some time, take for example Social Labs (Hassan 2014), transition research (Dewald 2014), systems practice (The Omidyar Group, no date), constructive technology assessment (Rip et al. 1995) etc. Members of these communities are hence bound to feel that RRI attempts mostly to put old wine in new skins. The

[3] STEM, abrv. for 'Science, Technology, Engineering and Mathematics'.
[4] SSH, abrv. for 'Social Sciences and Humanities'.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

challenge posed here is to the flexibility of the conceptual framework, which needs to accommodate and acknowledge 'RRI-like' approaches to 'RRI issues' and 'RRI-like issues' as much as genuine RRI.

[R5 requirement]: the accessibility requirement

The R5 requirement connects to the R3 requirement but extends it. The assumption here is that agency practitioners will not start doing RRI if they are not enabled to identify 'RRI issues' and 'RRI-like issues' within their everyday work-life context. Doing RRI, I claim, will come naturally once agency practitioners are capable of accessing the patterns in everyday experience that constitute 'RRI issues' and 'RRI-like issues'. The conceptual framework hence has to include some notion of how 'RRI issues' and 'RRI-like issues' play out on the level of an individuals' subjective experience.

[R6 requirement]: the relevance requirement

For agency practitioners to pick up on a comparably young development such as RRI its relevance for everyday business needs to be demonstrated. Relevance can for example be demonstrated via a profound argument for applicability to everyday business, an obvious need for action, a recourse on relevance to others or fruitful prior application through others.

A problem-focussed conceptual framework composed of six accounts, five explanatory and one systematic

The problem-focussed conceptual framework I use to convey the imperative of doing RRI is composed of five explanatory and one systematic account (A1-A6). The five explanatory accounts (A1-A5) are meant to provide agency practitioners with the information and theoretical background needed to appreciate the systematic account (A6) and trigger the realization that there is indeed an imperative to do RRI.

[A1 explanatory account]: RRI is not a monolith, it is a great many things developed to address four current problem constellations!

To start with: RRI is not this one concept! It is all but a monolith. It is very much an umbrella term for a broad portfolio of very different things which have been mostly carefully tailored to address very specific problem situations and topics (e.g. the development of an ethical framework for telecare technologies for older people at home, EFORTT, FP7 project; an integrated assessment of societal impacts of emerging science and technology within epistemic networks, EPINET, FP7 project; enhancing RRI through curricula in higher education, EnRRICH, H2020 project; etc.). With RRI we are hence very much looking at a box nicely labelled 'RRI' with a multiplicity of tools, concepts, learnings etc. inside.

A crude systemic perspective on RRI

Responsible Research and Innovation (RRI) as a term has been promoted by the Directorate-General for Research and Innovation of the European Commission (DG R&I). Under this term, the DG has funded a broad portfolio of projects. To be precise the Community Research and Development Information Service 'CORDIS' lists 36 projects funded so far via the SwafS[5] program of H2020 with a total EU contribution of EUR 100.701.207,60,- and 35 projects funded via the SiS[6] program of FP7 with a total EU contribution of EUR 100.400.465,00,- (CORDIS 2019). In addition 181 projects were flagged 'RRI' in H2020 in 2012-2017 (Farrer 2019).

It can hence be observed that what started out as a policy idea has over past years quickly turned into an emerging multi-disciplinary multi-stakeholder community researching, developing, testing and

[5] SwafS, abrv. for 'Science with and for Society'.
[6] SiS, abrv. for 'Science in Society'.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

evaluating responsible science and innovation. Currently the RRI community is still very much confined to academic players funded via the framework program (e.g. Austrian Academy of Sciences; Austrian Institute of Technology; Montanuniversität Leoben; Vienna University of Economics and Business), national and European Union science and innovation support systems (e.g. Austrian Research Promotion Agency; Austrian Ministry of Education, Science and Research), a number of non-profit organisations (e.g. European Science Engagement Association, Samariterbund, Science Shop Vienna) and a limited number of RRI front-runners in industry (e.g. Infineon, International Solid Waste Association, Lithoz, voestalpine)[7].

Strategic and operational objectives of RRI

The two strategic objectives of the RRI community are to work towards (SO1) a stronger alignment of science and innovation with the needs, expectations and ethical values of the European citizens (Stilgoe et al. 2013) and (SO2) stewardship of science and innovation towards providing a systemic contribution to the shaping of a sustainable and democratic future society that is economically, ecologically and socially stable for many generations to come (Braun et al. 2018, Deblonde 2015, Dewald 2014, Häussermann et al. 2018). In applying these two strategic objectives to the current situation they translate into the following four operative objectives: (OO1) enhancing the quality of science (Miedema 2019), (OO2) increasing the impact of innovation (EC 2013), (OO3) addressing growing public contestations of scientific knowledge claims (Moedas 2019) and (OO4) developing new scientific methods and innovation logics to tackle todays' societal and global challenges to postmodern technosociety (Häussermann et al. 2018).

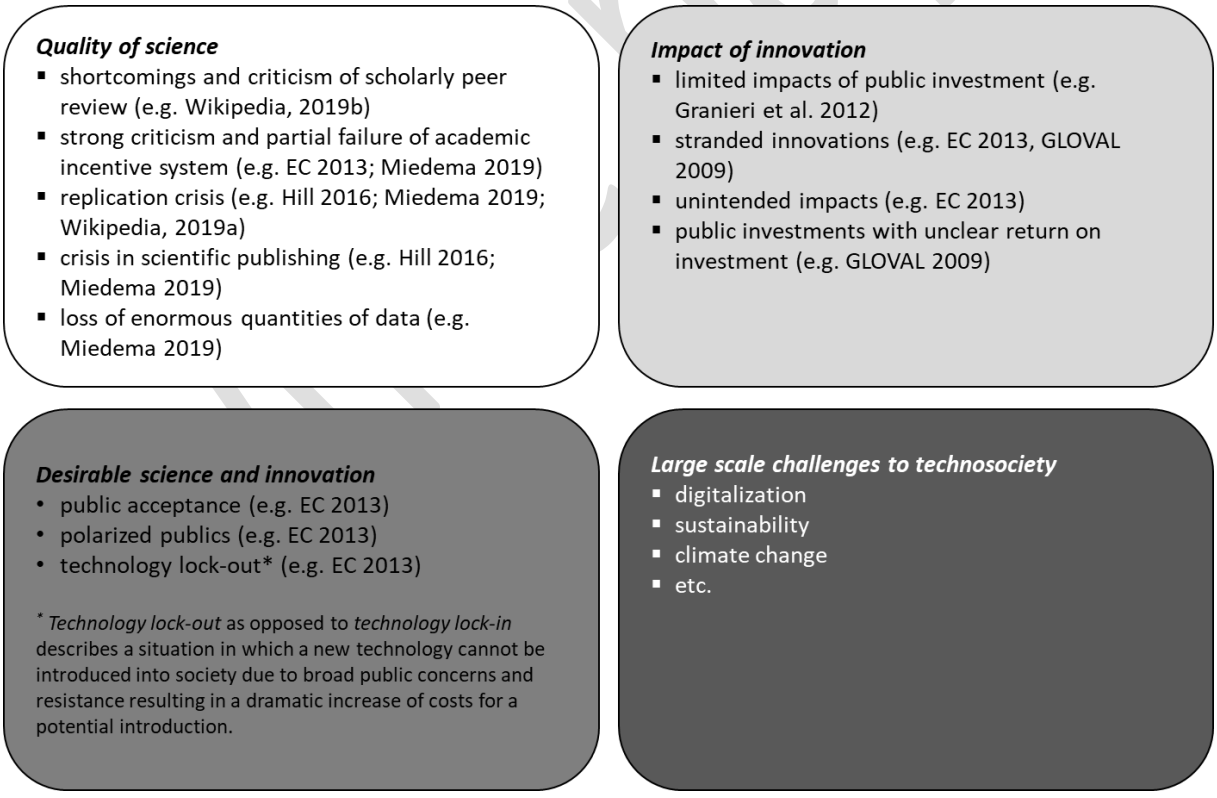

Figure 1: The four problem constellations RRI tries to tackle and the problem situations they are composed of.

[7] Please note that the mentioned organisations are all from Austria, because the workshop was held in Austria.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

The construction zones within the current science and innovation system RRI aims to address

A little context to better understand the four operative objectives of RRI: with the increasing understanding of the technological potentials of the natural sciences in the wake of the second World War European nation states and later the European Union have invested in the development of large scale S&I systems. To date this process has culminated in a combination of well-diversified national S&I systems tailored to national needs and requirements as well as the European Framework Program for Research and Innovation ***Horizon 2020*** and the European Research Area ***ERA*** that is both transnational and open to the world. Since their creation these S&I systems had to be continuously transformed in a large scale learning process shared by scientists, innovators, regulators and public administrators to ensure profound performance in increasingly fragmented and quickly changing contexts.

After decades of seemingly successful transformation towards increased outputs established S&I systems are currently finding themselves under increased scrutiny from within and outside. There are doubts about the actual overall quality of science, the factual impact of funded innovation processes and the desirability of new science and innovation. Beyond that there are growing worries whether the established S&I systems are built to tackle the large scale societal challenges becoming increasingly apparent in past years. Figure 1 provides an overview of the problem situations faced in these four highly interconnected problem constellations.

It is not up to me to go into details here others have done that already far more profoundly than I ever could. Quite on the contrary I want to take a step even further back and ask what these four problem constellations and the 'problem situations' they are composed of have in common. Now, I have already suggested the answer by speaking of problem situations rather than 'problems', but we will come to that later.

[A2 explanatory account]: todays' problem constellations are more similar to ecosystems than to designed systems!

To provide you with an even firmer grip on todays' problem constellations let me exemplify them by taking a look at what makes the difference between a 'designed system' (e.g. a robot, an automated production street etc.) and an 'ecosystem' (e.g. a jungle, the Austrian science and innovation system, etc.), an overview of the differences can be found in Figure 2 (the line of argument is based on Hassan 2014 and Schoisswohl 2017) but mostly based on my professional experience over the past 9 years at the Austrian Research Promotion Agency).

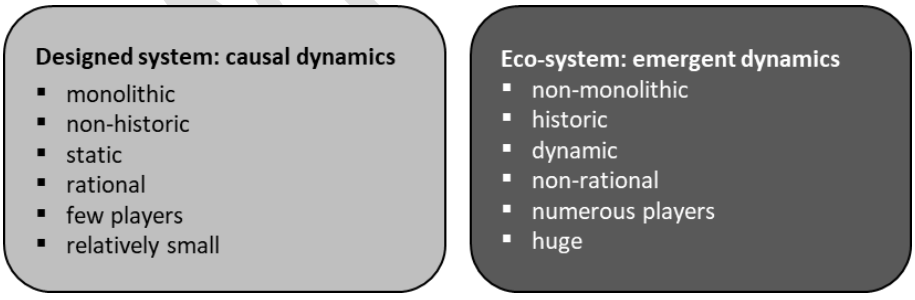

Figure 2: A comparison of the key features of designed systems and ecosystems.

Let's start out by stating that a designed system is 'monolithic' in design and intent while am ecosystem is not. Here monolithic means that a designed system is always being constructed based on one design (or an overarching design architecture) and a limited set of intended use cases in mind. In contrast an ecosystem is 'non-monolithic' because different elements of the system have been constructed based on different designs each intended for a specific intended use in mind and been placed in the

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

ecosystem. As a consequence there is no overall systems architecture beyond what emerges naturally from the use and activity of the individual elements.

A designed system is also 'non-historic'. It is designed and then built. It did not exist before someone put her or his mind to designing and building it. A date can be given for when the design process started and the building process ended, no matter whether these processes were linear or not. An ecosystem on the contrary is 'historic'. There have always been actualities in place which have of course been constantly changing. An ecosystem transforms over time almost beyond recognition, yet still it remains the same ecosystem.

Designed systems remain almost the same over time. They are mostly 'static' once they have been finished. Of course there might be updates, modifications and components exchanged. Ecosystems are characterised by a state of constant flux. They are 'dynamic' in the sense that individual elements are appearing, changing, disappearing and reappearing. This dynamic only stops if the ecosystems themselves or the players inhabiting it die off or leave it for good.

A designed system works the way it is supposed to work. If it doesn't we consider it broken. Once it is understood its actions can be predicted. It is by all means following a clear logic, it is kind of 'rational'. Ecosystems are not. At times they are 'non-rational' beyond imagination. Even if you had utterly understood its logic you could not predict its actions. The simple reason being: people. People are known to take non-rational actions.

If people are involved in the operation of a designed system it is normally only 'few players'. These players are generally highly trained up to a point where they know exactly how to decide and react to assure optimal performance of the designed system. If the designed system doesn't perform as expected it is due to wrong decisions and reactions of the players involved, this is an indicator for human error. A well-functioning ecosystem is home to 'numerous players'. These players often find themselves called up to decide and act in situations they practically don't and theoretically can't thoroughly comprehend. Make no mistake, this is not a personal shortcoming on the side of the players involved it is their human limitations as much as their unique strength that they are capable to decide and act in situations they can't fully comprehend.

A last difference is their scale. Designed systems are 'relatively small' with respect to size and interconnectedness to other designed systems. Ecosystems are 'huge'. If you take for e.g. the Austrian S&I system you are looking at 42.097 FTE[8] distributed over 3.384 companies doing research in 2011 (Schibany et al. 2013). Not counting those working at universities, universities of applied science and RTOs[9].

As a consequence of the above designed systems are 'causal'. It is mostly possible to predict or at least estimate the impact of an intervention. Ecosystems on the contrary are 'emergent'. It is mostly extremely difficult to estimate or even predict the impact of an intervention into an ecosystem.

[A3 explanatory account [10]]: todays' problem constellations seem new yet similar problem constellations have been studied and learned from in the past! (Conklin 2005)

What all four of these problem constellations have in common is that they are interlinked clusters of problem situations rather than individual problems. As a consequence they need to be resolved as

[8] FTE, abrv. for Full Time Equivalent.

[9] RTO, abrv. for Research and Technology Organisation.

[10] The 'A3 explanatory account' and the 'A4 explanatory account' are mostly taken from Jeff Conklin's book 'Dialogue Mapping' (Conklin 2005). To be precise from the chapter 'Wicked Problems and Social Complexity'. I

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

much as solved. Approaches to (re)solve such problem situations were first designed and perused by Horst Rittel and his team over 30 years ago when they encountered ill-structured problems in city planning that could not be sufficiently addressed with traditional planning methods (Rittel et al. 1973). The term 'wicked problem' was coined for these problem situations and a new opportunity-driven approach devised with human relationships and social interactions at its centre. Connections between RRI and wicked problems have been rightfully drawn before (e.g. by Pavie et al. 2014).

Let's have a look at what makes a wicked problem so to better understand what kind of issues RRI addresses.

Six key features of wicked problems

Wicked problems share six key features these are:

1. **You don't understand the problem until you have developed a solution.**
   Every solution that is offered exposes new aspects of the problem, requiring further adjustments of the potential solutions. Indeed, there is no definitive statement of 'the Problem'. The problem is ill-structured, an evolving set of interlocking issues and constraints. Moreover, what 'The Problem' is depends on who you ask – different stakeholders have different views about what the problem is and what constitutes an acceptable solution.
2. **Wicked problems have no stopping rule.**
   Since there is no definitive 'The Problem', there is also no definitive 'The Solution'. The problem solving process ends when you run out of resources, such as time, money, or energy, not when some optimal or 'final and correct' solution emerges. You stop when you have a solution that is 'good enough'.
3. **Solutions to wicked problems are not right or wrong.**
   They are simply 'better, worse, good enough', or 'not good enough'. With wicked problems, the determination of solution quality is not objective. Solutions are assessed in a social context and judgements are likely to vary widely and depend on the stakeholder's independent values and goals.
4. **Every wicked problem is essentially unique and novel.**
   There are so many factors and conditions, all embedded in a dynamic socio-technological context, that no two wicked problems are alike, and the solutions to them will always be custom designed and fitted.
5. **Every solution to a wicked problem is a 'one-shot operation.'**
   Every attempt has consequences. This is the 'Catch 22' about wicked problems: you can't learn about the problem without trying solutions, but every solution you try is expensive and has lasting unintended consequences which are likely to spawn new wicked problems.
6. **Wicked problems have no given alternative solutions.**
   There may be no solutions, or there may be a host of potential solutions that are devised, and another host that are never even thought of. Thus, it is a matter of creativity to devise potential solutions, and a matter of judgement to determine which are valid, which should be pursued and implemented.

Some clarifications on the nature of wicked problems

A problem doesn't have to possess all six characteristics in order to be wicked. Of course not all problems are wicked. In contrast, a 'tame problem' is one for which the traditional non-linear process

sincerely thank Jeff Conklin for his permission to use part of his text here. It is phrased so well that there is really no sense in writing up these arguments again. I have made only small changes and rearrangements to connect his line of reasoning with mine.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

of gathering, analysing, formulating and implementing (often called 'GAFI') is sufficient to produce a workable solution in an acceptable time frame (Conklin 2000). For a comparison between wicked and tame problems see Figure 3. Tame does not mean simple – a tame problem can be very technologically complex.

Mostly one can't tell from the outside if an issue is going to be a wicked problem. Many issues appear tame on the surface, but are indeed wicked once you get into them. There seems to be a natural inclination to see issues as tame, and to avoid the wicked ones. Who wants to take on an issue that, by definition, can't be solved!?

Wicked problems (i.e. problem situations)	Tame problems (i.e. problems)
1. You don't understand the problem situation until you have developed a solution.	1. A well-defined and stable problem statement.
2. No stopping rule.	2. A definite stopping point, i.e. when the solution is reached.
3. Solutions are not right or wrong	3. The solution can be objectively evaluated as right or wrong.
4. Every wicked problem is essentially unique and novel.	4. Every problem belongs to a class of similar problems which are all solved in the same similar way.
5. Every solution is a 'one-shot operation.'	5. Solutions can be easily tried and abandoned.
6. There are no given alternative solutions.	6. Every problem comes with a limited set of alternative solutions.

Figure 3: This table compares the key features of wicked problems with those of tame problems.

As a result, there are two common organizational coping mechanisms that are routinely applied to wicked problems: 'studying' the problem, and 'taming' it.

While 'studying' a novel and complex problem situation is natural and important, it is an approach that will run out of gas quickly if the problem is wicked. Pure study amounts to procrastination, because little can be learned about a wicked problem by objective data gathering and analysis. Wicked problems demand an opportunity-driven approach; they require making decisions, doing experiments, launching pilot programs, testing prototypes, and so on. Study alone leads to more study, and results in the condition known as 'analysis paralysis', a Catch 22 in which we can't take action until we have more information, but we can't get more information until someone takes action.

'Taming' a wicked problem is another very natural and common way of coping with it. Instead of dealing with the full wickedness of the problem situation, one attempts to reduce its inherent complexities in various ways to make it more manageable – to make it solvable! Numerous smart people have come up with clever approaches of how to best reduce these inherent complexities. What these approaches have in common is that while appealing in the short run, they fail in the long run. The wicked problem simply persist as if nothing had been done, transforms into a different guise, aggravates, or worse spawns additional problem situations as wicked or even more so.

[A4 explanatory account [10]]: how to recognize the dynamics underlying 'todays' problem constellations in everyday work-life experiences? (Conklin 2005)

What else is there to know about wicked problems? They are characterized by a high degree of 'fragmentation' which results from the interplay of a problem situation's 'wickedness' as well as 'social complexity' and 'technological complexity' (cp. Figure 4).

'Wickedness' is a property of the problem-solutions space and the cognitive dynamics of exploring that space. '*Social complexity*' on the other hand is a function of the number and diversity of players who

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

are involved in the problem situation. More players and a stronger diversity amongst these players both mean more social complexity. With diversity amongst these players being a consequence of all players having their own individual experience, personality type, style of thinking and learning, disciplinary background and represent organizations with different function, goals and commitments. To make matters even more complicated there is often a structural interrelationship between these players and the organizations they represent or simply work at.

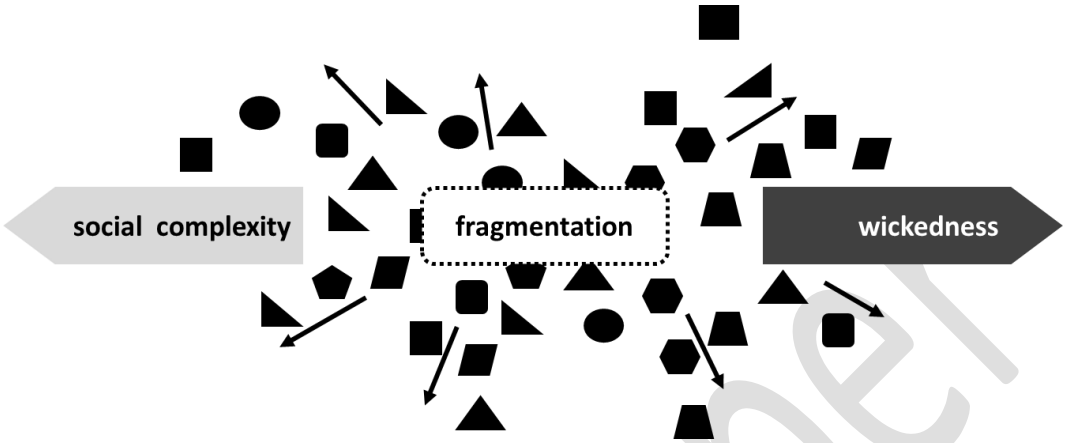

Figure 4: Fragmentation is to be understood as resulting from the interplay of the social complexity and wickedness inherent to a problem situation.

People involved in (re)solving a problem situation with a high degree of wickedness and social complexity (a) tend to see themselves as more separate than united, (b) come to a point where they realize that information and knowledge on the problem situation are chaotic and scattered, (c) have diverging perspectives, understandings and intentions and (d) have tendency to feel that only their version of the problem situation is really correct. Their experience is an 'experience of fragmentation'.

[A5 explanatory account]: how does technological complexity impact on todays' experience of fragmentation?

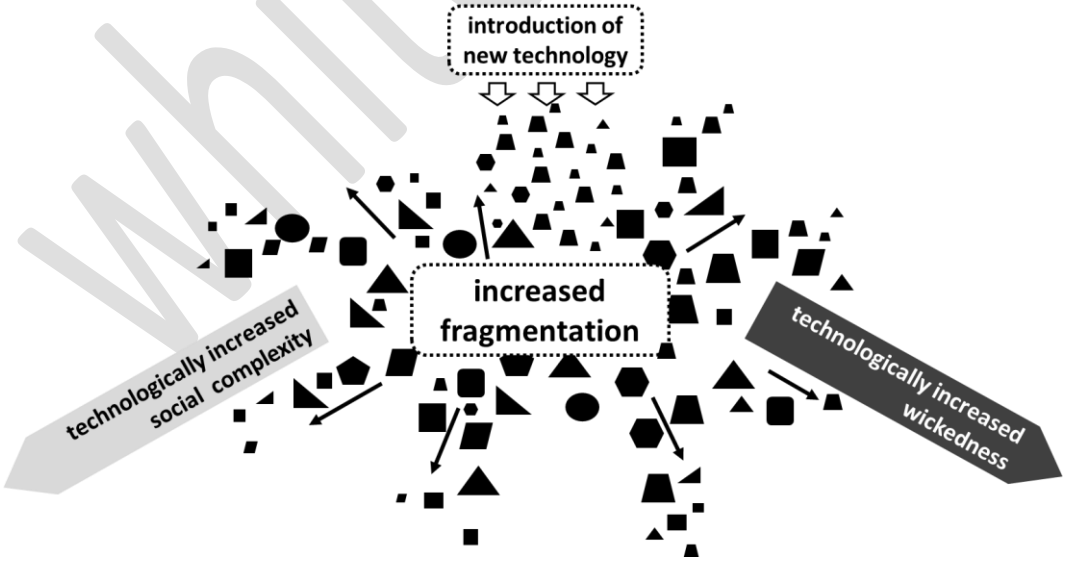

Figure 5: The introduction of new technology into society leads to technologically increased social complexity and wickedness. As a consequence fragmentation increases.

'Technological complexity' aggravates fragmentation coming in from both sides. Firstly, a new technology allows for new 'pathways for action' which did not exist prior to the introduction of that very technology into society. With these new pathways for action emerging, in most cases older more

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

established pathways don't close down. As a consequence the total number of available pathways for action increases resulting in a 'technologically increased wickedness' of the problem situation. Secondly, with new pathways for action available, what happens is that parts of society pick up on these new pathways while others don't. As a consequence (a) new individual experience emerges, (b) people's personality types change, as well as (c) their styles of thinking and learning, (d) new disciplinary backgrounds become established, (e) new organizations with new functions and goals are founded and (f) new structural interrelationships have to be considered. Hence, we are looking at new technological complexity driving postmodern technosociety into a 'technologically increased social complexity' (cp. Figure 5).

Take home messages from working with wicked problems

There are *take home messages* from this: (1) wicked problems cannot be (re)solved solely by the introduction of new technology – because thinking that way is an attempt at taming the problem situation at hand, (2) social complexity cannot and must not be reduced it needs to be incorporated into all (re)solution approaches and (3) the emergence of new unexpected wicked problems is a core dynamic inherent to every technologically innovative postmodern society.

Now, one might ask, and indeed this argument has been made, why not stop or at least decelerate the introduction of new technological artefacts? There are at least five good arguments against this: (1) no-one seriously thinking about this would want it. There would be no new pharmaceuticals or other medical products, no new digital services provided by the government, etc., (2) it is very much counter to the logic and requirements of opportunity-driven global market economy, (3) restricting innovation could seriously damage the institution of democracy as such, (4) to innovate is human. Humans have been innovating since the descended from the trees. The use of tools and fire, the formation of new complex societal structures, the development of new methods, languages and other ways of describing and changing the world around us driven by human creativity is what makes us human, and (5) it would only work by the introduction of extremely complex regulation.

Hence, we have to make peace with the actuality of wicked problems and find ways to at best (re)solve and mediate them or at least mitigate their effects. This is the mission of RRI.

[A6 systematic account]: a systematic account of the space of socio-technological complexity.

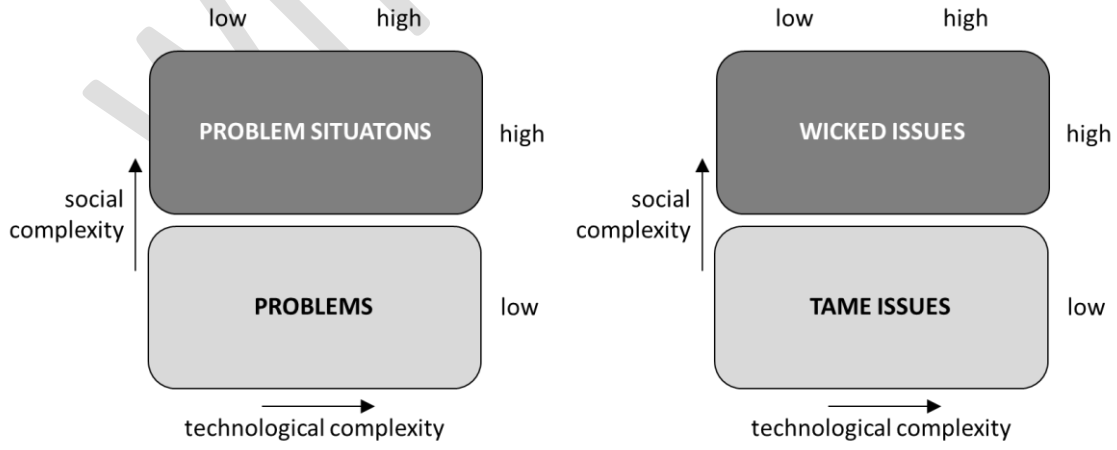

Figure 6: Exploring the space of social and technological complexity. (left) regimes of problem situations and problems. (right) regimes of wicked issues and tame issues.

Let's take a moment to explore the space of socio-technological complexity. To start with let's make a clear distinction between regimes of low and high social complexity. In the former we will henceforth

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

speak of 'problems' and in the latter of 'problem situations' (cp. Figure 6, left). The former are 'tame' the later 'wicked' (cp. Figure 6, right). In a sense problems have a lot in common with designed systems while problem situations share many characteristics with ecosystems. Problems can be solved (e.g. by creating a new designed system), problem situations on the contrary need to be resolved, mediated or mitigated at least as much as they need to be solved.

For illustrative purposes we postulate a crude 'four quadrant model' (cp. Figure 7) to exemplify differences within the space of socio-technological complexity. In quadrant Q1 we have 'tame problems' with a low degree of both social and technological complexity. Examples are: sending an email, cooking dinner, building a table, constructing a footbridge, etc. In quadrant Q2 we have tame problems with a high degree of technological complexity. Let's call these problems 'technologically complex, tame problems'. As stands to reason they are characterized by a low degree of social complexity yet a high degree of technological complexity. Examples are: building the particle accelerator CERN, the fusion reactor ITER, an atomic bomb, etc. In quadrant Q3 issues are characterized by a high degree of social complexity and a low degree of technological complexity. We call these issues 'socially wicked problem situations'. Examples are: negotiating a Nuclear Non-Proliferation treaty, mediating globalization, etc. Most difficult to address are the issues in quadrant Q4. These issues are 'socio-technologically wicked problem situations' which are characterized by both a high degree of social and technological complexity. In quadrant we find emerging as well as prevalent problem situations like digitalization, climate change and other large scale challenges to postmodern technosociety. Technological solution to a tame problem which spawn at least one wicked problem when introduced into society (e.g. gender-biased search algorithms, predictive policing, big data informed insurance rates and efforts at persuasion, etc.) are also located in quadrant Q4.

It is the achievement of science and technology studies to have brought the strong interlinkage of technology and society to our awareness, which led to the discovery, framing and better understanding of the 'socio-technologically wicked problem situations'[11] and the understanding that todays' postmodern society is really a 'technosociety'.

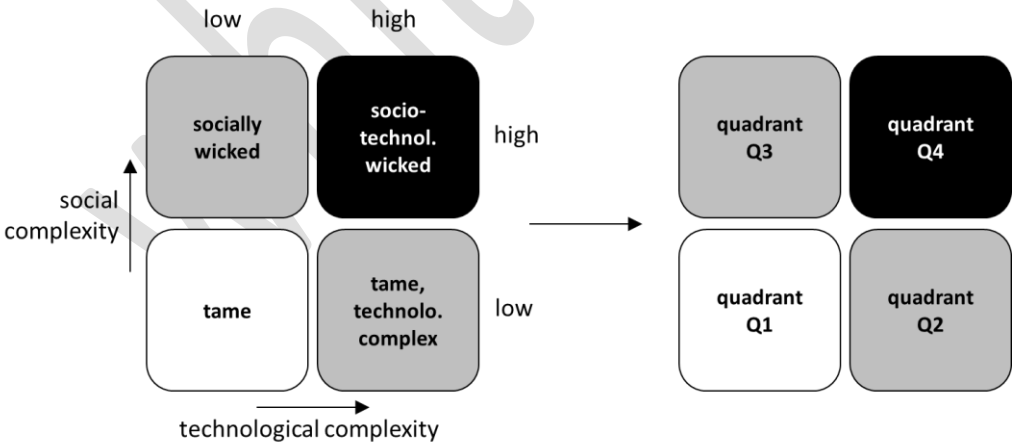

Figure 7: The 'four quadrant model' for the space of socio-technological complexity.

Before we come to the conclusions let me draw your attention to a few last observation: different types of problems and problem situations call for different approaches to (re)solution (*cp.* Figure 8). There are 'opportunity-driven solution approaches' and 'challenge-driven (re)solution approaches'. 'Opportunity-driven solution approaches' work for 'tame problems' which are traditionally addressed

[11] Introducing a new type of problem situation does of course mean that all problems are suddenly of that type now. I think this is where many in STS and queer studies are at fault. It is rather like realising that there distinct problem regimes coexisting of which one has so far be unnoticed.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

through 'problem solving', and 'technologically complex tame problems' which are virtuously tackled by 'science & innovation'. 'Challenge-driven (re) olution approaches' are used to tackle 'socially wicked problem situations' through 'practices and spaces of mediation, negotiation, participation and representation'. The development of 'challenge-driven (re)solution approaches' to address 'socio-technologically wicked problem situations' is still pretty much in its early stages. Yet, what is certain is that we are in need of novel multi-disciplinary, multi-stakeholder approaches based on an integration of science & innovation with practices and spaces of mediation, negotiation, participation & representation. It seems fit to call these approaches 'RRI approaches' and 'RRI-like approaches', while we call the socio-technologically wicked problem situations they are addressing 'RRI issues' or 'RRI-like issues'.

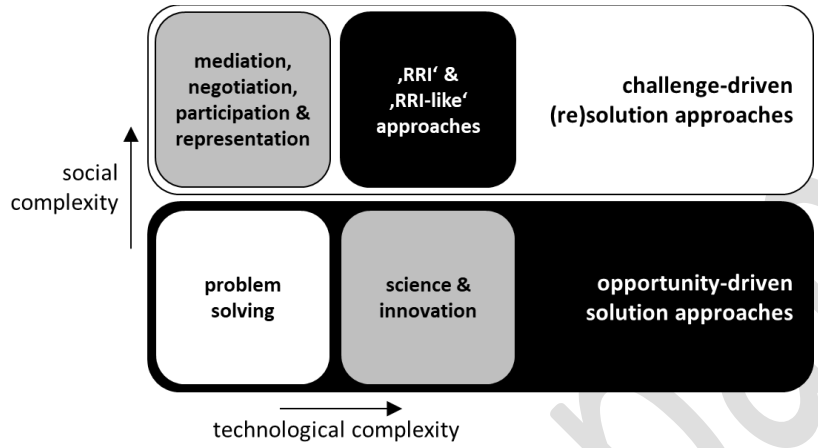

Figure 8: An overview of 'opportunity-driven solution approaches' and 'challenge-driven (re) solution approaches'.

Evaluating the 'problem-focussed conceptual framework' based on testing it in a workshop setting

The 'problem-focussed conceptual framework' for conveying the imperative of doing RRI was tested in a one-day workshop at the Austrian Research Promotion Agency FFG on May 2nd, 2019. The workshop ran under the title 'RRI: imperative or option for national science, research and innovation funding?'[12].

Primary and secondary workshop objectives

Primary objective of the workshop

The primary objective of the workshop was to raise the level of awareness for and understanding of 'RRI issues' within the Austrian Research Promotion Agency FFG. The ambition was to provide the workshop participants with the information and understanding necessary to make a qualified decision on whether RRI was indeed an imperative or just an option for national science, research and innovation funding.

Secondary objective of the workshop

The secondary objective was to evaluate whether the conceptual framework did indeed comply with requirements R1-R6.

[12] Contrary to what the workshop title suggests RRI was not discussed with respect to science funding as no science funders were present to contribute.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Test questions T1-T6 used to evaluate the conceptual framework[13].

To evaluate whether the problem-focussed conceptual framework does indeed fulfil the requirements R1-R6, the following six test questions were designed before the workshop and then evaluated after the workshop based on the workshop experience and documentation. Since I wanted to find out whether the conceptual framework fulfils the requirements the test questions were formulated to call for a simple 'yes' or 'no' answer. I don't see this as a problem, because I still have to provide an argument why I come to a 'yes' or 'no'. Here are the questions:

- **[T1, test question for R1 requirement]:** Does the conceptual framework enable the participants to identify already ongoing 'de facto RRI' and 'RRI-like' activities and recontextualize them from within the conceptual framework?
- **[T2, test question for R2 requirement]:** Is the conceptual framework suitable for the participants no matter their educational background?
- **[T3, test question for R3 requirement]:** Does the conceptual framework enable the reimagination of complexity and the interrelatedness of different types of complexity?
- **[T4, test question for R4 requirement]:** Is the conceptual framework sufficiently flexible to acknowledge 'RRI-like' approaches to 'RRI issues' and 'RRI-like issues'?
- **[T5, test question for R5 requirement]:** Does the conceptual framework enable participants to connect participants abstract reasoning of what constitutes RRI issues with practical understanding of what it is like to experience 'RRI issues'?
- **[T6, test question for R6 requirement]:** Is the conceptual framework suitable to demonstrate relevance of RRI for everyday business?

Workshop participants

Before going into the evaluation of the six test question, let's quickly have a look at the structure of the workshop participants. In total 16 employees (1 moderator, 15 participants) of the Austrian Research Promotion Agency FFG participated in the workshop on May 2nd, 2019 in Vienna, Austria. Of these 15 participants (a) 8 were male and 7 female, (b) 4 were mid-level management, 1 a strategist, 3 European level experts and NCP[14]s to H2020, 7 national level innovation funding experts tasked with bottom-up funding or structural funding and (c) 7 were educated in STEM, 4 in SSH, 2 in spatial planning[15], and 2 in STEM and SSH. See also Figure 9.

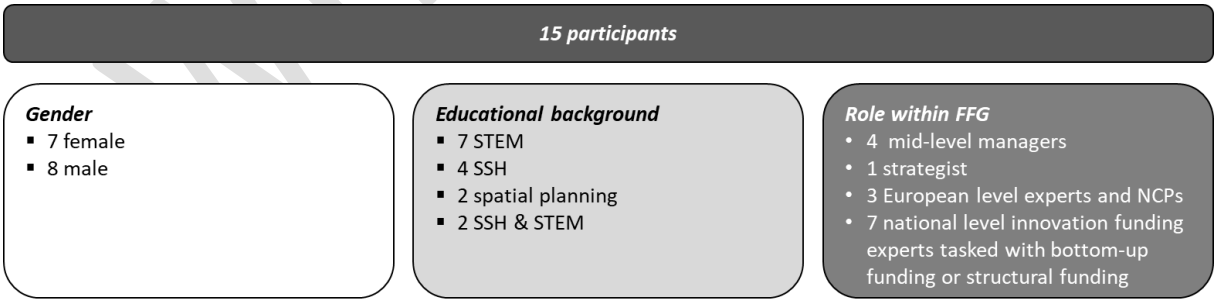

Figure 9: Structure of the workshop participants with respect to gender, educational background and role in FFG.

[13] Documentation and outcomes of the workshop are only partly cleared for publication. Therefore the evaluation of the test questions needs to remain a bit abstract.
[14] NCP to H2020, abrv. for 'National Contact Point to Horizon 2020'.
[15] ‚Spatial planning' is mentioned separately because it is an interdisciplinary field bringing together approaches from SSH and STEM.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Evaluation of test questions T1-T6

[Evaluation of test question T1]: Does the conceptual framework enable the participants to identify already ongoing 'de facto RRI' and 'RRI-like' activities and recontextualize them from within the conceptual framework?

Based on a presentation of the conceptual framework workshop participants were able to, without help, identify five 'de facto RRI' and ten 'RRI-like' activities, all with different degrees of 'RRI-likeness'. They were also able to recontextualize them as challenge-driven (re)solution approaches to underlying 'RRI issues' or 'RRI-like issues'. Test question T1 can be answered with a definitive 'yes'.

[Evaluation of test question T2]: Is the conceptual framework suitable for the participants no matter their educational background?

Based on a sociometric exercise done at the beginning of the workshop 14 out of 15 participants were convinced that they 'knew nothing about RRI' when they started into the day (cp. Figure 10, left). At the end of the day the same participants where asked whether they considered RRI indeed an imperative or just an option for national science, research and innovation funding. The result of this final exercise can be seen in (Figure 10, right). 12 out of 15 participants perceived themselves as sufficiently informed about RRI to voice the opinion that RRI is indeed an imperative for national science, research and innovation funding. Out of the 3 remaining participants 2 had to leave early and 1 either forgot or consciously decided not to voice an opinion.

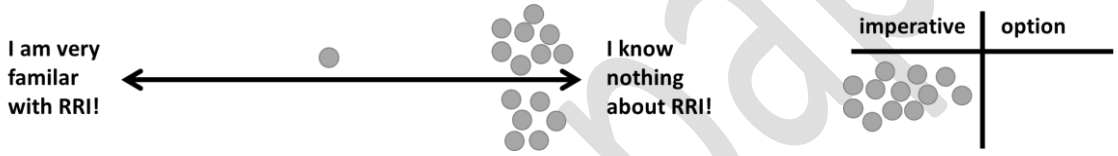

Figure 10: (left) result of sociometric exercise, the question asked was 'How familiar are you with RRI?'. (right) Opinion of the participants at the end of the workshop. The question askes was 'Is RRI indeed an imperative or just an option for national science, research and innovation funding?'.

Process-wise all participants were given a green point that they could glue on a flipchart that looked like Figure 10 (right). The flipchart was positioned in such a way that participants were more or less unobserved and no peer pressure was to be expected.

Based on this result we can assume that the conceptual framework was well perceived independently of the participants educational background and lead to a significant increase in understanding of RRI. Test question T2 can hence also be answered with a 'yes'.

[Evaluation of test question T3]: Does the conceptual framework enable the reimagination of complexity and the interrelatedness of different types of complexity?

To test test question T3 workshop participants were asked to form three groups of five. Each group was then tasked with identifying practical examples for each of the quadrants of the 'four quadrant model' and decide where to position them within the respective quadrants. They were then asked to present the identified examples and, with the assistance of the moderator, position them within the four quadrant model drawn on a pinboard according to their specific degree of technological and social complexity (cp. Figure 11).

Following the discussions in the three groups it was obvious that the participants were mostly interested in identifying and discussing wicked issues. 'Tame, technologically complex' issues seemed to be of little interest. Most participants voiced strong opinions on the exact position of the identified examples within the four quadrant model (Figure 11, filled circles). This triggered a series of brief discussions among the participants. Participants were obviously convinced that they had gained sufficient understanding of the 'four quadrant model' to voice strong claims and defend these claims.

white paper

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

What I find particular noteworthy, and of relevance for evaluating of the test question T3, is that they immediately started to contest the four quadrant model, by identifying issues that had to be positioned in between the four quadrants. They had a clear understanding that some issues that used to be 'socially wicked' are currently transforming into 'socio-technologically wicked' issues (hence moving from quadrant Q3 to Q4) due to the current digital transformation (Figure 11, empty circles). They also found one example each for issues that were (a) utterly in between (Figure 11, empty diamond), (b) used to be 'tame' but are becoming increasingly 'socially wicked' due the current digital transformation (moving from quadrant Q1 to Q3), yet remain technologically simple (Figure 11, empty triangle), or (c) used to be 'tame, technologically complex' and are becoming increasingly 'socio-technologically wicked' (moving from quadrant Q2 to Q4) (Figure 11, empty square).

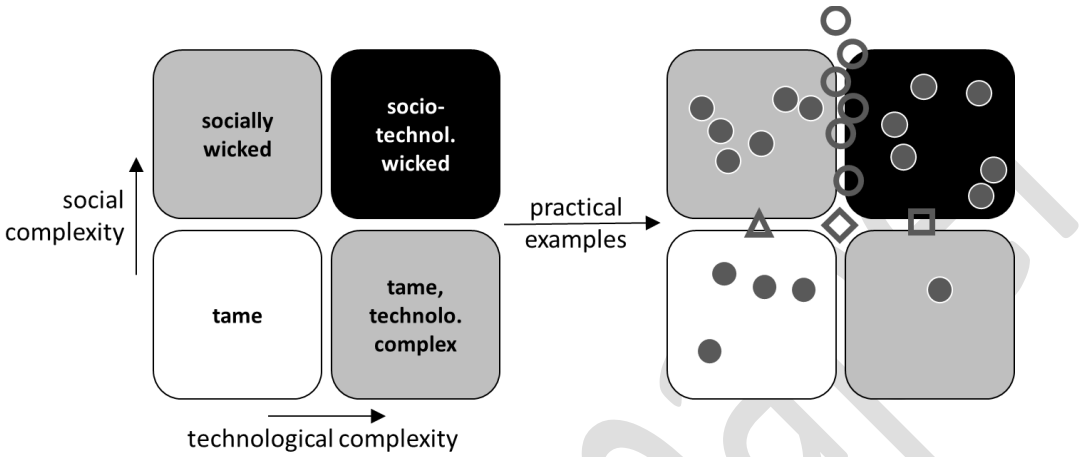

Figure 11: The four quadrant model (left) and the position of the practical examples within the model (right).

I'm personally quite certain that some of the identified examples are positioned in the wrong quadrant or in the wrong spot within the respective quadrant. Still, the presented conceptual framework clearly enabled the participants to (1) identify practical examples for all quadrants, (2) make strong claims on the exact position of these examples within in the four quadrants, (3) defend these claims based on the logic of the conceptual framework and (4) even contest the 'four quadrant model' by identifying and defending examples which they perceive as currently in a process of transition between quadrants. Test question T3 is a clear 'yes'.

[Evaluation of test question T4]: Is the conceptual framework sufficiently flexible to acknowledge 'RRI-like' approaches to 'RRI issues' and 'RRI-like issues'?

All indications suggest that the conceptual framework seems to connect well to the participants reasoning prior to the workshop. None of the participants contested the claim that 'socio-technologically wicked issues' were of a RRI or RRI-like nature. Quite on the contrary they immediately started to reflect and inquire how their understanding of the 'RRI issues' or 'RRI-like issues' they were currently working on could be enriched by recontextualizing them from within the provided conceptual framework. Especially the spatial planers found the conceptual framework very elusive. My conclusions are that (1) the conceptual framework was accepted as an umbrella model for 'RRI activities' and 'RRI-like activities', (2) the claims made by the terms 'RRI issues' and 'RRI-like issues' were accepted, (3) all participants already working on 'RRI issues' or 'RRI-like issues' accepted to be perceived and identified as working on 'RRI issues' or 'RRI-like issues' without being aware of it prior to the workshop and that (4) RRI was still perceived as distinct notion which was significantly more ambitious than the 'RRI-like' approaches they were employing. Test question T4 is definitely a clear 'yes'.

white paper

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

[Evaluation of test question T5]: Does the conceptual framework enable participants to connect participants abstract reasoning of what constitutes RRI issues with practical understanding of what it is like to experience 'RRI issues'?

Reviewing the workshop experience and documentation I am convinced that a certain understanding what constitutes 'RRI issues' and 'RRI-like issues' could be successfully conveyed. Yet, I feel that I failed requirement R5 at least partly and I am simply not convinced that the participants are now capable of realizing it when they experience 'RRI issues' or 'RRI-like issues'. Should I do the workshop again I will include a number of good practice examples for 'RRI issues' including some elaboration of the associated (re)solution approaches. Hence, the test question T5 has to be answered with a moderated 'no'.

[Evaluation of test question T6]: Is the conceptual framework suitable to demonstrate relevance of RRI for everyday business?

There was a clear consensus that bringing RRI into national science, research and innovation funding is an imperative (cp. Figure 10, right). There is also shared understanding that the Austrian Research Promotion Agency FFG is and has been addressing 'RRI issues' and 'RRI-like issues' for quite some time via 'RRI-like approaches' and some 'de facto RRI'. While the relevance of the 'RRI discourse' for agency business was perceived as a given, it seems no yet clear how it translates into factual changes at the level of everyday funding practice. A more profound theoretical understanding and practical piloting of the 'AIRR approach' (Stilgoe et al. 2013) was perceived as a potential first step to bridging this 'relevance-practice gap'. Seems conclusive to say that test question T6 is also at least a moderate 'yes'.

Concluding remarks: assessment of the problem-focussed conceptual framework and steps ahead

It is my assessment that the 'problem-focussed conceptual framework' provided works quite well. Out of the six test questions T1-T6 all but test question T5 score at least a moderate 'yes'. Test question T5 itself scores a moderated 'no'. Of course there is still a lot of room for improvement. A suggestion for one such improvement is give in my above evaluation of test question T5.

With respect to transferability of the presented conceptual framework I am quite sure that it is suited for practitioners in most settings and on most levels of public administration concerned with science and innovation. What remains to be done is of course to test and evaluate whether this is indeed the case. Due to the nature of my employment I will most likely not be able to do this, yet I am more than happy if others show an interest in using and/or evaluating the provided 'problem-focussed conceptual framework'. The presentation I used at the workshop is freely accessible under a creative commons licence on http://newhorrizon.eu/ambassadors. Feel free to use it, please give the proper credit.

To end on a personal note: up to now RRI is a comparably young and still fragile new multi-disciplinary multi-stakeholder specimen thriving in a garden that is still mostly hidden behind academic walls. If RRI manages to endure I am certain we will see it grow strong and powerful, driving its profound integrative participatory roots far beyond the walls of this garden. United in diversity: inspiring courage and rooting inspiration to face the challenges up ahead.

References

Bammé, Arno [2009]: Science and Technology Studies – Ein Überblick. *[A/N; engl.: Science and Technology Studies – An Overview]*. Metropolis-Verlag, Marburg.

Bellinger, Andréa; Krieger, David J. [2006]: ANThology: Ein einführendes Handbuch zur Akteur-Netzwerk-Theorie (Science Studies). *[A/N; engl.: ANThology: an introductory handbook to Actor-Network-Theory].* Transcript Verlag, Bielefeld.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Bernstein, Michael [2016]: Responsible Innovation and Sustainability: Interventions in Education and Training of Scientists and Engineers. Dissertation, Arizona State University.

Bessant, John [2013]: Innovation in the Twenty-First Century. in "Responsible Innovation" by Richard Owen, John Bessant and Maggy Heinz. John Wiley & Sons, Ltd.

Bevir, Mark [2012]: Governance. Oxford University Press, Oxford.

Björnsson, Anette [2019]: Open Science in the European context. Presentation at 'EU networking: Open Science in Horizon 2020 and Horizon Europe', Austrian Research Promotion Agency, Vienna, January 16th, 2019. Affiliation: dHoU Open Science, DG RTG, EC.

Blackburn, Simon [2003]: Ethics. Oxford University Press, Oxford.

Braun, Robert; Griessler, Erich [2018]: For a more democratic European Republic of Science. Journal of Science Communication, September 2018.

Bruce, Steve [2018]: Sociology. Oxford University Press, Oxford.

Conklin, Jeff [2000]: The Age of Design. CogNexus Insitute, https://www.cognexus.org.

Conklin, Jeff [2005]: Dialogue Mapping: Building Shared Understanding of Wicked Problems. Wiley, Chichester – West Sussex.

CORDIS [2019]: EC Community Research and Development Information Service CORDIS. Accessed on April 30th, 2019.

Deblonde, Marian [2015]: Responsible research and innovation: building knowledge arenas for glocal sustainability research. Journal of Responsible Innovation, 2015, Vol. 2, No. 1, 20-38.

Dewald, Ulrich [2014]: Grand challenges, bold concepts – Was kann die RRI-Debatte von der Transitions-Forschung lernen? *[A/N; engl.: Grand challenges, bold concepts – What can the RRI debate learn from transition research?]*. Conference presentation.

DeWoot, Philippe [2017]: Responsible Innovation. Routledge, Oxon & New York.

Dodgson, Mark; Gann, David [2018]: Innovation. Oxford University Press, Oxford.

Eubanks, Virginia [2017]: Automating Inequality. St. Martin's Press, New York.

EC [2013]: Options for Strengthening Responsible Research and Innovation. European Commission, Brussels. Expert Group on the State of Art in Europe on RRI, Directorate-General for Research and Innovation.

Farrer, Linden [2019]: Presentation on SwafS, RRI and beyond at the kick-off meeting of the SUPER_MoRRI project. EC.

Felt, Ulrike et al. [2003]: Taking European knowledge society seriously. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate, Directorate-General for Research, EC.

Felt, Ulrike et al. [2013]: Science in Society: caring for our turbulent times. Science Policy Briefing. European Science Foundation.

Felt, Ulrike; Fochler, Maximilian; Richter, Andreas; Schroeder, Rene; Sigl, Lisa [2018]: How to weave societal responsibility into the fabric of universities. Times Higher Education.

Fenstermacher, Gary D.. [1994]: The knower and the known: The nature of knowledge in research and teaching. Review of Research in Education, 20 (1), 3-56.

Galiay Philippe [2017]: Citizen Science. Presentation given at the 29th KoWi Annual Conference on EU Research & Innovation Funding. EC.

GLOVAL Project [2009]: Global Value Chains as an Emerging Challenge for National and European RTD Policies. EC FP7 project.

Granieri, Massimiliano; Renda, Andrea [2012]: Innovation Law and Policy in the European Union. Towards Horizion 2020. Sxi – Springer for Innovation. Springer-Verlag Italia, Milano.

Hassan, Zaid [2014]: The Social Labs Revolution – a new approach to solving our most complex challenges. Berrett-Koehler Publishers, Inc., San Francisco.

Häussermann, Johann Jakob; Heidingsfelder, Marie; Schroth, Fabian [2018]: Zwischen Normativität und Partizipation – Responsible Innovation als partizipativer Verhandlungsraum. *[A/N; engl.: Between normativity and articipation – Responsible Innovation as a participatory space of negotiation].* TA18 conference of the Austrian Academy of Sciences, 2018. Conference presentation.

White paper

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Hawley, Katherine [2012]: Trust. Oxford University Press, Oxford.

Hill, Kevin [2016]: The Crisis in Scientific Publishing and its Effect on the Admissibility of Technical and Scientific Evidence. 49 J. Marshall L. Rev. 727 (2016)

ICAEW and SAID Business School [2014]: Keywords. Building a language of systems change. ICAEW and Marc Ventresca.

Miedema, Frank [2019]: New incentives and rewards for better and Open Science: 'The Dean's Perspective'. Presentation at 'EU networking: Open Science in Horizon 2020 and Horizon Europe', Austrian Research Promotion Agency, Vienna, January 16th, 2019. Affiliation: UMC Utrecht.

Miller, David [2003]: Political Philosophy. Oxford University Press, Oxford.

Moedas, Carlos [2019]: 'Rekindle the love affair' in 'Views from a continent in flux'. Nature vol. 569, p. 481-482, March 23rd, 2019.

Moon, Jeremy [2014]: Corporate Social Responsibility. Oxford University Press, Oxford.

Monaghan, John [2000]: Social and Cultural Anthropology. Oxford University Press, Oxford.

Nicholson, Craig [2017]: Societal impact gains prominence in FP9. Research Europe, April 6th, 2017.

Ortmann, Günther [2014]: Kunst des Entscheidens. *[A/N; engl.: The Art of Decision Taking].* Velbrück Wissenschaft, Weilserswist.

Owen, Richard; Bessant, John; Heintz, Maggy [2013]: Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society. Wiley, Chichester – West Sussex.

Owen, Richard et al. [2017]: Insights and reflections from National Responsible Research and Innovation Stakeholder Workshops. RRI-Practice consortium.

Pavie, Xavier; Carthy, Daphné [2014]: Addressing the Wicked Problem of Responsible Innovation through Design Thinking. Responsible Innovation. SZTE GTK, Szeged, pp. 13-27.

Pinder, John; Usherwood, Simon [2013]: The European Union. Oxford University Press, Oxford.

Rammel, Stephanie; Hoffmann, Andrea; Halbmayr, Brigitte [2017]: ERA topics dossier 'Social Sciences and Humanities (SSH) in Horizon 2020'. . FFG – Austrian Research Promotion Agency.

Res-AGorA Project [2016]: Navigating Towards Shared Responsibility in Research and Innovation. EC FP7 project.

Rifkin, Jeremy [2004]: Der Europäische Traum: Die Vision einer leisen Supermacht. *[A/N; engl.: The European Dream: How Europe's Vision of the Future is Quietly Eclipsing the American Dream].* Campus Verlag GmbH, Frankfurt/Main.

Rip, Arie et al. [1995]: Managing Technology in Society. The Approach of Constructive Technology Assessment. Pinter Publishers, London.

Rip, Arie [2014]: The past and future of RRI. Life Science, Society and Policy 2014, 10:17. A SpringerOpen Journal.

Rittel, Horst W. J.; Weber, Melvin M. [1973]: Dilemmas in a general theory of planning. Policy Sciences (4), pp. 155-169.

Ruffing, Reiner [2009]: Bruno Latour. Wilhelm Fink GmbH & Co. Verlags-KG, Paderborn.

Rutter, Lynne [2009]: ‚Theory' and 'practice' within HE professional education courses – integration of academic knowledge and experiential knowledge. 6th LDHEN Symposium: Bournemouth University 'The Challenge of Learning Development', April 6th -7th, 2009.

Schibany, Andreas; Ecker, Brigitte; Gassler, Helmut; Reiner, Christian [2013]: IHS – POLICY BRIEF. Ergebnisse der F&E-Erhebung 2011 und Standortqualität. Institute for Advanced Studies Vienna.

Schoisswohl, Ulrich [2017]: NewHoRRIzon:taking RRI from vision to pragmatism. 16th Annual STS Conference Graz 2017 – Critical Issues in Science, Technology and Society Studies. Conference presentation.

Schon, Donald A. [1973]: Beyond the Stable State: Public and Private Learning in a Changing Society. The Norton Library. United States of America.

Simon, Judith [2014]: RRI, TA und die Frage der Verantwortung. *[A/N; engl.: RRI, TA and the question of responsibility].* TA14 conference of the Austrian Academy of Sciences, 2014. Conference presentation.

Stilgoe, Jack; Owen, Richard; Macnaghten, Phil [2013]: Developing a framework for responsible innovation. Research Policy, 2013, Vol. 42, 1568-1580.

The Omidyar Group [no date]: Systems Practice. Creative Commons.

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0

Tiesinga, Hendrik; Berkhout, Remko [2014]: labcraft: How social labs cultivate change through innovation and collaboration. Version 1.2 September 2014, Labcraft Publishing, London & San Francisco.

Tzatzanis, Michalis [2018]: ERA topic dossier on Climate Action in Horizon 2020. FFG – Austrian Research Promotion Agency.

VanDeMark, Brian [2005]: Pandora's Keepers: Nine Men and the Atomic Bomb. Hachette Book Group, New York.

Vandenbroeck, Philippe [2012]: Working with wicked problems. King Baudouin Foundation, Brussels.

Westhead, Paul [2013]: Entrepreneurship. Oxford University Press, Oxford.

Wikipedia [2019a]: Replication crisis. Accessed on April 30th, 2019.

Wikipedia [2019b]: Scholarly peer review. Accessed on April 30th, 2019.

Acknowledgements

There are a number of people I would like to give special credit to because without them the creation of this text would not have been possible. First I would like to thank Stefan Wolf who introduced me to Latours' actor-network-theory and helped me to grasp the experience of it. Harald Leibinger has, for many years, been a profound sounding board for refining my understanding of many things. Pia Weinlinger for helping me reflect on wicked problem situations and the current state of affairs in science & technology studies. Anne Loeber for introducing me to Donald A. Schon and reflecting with me on a potential overall architecture of RRI. Michael Strähle for his insistence that RRI needs to be articulated in a way that is both easily accessible and to the point. Jeff Conklin for his generosity of allowing me to use some of his work. Erich Griessler for drawing me into our joint in-depth RRI experience. Erik Fisher for insisting that I put my thoughts on paper. All my colleagues, friends and familiy who helped through conversation and inquiry.

This publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 741402.

Notes on contributor

Ulrich Schoisswohl works as an expert for knowledge & technology transfer and Responsible Research & Innovation in the division of structural programmes at the Austrian Research Promotion Agency FFG in Vienna, Austria. He holds a MSc in Astrophysics and Astronomy and a PhD in Engineering. Trained as a professional conflict mediator he has a strong interest in issues of cooperation, mediation and negotiation. He is familiar with issues in the scope of Science & Technology Studies, ethics and the philosophy of science.

Miscellanea

The views expressed here are solely the views of the author and may not in any circumstances be regarded as stating an official position of the Austrian Research Promotion Agency.

white paper

Work licensed by Ulrich Schoisswohl under CC BY NC SA 4.0