Conceptions of Responsible Research and Innovation in Funding Processes

A case study of Convergence Environments at the University of Oslo: Life Science

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Abstract

Responsible Research and Innovation (RRI) has become prevalent in contemporary science policy debates and initiatives. This new agenda urges science to contribute to more socially desirable outcomes through deliberative processes which includes relevant stakeholders in research and innovation processes. Although the conceptualization of RRI has been thoroughly elaborated on by scholars during recent years, the question of how RRI is understood and practiced at a micro-level of research practices needs further studies.

The purpose of this case study is two-fold: First, the aim is to understand how RRI is introduced, interpreted and framed in research proposals in a specific research environment. Second, it identifies the challenges this research environment faces when interpreting and framing RRI. To do so the RRI framework in the newly established UiO: Life Science *Convergence Environments* is compared with existing RRI frameworks (Stilgoe, Owen, & Macnaghten, 2013). The thesis subsequently looks at conceptions and framings of RRI of both applicants and reviewers.

The main findings suggest that Responsible Research and Innovation is subject to *interpretive flexibility*, resulting in different RRI conceptions and framings. The interpretive flexibility is evident both in the applications and in the evaluation of these. The thesis also finds that RRI is difficult to discern from research quality, where research quality is seen as a prerequisite for RRI. RRI is reduced to questions about innovation and the potential for societal and technological useful outcomes. Furthermore, stakeholder engagement is often reduced to a notion of science communication, where publics are informed rather than engaged. This study suggests that there is a need for improved efforts to translate RRI from theoretical concepts, to action. It highlights the importance of clear and stable criteria for RRI, and the need to incentivize applicants to deal with the "sticky questions" of RRI. Policy makers, research funders and research environments should be aware of the difficulties of framing and motivating RRI, and how easily the concept is influenced by individual perceptions and institutional mechanisms.

Preface

Growing up, I thought that wisdom comes with age, and that all grown-ups are responsible. If that was true, science would truly be one of the most responsible things in this world. I am however increasingly recognizing that we live in a messy and complex world, where words such as "responsibility" can be attached with a multitude of different meanings. This complexity can inspire us, but also leave us with feelings of apathy. I hope that this thesis will inspire discussions about the role and purpose of RRI, and how we can work towards a socially desirable future.

This thesis owes thanks to a great deal of people who have been directly or indirectly involved in this work. First, I would like to thank my supervisors, Magnus Gulbrandsen and Clare Shelley-Egan for invaluable insights and support throughout the process. To Magnus, your constructive feedback and pragmatism has been very helpful. Clare, your familiarity with RRI and your detailed comments have been precious. Any errors or faults in this thesis are solely my responsibility. I am also grateful to Robin Reistad Fiske for constructive feedback in the last phase of the work.

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I have learned a lot over the last fourteen months. Not the least, I have got to know so many bright and compassionate people. I would like to thank my fellow students at TIK for all of the good times we have had together so far.

Last, I want to thank Maria. Thank you for your unwavering support and for reminding me of the important things in life. Thank you for pushing me to jump into things, and out of planes.

October 2017, Oslo.

Henrik Andersen

List of abbreviations

CE	Convergence Environment
ELSA	Ethical Legal and Social Aspects
ELSI	Ethical, Legal and Social Issues
EPSRC	Engineering and Physical Sciences Research Council, UK
ERC	the European Research Council
HGP	the Human Genome Project
NRC	the Norwegian Research Council
RRI	Responsible Research and Innovation
RTA	Real-Time Technology Assessment
STS	Science and Technology Studies
TA	Technology Assessment
UIO	the University of Oslo
UIO:LS	the University of Oslo: Life Science

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1 Introduction

Modern science is evolving at an extremely fast pace. This rapid evolution comes with novel technologies and applications of science, providing us with ever greater tools to shape ourselves and the world. We live in a knowledge society and a knowledge economy (Ranga & Etzkowitz, 2013), where almost all aspects of human life intersect with science. Science can truly be attributed with much of the social and technological development of modern society.

With great power comes great responsibility. Science has become a debated enterprise. Research on genetically modified organisms and stem cell research are examples of research agendas that spur controversy and socio-political debates. Evermore can be achieved with science, but what should it actually do? And what sort of world do we want science to contribute towards? These questions are not novel, but are now being embedded in science policy in large scale. The need to address these questions has led to the development of Responsible Research and Innovation, most notably known as RRI or RI. RRI is approach to science and innovation that encourages different actors to ensure a collective commitment of care for the future through responsive stewardship of science and innovation in the present (Stilgoe et al., 2013). It seeks to promote more socially desirable outcomes, by opening up discussions about risks, values and norms to a broader set of actors, and by responding to these discussions.

As a "social movement" and a policy discourse, Responsible Research and Innovation has gained increasing importance in research funding processes in research councils in the UK, Norway, and the Netherlands, and as a "cross-cutting issue" in the European Commission Framework Program for Research and Innovation, Horizon2020. Whatever the future might bring for RRI, policy will certainly be marked by it in coming years.

Responsible Research and Innovation serves as a continuation of previous policy discourses revolving around the responsible governance of emerging technologies, such as a variety of forms of *technology assessment, anticipatory governance, upstream public engagement* and *midstream modulation* (Fisher et al., 2006; Rip et al., 1995; Schuurbiers, 2011). Despite an extensive amount of literature on the application of RRI to specific technologies and contexts,

there is still a need to examine what this framework means in practice (Ribeiro, Smith, & Millar, 2017; Wickson & Forsberg, 2015).

1.1 The Case of RRI and Convergence Environments

Although RRI initiatives started out in large scale research bodies, it is now being adopted by more local research environments in higher education institutions. The present thesis will focus on such a case. There is a need to examine how RRI is conceived and operationalized in such a setting, and to report on the present status and provide future directions. An important point of departure for the present thesis is the assumption that it may take time before policy discussions "trickle down" to institutions such as the case studied here. When the *University of Oslo: Life Sciences* (UiO:LS) announced the establishment of *Convergence Environments* they revealed that RRI would be included as a criterion for allocating research funding. This provided a valuable opportunity to study how RRI is understood and operationalized in a higher education research environment.

UiO: Life Sciences has been called the University of Oslo's "greatest commitment ever" (Torheim, 2015). [1] It was established in 2015 and was funded with 200 million NOK, meant for a five-year period. The purpose of The Life Science initiative is to provide "better methods in diagnostics, prevention and treatment of diseases" (Torheim, 2015).[2] It is an ambitious research program that aims to solve challenges through interdisciplinary research. It combines the insights from disciplines such as medicine and biology as the core, supplemented by mathematics, chemistry, pharmacology, physics, and computer science. It also includes researchers from social sciences and the humanities to explore the broader social impacts of science (Torheim, 2015).[3] This interdisciplinarity is thought to be an important way for UiO:LS to gain a world leading position in the field of life sciences.

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[1] Statement by Ole Petter Ottesen, former principal at UiO.
[2] Statement by Ole Petter Ottesen, former principal at UiO.
[3] Statement by Svein Stølen, former chair of the UiO:LS board. Stølen became the principal of UiO the 1st of August 2017.

The strategy for UiO:LS emphasize the role that their research has in solving "The Grand Challenges"[4], as described in the Lund Declaration (Lund Declaration, 2009). These are challenges such as global warming, tightening supplies of water, food and energy, an aging population, public health and more. Many of the Grand Challenges require research in areas such as medicine and biology, which make them a natural target area for UiO:LS. The strategy for UiO: Life Science is also characterized by a focus on convergence and interdisciplinarity. This means that the institution encourages new collaborations among researchers from different disciplines, emphasizing interaction rather than studying problems in isolation (Torheim, 2016).[5] As part of this strategy, the UiO:LS decided to fund Convergence Environments. In May 2016, the director of UiO:LS, Finn-Erik Johansen presented the plans to establish convergence environments under UiO:LS. According to Finn-Erik Johansen, "convergence in research and education involves ground-breaking integration through widespread collaboration between researchers from different disciplines, aiming to create new fields of knowledge, applications and opportunities" (Torheim, 2016). [6]

At the end of September 2016, workshops were held as a preliminary phase for the call for research proposals. The final deadline for research proposals was the 1. March 2017. At the end of April, the research proposals were evaluated by an international board appointed by UiO:LS. Seven convergence environments were selected for funding in May 2017. The Convergence Environments will start during the autumn of 2017.

1.2 Aims and Objectives

The establishment of Convergence Environments at the University of Oslo, and the emphasis on Responsible Research and Innovation represents an exciting opportunity to study the role of RRI

[4] UiO Strategy for the Life Sciences, 2014.
[5] Finn-Erik Johansen, 26. May 2016.
[6] Finn-Erik Johansen, 26. May 2016.

in funding processes. A contemplation was made on what happens when such a research institution adopts RRI, how RRI will be conceptualized, and what function it will serve.

By studying the role of RRI in funding processes, this thesis aims to provide directions for future funding processes. This entails both directions for institutions that fund RRI related projects, and researchers who want to articulate the RRI dimensions of their research. It should also be of interest to researchers that study RRI and its role in research practice.

The study maps how RRI is understood in the Convergence Environments at UiO:LS, and compares such an understanding with other understandings in policy literature and academic literature. To answer this, the thesis will look at how RRI is framed by UiO:LS, how RRI is conceived and integrated in five specific research proposals and in the review process of the research proposals. This is represented under the following research question:

> *How is Responsible Research and Innovation understood in the Convergence Environments, and how is it integrated in the research proposals?*

The present thesis looks both at how RRI is understood, and how it is applied and implemented in research proposals. This includes how activities and configurations of the research are proposed to promote Responsible Research and Innovation. Furthermore, this thesis aims at identifying the challenges that the research environments face in integrating Responsible Research and Innovation into research proposals. It therefore asks whether there are any barriers that challenge the promotion of Responsible Research and Innovation.

1.3 Thesis structure

The thesis will be structured after the main research question, and includes discussion of challenges for RRI in research funding processes. The next chapter presents relevant concepts and debates around Responsible Research and Innovation. It describes where RRI comes from and the direction RRI proposes to move research and innovation processes. The second chapter also includes a critique of RRI and challenges for RRI as an effective and instrumental policy measure.

The third chapter discusses the methods used and the data gathered. The data is based on observations at review meetings, documents i.e. research proposals, and semi-structured interviews with reviewers.

Chapter four presents the empirical and analytical findings. The chapter deals with how RRI was framed by UiO:LS, how the applicants described and implemented RRI in their proposals, and how the reviewers talked about RRI in the review meetings. The empirical and analytical findings are presented together because of the difficulty of applying the data to a strict analytical framework. The empirical data consist of both observations, document studies and interviews, and will therefore be presented in tandem with the analytical findings.

The fifth chapter is a discussion of the central conclusions, implications of the findings, and suggestions for further studies.

2 Literature review

This chapter presents central elements of, and issues relating to Responsible Research and Innovation. It shows that RRI is concerned with the ways in which we govern emerging sciences and technologies, and how we can promote more socially desirable outcomes through these governance processes. There is a dual purpose of this: what we want more of and what we want less of. It aims to diminish risks and negative impacts, and increasing knowledge about the social, ethical, and environmental effects of research and technology. It also aims at harnessing the positive impacts of research and technology, by targeting "grand challenges" and working towards socially desirable futures.

This main part of this chapter presents literature on the motivations and purposes of RRI and its origins. It describes where RRI comes from and where it proposes to move research and innovation practices. It also includes a discussion of what the moral responsibilities of scientists are, and how research funding can affect the cognitive development of science. The purpose of this chapter is to provide a theoretical base from which findings in chapter 4 can be understood and analyzed.

Three sets of questions are central to Responsible Research and Innovation[7]: (i) What kinds of futures do we want science and innovation to contribute to, and what are the right impacts of science and innovation? (ii) How should we proceed in situations of uncertainty and ignorance, to acceptable and desirable ends? And (iii) What are our role responsibilities as scientists, innovators, etc.? And if those responsibilities are institutionally divided, what does this mean? Considering this, RRI is about (a) promoting socially desirable outcomes, (b) finding ways of dealing with risks, and (c) identifying responsibilities to ensure (a) and (b).

Responsible Research and Innovation represents an attempt to politicize research, by increasing the democratic input to research governance by enabling broader participation and reflection about the purpose of publicly funded science (Hartley, Pearce, & Taylor, 2017). Because science involves debates about risks, it also deals with questions about values, and questions about values

[7] Lecture by Prof. Richard Owen at the University of Oslo's Summer School, 31st July to 4th August 2017.

are political. Whereas the output side of science policy is often politicized, the input side has been left depoliticized (Hartley et al., 2017). The output side of science policy becomes politicized when "publics mobilize and participate to challenge policy decisions" (Bang, 2009). The institutional denial of these implicit values in scientific activities is what explains the public's lack of trust in science governance, according to Wynne (2006). He argues that this situation of the public mistrust of science is not a constructive way of governing science. What RRI proposes is that the input side of science should be opened to democratic deliberation, which can result in less controversy on the output side of scientific practices.

Science and innovation are ways of creating futures. This means that the things we do today, are shaping the world of tomorrow. It is increasingly recognized that our way of life and our economic system are putting pressure on the Earth, leaving us with questions about what kind of planet we are passing on to our children. Furthermore, because science and innovation is about techno-visionary futures[8], the public naturally have some interest in what these futures are, how they are decided on, and the way in which they are carried out. This is especially pressing given that scientific- and technological endeavors also come with *risks*. These risks amount to *uncertainty* and *ambiguity* about the outcomes of science and innovation. This urges important questions about how do we deal with this uncertainty and ambiguity, and whether there any ways in which they can be diminished. One answer has been that the risks and benefits of emerging technologies have to be democratically weighed (Sarewitz, 2015). This is where RRI gets off. It deals with how science can be both *with and for society* (Owen et al., 2012), as put by the European Commission[9]. In this sense, RRI delves into important discussions about what we expect from science, and what its role in society is.

RRI can also be viewed as a renegotiation of the *social contract* (Hessels et al., 2009) between science and society. The traditional contract between science and society has provided autonomy to science under the assumption that science contributes to the progress of society. Society provides financial support for scientific activity, and demands something in return, like e.g.

[8] Lecture by Prof. Richard Owen at the University of Oslo's Summer School, 31st July to 4th August 2017.
[9] The "Science with and for Society" program, under Horizon2020. The European Commission.

economic and technological progress. Previous science policies have taken for granted the social desirability of science (Bush, 1945). Vannevar Bush argued that funding of basic science would result in the creation of new industries and jobs, new drugs, military success, improvements in agriculture, and more. Bush's argument is that all of this would benefit society. Responsible Research and Innovation questions the assumption that science is always good, and always socially desirable. Controversies around synthetic biology and genetically modified organisms are examples of science being socially, ethically and politically contested.

There has been an enormous increase in articles about Responsible Research and Innovation over the last couple of years. From 2012 to 2014 the number of peer-reviewed articles on RRI doubled each year (Saille & Medvecky, 2016, p. 3). There has, however, been a tendency of decreasing numbers of proposals and grants referring to RRI since 2016[10]. Although Responsible Research and Innovation is a relatively new research policy, the Journal of Responsible Innovation, and several articles and handbooks address key concepts of RRI and issues related to Responsible Research and Innovation. Central literature in this review is also inspired by the literature list for the University of Oslo Summer School course on Responsible Research and Innovation, held by Prof. Richard Owen[11] and Dr. Sarah Hartley[12].

2.1 Contextualizing Responsible Research and Innovation

The idea of Responsible Research and Innovation derives from work in controversial areas of emerging technologies, such as geoengineering (Stilgoe et al., 2013, p. 1568), nanoscience and nanotechnology (Fisher & Rip, 2013) and synthetic biology (Marris, 2015). Responsible Research and Innovation, and its precursors, have been responses to deficits in risk regulation of such emerging technologies. Emerging technologies often come with few agreed structures or rules on how to govern them, and this results in what has been called an *institutional void* (Hajer,

[10] Literature search presented by Richard Owen at The University of Oslo Summer School, 31. July – 4. August. Literature search of applications and funded grants containing "RI", "RRI", or "AREA framework" keywords.
[11] Professor Richard Owen, Professor of Management, at the time employed at University of Exeter Business School.
[12] Dr. Sarah Hartley, Senior Lecturer in Management, University of Exeter Business School.

2003). The Ethical, Legal and Social Issues (ELSI/ELSA) program is in a sense a precursor to RRI and was established as part of the Human Genome Project (HGP). The goals of ELSI were to anticipate and address the implications of the Human Genome Project, both for individuals and society. The ELSI program was also intended to stimulate public discussion by examining the ELSI consequences of mapping and sequencing the human genome. Interdisciplinarity was therefore an important part of the program, and the HGP included a 5 % funding for social sciences and humanities that would support ELSA research. This embedment of social scientists and humanists is also recognized as an important feature of RRI, as it can serve to catalyze reflection, and modulate research trajectories in response to deliberation (Owen et al., 2012, p. 756).

As noted by Ribeiro et al. (2017), RRI seems to function as an umbrella term for different approaches in the academic literature. Under this umbrella are Science and Technology Studies (STS), Technology Assessment (TA), and Upstream Engagement and Mid-stream modulation. Science and Technology studies (STS) is an interdisciplinary study of the social dimensions of science. It emphasizes the importance of not only studying the technical sides of science and technology, but also its social and political aspects. STS also prompts important discussions about the public understanding of science (Wynne, 1993), the role of scientific expertise (Whatmore, 2009), and issues of science governance. These issues have led to what has been coined the “participatory agenda”. The participatory agenda marks a turn in science policy where the importance of including different stakeholders is increasingly recognized for the responsible and effective governance of science and technology. The participatory agenda presents difficult questions about what public engagement in science means, and what it requires (Delgado et al., 2011). These questions include: why should we do public engagement, who should be involved in it, how should it be organized, when should it be done, and where should it be grounded (Delgado et al., 2011, p. 826).

Technology assessment is an interdisciplinary approach focusing on the social dimensions of technology development (Ribeiro et al., 2017, p. 91). Technology assessment came from a demand for governments and organizations to anticipate the potential impacts of technologies,

and includes a variety of forecasting techniques (Guston & Sarewitz, 2002). These approaches are characterized by:

> *its commitment to what we see as an overall TA philosophy: to reduce the human costs of trial and error learning in society's handling of new technologies, and to do so by anticipating potential impacts and feeding these insights back into decision making, and into actors' strategies* (Schot & Rip, 1997).

In this sense, TA is an important part of what is called "anticipation" in RRI frameworks (Stilgoe et al., 2013). It should also be emphasized that technology assessment implies a relationship with decision making and strategies. This connection with governance is also essential in RRI.

Real-Time Technology Assessment (RTA) proposes research programs that "integrate natural science and engineering investigations with social science and policy research from the outset" (Guston & Sarewitz, 2002). RTA includes methods such as analogical case studies, research program mapping, communication and early warning, and technology assessment and choice. The approach provides mechanisms for "observing, critiquing and influencing social values as they become embedded in innovations" (Guston & Sarewitz, 2002).

Responsible Research and Innovation has become an important focus in research council strategies in the UK, Norway and the Netherlands, and in the European Commission (von Schomberg, 2013). In addition, the Lund Declaration of 2009 called for European research to focus on the "Grand Challenges" of our time to involve stakeholders from both public and private sectors through transparent processes of research and innovation ("Lund Declaration: Europe must focus on the grand challenges of our time," 2009). Five years later, the Rome Declaration called for aligning research and innovation to the needs, values and expectations of society ("Rome Declaration on Responsible Research and Innovation in Europe," 2014). As RRI continues to gain traction, different definitions and understandings of what RRI is and what policy measures it implies continues to evolve. RRI is a concept under constant development. It implies different foci and measures in research, industry and policy. The strength of Responsible Research and Innovation lies in how it unifies and gives political momentum to already articulated ethical and political issues. However, this dynamism and complexity of RRI is also one of its greatest challenges, according to Ribeiro et al. (2017, p. 81). RRI needs to clarify what

it has to offer in practice – beyond what it has contributed so far – and engage with research and institutional cultures of responsibility (Ribeiro et al., 2017, p. 81).

2.2 Three Conceptualizations of Responsible Research and Innovation

As noted by Wickson & Forsberg (2015), there is not one universally accepted definition of RRI. Despite this, three influential articulations of RRI share common characteristics and lines of thought. These are: *the von Schomberg definition*, *the EPSRC definition*, and *the EC definition*.

René von Schomberg, an influential contributor in the European Commission (EC), has defined Responsible Research and Innovations as:

> *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)* (von Schomberg, 2013).

Within the context of the Engineering and Physical Sciences Research Council (EPSRC) in the UK, three British scholars have described RRI as "a collective commitment of care for the future through responsive stewardship of science and innovation in the present" (Stilgoe et al., 2013). The responsive stewardship is defined along four dimensions: anticipation, reflexivity, inclusion, and responsiveness" (Stilgoe et al., 2013). These dimensions are represented through four action-terms called AREA: anticipate, reflect, engage, and act. The EPSRC definition is an approach that invites to learning and configuration of research activities within the framework (Engineering and Physical Sciences Research Council, 2017).

The EPSRC framework emphasizes that Responsible Research and Innovation should continuously seek to:

- Anticipate: Describing and analyzing the impacts, intended or otherwise, (for example economic, social, environmental) that might arise. This does not seek to predict but rather to support an exploration of possible impacts and implications that may otherwise remain uncovered and little discussed.
- Reflect*:* Reflecting on the purposes of, motivations for and potential implications of the research, and the associated uncertainties, areas of ignorance, assumptions, framings, questions, dilemmas and social transformations these may bring.
- Engage*:* Opening up such visions, impacts and questioning to broader deliberation, dialogue, engagement and debate in an inclusive way.
- Act*:* Using these processes to influence the direction and trajectory of the research and innovation process itself.

In 2012, the European Commission (EC) released "Responsible Research and Innovation: Europe's ability to respond to societal challenges". (European Commission, 2012). The European Commission described RRI in the following way:

> *Responsible Research and Innovation means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society. RRI is an ambitious challenge for the creation of a Research and Innovation policy driven by the needs of society and engaging all societal actors via inclusive participatory approaches* (European Commission, 2012).

The European Commission has identified five target keys for RRI in the large-scale funding scheme Horizon2020. In the EC, RRI implies a focus on (1) public engagement, (2) open access, (3) gender, (4) ethics, and (5) science education. It also focuses on (6) integrated actions that e.g. promote institutional change, to foster the uptake of the RRI approach by stakeholders and institutions. The European Commission has also coupled these targets with indicators for each of the RRI keys (European Commission, 2015).

We can identify four common characteristics from these three articulations. Wickson and Forsberg (2015, p. 1164) describe them as follows:

(i) A specific focus on addressing significant societal needs and challenges.
(ii) A research and development process that actively engages and responds to a range of stakeholders
(iii) A concerted effort to anticipate potential problems, identify alternatives, and reflect on underlying values, and
(iv) A willingness from relevant actors to act and adapt according to 1–3.

These articulations also share some other similarities. All three articulations emphasize a *collective* responsibility between different societal actors. RRI does not only introduce restrictions and guidelines for researchers, but for all actors in the science and innovation ecosystem. There is also an increased focus on processes of science and innovation, assuming that RRI needs to deal with the ways in which science and innovation is governed, rather than controlling and governing the outcomes and products.

The three articulations are also different. The EC definition contains target keys which are easier to monitor and evaluate, compared to the two other frameworks. The EPSRC definition focus on four dimensions that are open to interpretation – for example, what does it mean to be inclusive, and when has a research group been inclusive enough? This *interpretive flexibility* is also evident in the von Schomberg definition, where "mutually responsive" is hard to define or measure.

Van Oudheusden (2014) argues that three other characteristics are implicitly or explicitly integrated in definitions of RRI: "A problem definition, moral evaluation, and treatment recommendation". The *problem definition* states that "the introduction of science and technology into society fails when this process and the values it stands for conflict with societal values". The *moral evaluation* states that "societal needs and values need/deserve to be heard". The *treatment recommendation* states that "the scientific, policy and industry communities must solicit society's opinions by listening to what society has to say about science and technology innovations". In this sense, RRI is a normative and evaluative concept with implications for science policy and practice.

2.3 Motivations: Moving towards Transparency, Interactivity and Responsiveness

RRI emerges from a desire to improve the ways in which different aspects of science and technological development are governed (Ribeiro et al. 2017). This governing should include transparent processes, which means that we open up about the purpose, execution and spread of research and innovation. RRI urge for interactive processes that implicitly ask questions regarding the goals of research, who will be involved in said research and how will it be performed, and how will such research benefit society. Science and innovation projects need to include the public and relevant stakeholders, to ensure that the projects promote socially desirable outcomes. This interactive process must be present throughout all stages of projects, to ensure genuine interactive processes that are not just symbolic. Research and innovation also needs to be sensitive to the dimensions of ethical acceptability, sustainability and social desirability, in order to ensure scientific and technological development in a socially desirable way. There are particularly two lines of argument that relate to the motivations for RRI. The first motivation is that "technology development poses a series of risks that might have detrimental effects on environment and society" (Ribeiro et al., 2017, p. 89). These detrimental effects can be unintended consequences, or unforeseen impacts of new developments. That is why RRI emphasizes anticipation. Such consequences must be thought of and dealt with, insofar as one is capable of gazing into the future. Anticipation is also important for the second motivation of RRI. The second motivation is to change the science and innovation governance away from the reactive, to a proactive form of governance. That is why governance is not just occupied with what science should not do, but also what innovation should do (Owen et al., 2012).

Increased engagement with the public and stakeholders is an important way to meet the motivations for RRI. This is important to ensure a proper understanding of how technologies are socially embedded. By including the perspectives of different stakeholders, scientists and innovators can understand better how to reduce the negative impacts and promote the positive effects. Stakeholders are therefore given a more central role in technology development.

2.4 Translating RRI into practice

RRI incorporates already existing sets of tools from a variety of domains. One single unified RRI approach does not exist (Ribeiro et al., 2017, p. 92). Therefore, different techniques and approaches can serve the different purposes of RRI. Stilgoe et al. (2013) provides a useful overview of activities related to the four dimensions of Responsible Research and Innovation.

Figure 1. RRI dimensions, techniques and approaches

Four dimensions of responsible innovation.

Dimension	Indicative techniques and approaches	Factors affecting implementation
Anticipation	Foresight Technology assessment Horizon scanning Scenarios Vision assessment Socio-literary techniques	Engaging with existing imaginaries Participation rather than prediction Plausibility Investment in scenario-building Scientific autonomy and reluctance to anticipate
Reflexivity	Multidisciplinary collaboration and training Embedded social scientists and ethicists in laboratories Ethical technology assessment Codes of conduct Moratoriums	Rethinking moral division of labour Enlarging or redefining role responsibilities Reflexive capacity among scientists and within institutions Connections made between research practice and governance
Inclusion	Consensus conferences Citizens' juries and panels Focus groups Science shops Deliberative mapping Deliberative polling Lay membership of expert bodies User-centred design Open innovation	Questionable legitimacy of deliberative exercises Need for clarity about, purposes of and motivation for dialogue Deliberation on framing assumptions Ability to consider power imbalances Ability to interrogate the social and ethical stakes associated with new science and technology Quality of dialogue as a learning exercise
Responsiveness	Constitution of grand challenges and thematic research programmes Regulation Standards Open access and other mechanisms of transparency Niche management[a] Value-sensitive design Moratoriums Stage-gates[b] Alternative intellectual property regimes	Strategic policies and technology 'roadmaps' Science-policy culture Institutional structure Prevailing policy discourses Institutional cultures Institutional leadership Openness and transparency Intellectual property regimes Technological standards

Figure 1: (Stilgoe et al., 2013, p. 1573)

Responsible research and innovation can be concerned with the products, processes or purposes of innovation (Stilgoe et al., 2013, p. 1570). The products of innovation can be scrutinized based on their potential social, environmental and economic effects. The processes need to be reflexive on how the research and innovation process is envisioned, and who are included in the process. The purposes of projects can be questioned on the grounds of what its motivations are, and whether they are socially desirable. RRI also ask questions about governance. In this case study, processes, purposes and governance are relevant, when the research is in a planning phase. To

address these questions, Stilgoe et al. (2013) introduce four dimensions to discuss and address the questions. These dimensions are: *anticipation, reflexivity, inclusion and responsiveness*. As explained by the authors, these dimensions overlap, and should be treated as integrated elements of RRI (Stilgoe et al., 2013).

Anticipation

Anticipation is in a sense about gazing into the future. This form of future-gazing is especially difficult, because it not only involves predictions about the natural world, but also social and political dimensions of science and innovation. These dimensions important because previous top-down risk-based models are not capable of fully encapsulating the social, ethical and political stakes associated with techno-scientific advances (Stilgoe et al., 2013). Anticipation is also something more than just risk management and precaution. As Jack Stilgoe comments:

> *Precaution, as seen in environmental risk management, connotes acting to avoid predicted but uncertain hazards. Anticipation, in contrast, denotes building the capacity to respond to unpredicted and unpredictable risks. (…) Giving up on prediction does not mean giving up on anticipation. We must exercise the various intellectual and imaginative capacities that will prepare us for the challenges that innovation will surely offer* (Stilgoe, 2014).

The future-gazing aspect of RRI urges scientists to ask "what if…?" questions to consider what is known, what is likely, what is plausible, and what is possible (Stilgoe et al., 2013). It includes perspectives of risks where we ask questions about a technology's function, its known and unknown side-effects, and how we can increase our knowledge of these side-effects. It opens up for questions with a social perspective on who is likely to benefit from it and not. It also urges ethical reflection on issues that come with the development, use, and dissemination of the technology. RRI also deals with bodies of knowledge and not just technologies. Research can be used in several ways, and often result in dual-use research and technologies. In 2012, controversies arose over the publishing of potentially dangerous flu virus research (Kaiser & Moreno, 2012). Arguments were made for the importance of publishing these results, e.g. to enable the development of strategies for pandemic outbreaks. However, others argued that the

research could also result in bioterrorism. Some might see this controversy as an argument for more anticipatory research practices.

According to Stilgoe et al. (2013, p. 1571), anticipatory capacities can be strengthened through techniques such as *upstream public engagement* and *constructive technology assessment.* These techniques involve anticipatory discussions of possible and desirable futures. *Real-Time technology assessment* can also be called *anticipatory governance* (Guston & Sarewitz, 2002). A crucial aspect of anticipation is that the processes that ensure anticipation are well-timed. They need to be early enough to be constructive, but also late enough to be meaningful.

Reflexivity

Stilgoe et al. (2013, p. 1571) argue that there is a need for *institutional reflexivity* in the governance of emerging technologies. This reflexivity can be explained as "holding up a mirror to one's own activities, commitments and assumptions, being aware of the limits of knowledge and being mindful that a particular framing of an issue may not be universally held" (Stilgoe et al., 2013, p. 1571). This reflexivity should be found both at the level of individual actors, such as scientists, but also at the institutional level. Relevant institutions can be higher education institutions, like UiO or research funding agencies such as the Norwegian Research Council. Scientists are used to being reflexive on some levels. They must be critical of how their research positions itself in the respective discipline, and be self-critical of their findings and conclusions. The reflexivity posed in Responsible Research and Innovation goes beyond this. It is a form of second-order reflexivity (Schuurbiers, 2011) where responsibility makes reflexivity a public matter (Wynne, 2011), and not just an intra-organizational matter. This urges actors and institutions to go beyond the normal reflexivity, to perspectives about the role of science in society.

To build this second-order reflexivity, useful measures can be the development of codes of conduct, the use of moratoriums, and the adaption of standards (Stilgoe et al., 2013, p. 1571). Moratoriums are temporary prohibitions of an activity. Typically, research is put to a halt because of controversy, risks, or fear of undesirable consequences. In 2015 a moratorium was established on edits to the Human Genome (Wade, 2015). The National Academy of Sciences in the United

States, among others, held a conference where they stated that it would be "irresponsible to proceed until the risks could be better assessed" and there was a "broad social consensus about the appropriateness" of any change[13] (Wade, 2015). It should be noted that moratoriums represent a drastic measure on research processes. Scientists don't want to put their research to a halt, but research can become socially and politically contested. The lack of knowledge of risks and effects of the research can make it irresponsible to proceed with the same research agenda. Another approach has been to include social scientists and philosophers in the work of natural scientists. Social scientists and philosophers can contribute to "reflections of natural scientists on the socio-ethical context of their work" (Schuurbiers, 2011, p. 769).

Inclusion

The inclusion of new voices in the governance of science and innovation is an important part of Responsible Research and Innovation (Stilgoe et al., 2013, p. 1571). Stakeholder engagement has gained increasing attention, as the authority of the expert and top-down policy making has been increasingly challenged. This has led to new deliberative forums that go beyond stakeholder engagement, and increasingly includes the wider public in debates about science and innovation. These deliberative forums can manifest in consensus conferences, citizen juries, deliberative mapping, deliberative polling and focus groups (Chilvers, 2012). Multi-stakeholder partnerships, forums, and including lay members in scientific advisory committees are also ways in which input to governance can be diversified (Stilgoe et al., 2013, p. 1571). The inclusive methods mentioned above have been criticized by scholars (e.g. Horlick-Jones et al., 2007; Kerr, Cunningham-Burley, & Tutton, 2007; Rothstein, 2007), because stakeholder engagement is not a good in itself.

Engagement processes needs to have certain characteristics in order to be effective. One way to evaluate how inclusive the approaches are is through three criteria (Callon, Lascoumes, & Barthe, 2009): *intensity*, *openness*, and *quality*. Intensity is related to how early members of the public are included and how much care is given to the composition of the discussion group. Openness is

[13]Statement by the international group of experts, led by David Baltimore, former president of the California Institute of Technology.

related to how diverse the group is and who is included in the group. Quality is related to the gravity and continuity of the discussions (Stilgoe et al., 2013, p. 1572).

Responsiveness

Responsiveness means that science and innovation must respond to the questions that derive from anticipation, reflexivity and inclusion. If the research and innovation communities do not respond to the feedback from stakeholder engagement, RRI becomes a cover-up – a procedure to be followed, but has no real consequences for how the research and innovation activities are performed. As formulated by Stilgoe et al. (2013, p. 1572), "Responsible Research and Innovation requires a capacity to change shape or direction in response to stakeholder and public values and changing circumstances". Facilitating this responsiveness can be a great challenge. As research projects often have pre-defined goals, scientists need to think of how these plans can be changed in light of feedback from stakeholders and the public. That is why one should think of how systems of innovation can be shaped to be as responsive as possible (Stilgoe et al., 2013, p. 1572). For RRI to be responsive, it needs to know what to respond to. One important direction for responsiveness has been to focus on societal challenges (von Schomberg, 2013). These challenges are often framed as Grand Challenges and align with previously existing objectives in governing organizations such as the European Union. Issues related to health, environment, energy supply etc. can provide direction for responsive research programs. To ensure a responsive RRI, several mechanisms can be put to use. An application of the precautionary principle, moratoriums, value-sensitive design and codes of conduct are just some ways in which research and innovation can become more responsive.

What are the moral responsibilities of scientists?

As RRI involves a re-negotiation of scientists' responsibilities, it is timely to address what the basis of such a re-negotiation is. RRI takes for granted that scientists have responsibilities beyond their roles as scientists (Fisher & Rip, 2013). They also have general and social responsibilities. As argued by Douglas (2003), the moral responsibilities of scientists consist of both *role responsibilities* and *general responsibilities*. The role responsibilities of scientists are oriented around the scientific goal of developing knowledge about the world (Douglas, 2003). Other

expectations also derive from this goal: Scientists should be honest in reporting data, and results should be shared with the scientific community, scientists should respond to valid criticism, and scientists are expected to serve as peer-reviewers of fellow scientists' work. The general responsibilities of scientists are related to the intended and unintended consequences of their work. There are two ways in which scientists can be responsible for these consequences: (i) Through negligence, or (ii) through recklessness. Moral actors are negligent when they are uninformed about the consequences of their actions, and they are reckless when they act despite knowing about the unacceptable risks of their actions. In this sense, scientists are responsible for the intended and unintended social, ethical, political and economic consequences of their work.

Some might object to this notion of responsibility, arguing that science should be treated as a protected space, concerned with the development of knowledge and without responsibilities beyond this. The problem with such a notion of responsibility is that it results in a *responsibility gap*. The responsibility gap describes a situation where single actors can act responsibly, but where the sum of all their actions are irresponsible. Beck (1995) has defined this as "organized irresponsibility".

2.5 Funding processes and its effects on the cognitive development of science

Scientists have asked whether external demands influence the cognitive development of science, or if science is "immune" to such influences. One view has been that science is so differentiated into specialized and knowledge-intensive units that it escapes such external inferences (Braun, 1998). Braun (1998) argues that "the interplay of structures, norms and interests" is important in explaining "the multi-level and complex decision-making processes in funding agencies". Furthermore, Braun argues that "influencing the cognitive development of science is not a direct and linear relationship between the will of external actors and what scientists think and do, but rather a mediated and indirect relationship" (Braun, 1998, p. 808).

Funding agencies can therefore influence the cognitive development of science through the distribution of economic capital: "whoever has authority over the distribution of economic

capital, therefore, obtains, in due consequence, at least indirectly and partially, influence on the cognitive development of science" (Braun, 1998, p. 809). Those who distribute economic capital can influence *what* is being investigated and by *whom.* There are mainly two important ways in which funding criteria can influence RRI framings and understandings. First, through definitions of what constitutes the central elements of Responsible Research and Innovation. Secondly, through the funding of specific ways of doing RRI. By including RRI as a funding criterion, funding agencies can nudge the cognitive development of science in a direction where societal concerns are embedded in research proposals. It is therefore important not to just put RRI on the agenda of research funding, but also the way in which this is done.

2.6 Critique of and challenges for RRI

Responsible Research and Innovation can be criticized for its *interpretive flexibility* (Wickson & Carew, 2014). Interpretive flexibility means that a concept has different meanings for different groups of people. Some groups of people might understand RRI as working towards economic growth and increased productivity, while other group see RRI as entailing dematerialization and economic stagnation. In this sense, RRI can contain very different meanings for science policy advisors, scientists, and innovators. In addition to this, people are heuristically predisposed to be in favor of Responsible Research and Innovation. Who would not want research and innovation to be responsible? This makes it easy to agree with the motivations of RRI, but that does not guarantee a commitment to more reflexive, inclusive and anticipatory research and innovation processes. RRI then becomes a concept that is easy to agree with, but hard to follow.

This chapter has devoted attention to some challenges that face RRI as a concept and a movement. RRI is interpretively flexible with a heuristically positive predisposition towards the concept, and it is easily closed down by institutional mechanisms. Because of this, I expect to find different conceptions and integrations of RRI in research proposals. The purpose of this chapter has been to provide a theoretical base from which conceptions and integrations of RRI in research proposals can be discussed. The framework by Stilgoe et al. (2013) about purposes, motivations and translations into practice, will provide an analytical framework in which the empirical findings can be analyzed.

3 Methodology

This thesis is a qualitative study on how research environments understand and operationalize a concept in their research. Because it is a qualitative study, it involves an "interpretive, naturalistic approach to the world" (Ritchie & Lewis, 2003, p. 3). This means that the thesis will "…study things in their natural setting, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" (Ritchie & Lewis, 2003, p. 3). We are concerned with what Iain Hay calls "elucidating human environments and human experiences within a variety of frameworks (Hay, 2016, p. 5). A qualitative approach is useful when studying a "real-world setting" (Yin, 2011, p. 3), in which facts and understandings are negotiated and re-negotiated between individuals.

The qualitative approach differs from other approaches in terms of what kinds of answers it might provide. "Unlike quantitative researchers who seek causal determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations" (Golafshani, 2003, p. 600). This thesis therefore aims to understand circumstances around, and conceptions of RRI, rather than generalizing and predicting future events and understandings. Qualitative methods are defined in many ways by different scholars. One fruitful way to understand qualitative research is to understand its features. Robert Yin identifies five features of qualitative studies (Yin, 2011, pp. 7–8):

(i) Studying the meaning of people's lives, under real-world conditions;
(ii) Representing the views and perspectives of the people in a study;
(iii) Covering the contextual conditions within which people live;
(iv) Contributing insights into existing or emerging concepts that may help to *explain* human social behavior; and
(v) Striving to use multiple sources of evidence rather than relying on a single source alone.

These five features correspond with the ambition of the research question. Frist, the thesis studies the actual individuals in the case study, and not an "ideal scientist" or any other stereotypical

scientist. Second, the study focuses on the views and perspectives of the applicants and evaluators in the Convergence Environments, and not on "the values, preconceptions, or meanings" (Yin, 2011, p. 8) held by me as a researcher. The study also describes the context that the scientists are confined to. This includes social and institutional conditions, such as those pertaining to UiO:LS, or life science research in general, which are assumed to affect human action (Yin, 2011, p. 8) and, I propose, cognitive frameworks. These social and institutional conditions can include, but are not restricted to, perceptions of Responsible Research and Innovation, and the demand for universities to contribute to solving grand challenges. The qualitative study can also be useful to develop new concepts or to evaluate existing concepts. Lastly, this study uses a multitude of sources to extrapolate from, documents, observations and interviews.

I have chosen to use a qualitative approach for the present thesis. Other methods could however have been utilized. A survey or questionnaire could have provided more quantifiable answers, and an economic analysis could have been used to indicate the financial effect of RRI in the research environments. An analysis of the funding could have provided some indications about the role and importance of RRI in the applications. However, it would not have provided nuances into the conceptions of RRI as a concept that a qualitative case study provides. Because of this methodological advantage, the qualitative approach was favored over other alternative approaches.

The most common methods used in qualitative research are observations and interviews (Golafshani, 2003, p. 600). A qualitative approach means that I embrace the involvement and role within the research, instead of distancing myself from it (Golafshani, 2003). I must get involved with the material that I am studying to gain access to the relevant data, and to identify institutional conditions and individual experiences. This can be both an effective and challenging approach, as will be elaborated on in the next sub-chapters.

3.1 Qualitative Case Study

According to Yin (2014), studies that start with "how" and "why" questions are favorable for case studies. "How" and "why" questions typically motivate intensive studies of a particular phenomenon or situation. The qualitative case study is an approach to research design or methodology, that assumes that an in-depth understanding of one case, or one manifestation, is valuable in its own right, without regard to other cases that are not studied (Hay, 2016, p. 131). Case studies can be both qualitative and quantitative, or a mix of the two. A qualitative case study can also be viewed as "an intensive study of a single unit for the purpose of understanding a larger class of (similar) units" (Hay, 2016, p. 130). More specifically, this thesis represent an instrumental case study, which Robert Yin characterizes as "a case study of a particular situation but, in spite of its uniqueness, being conducted because of its potential applicability to other like-situations" (Yin, 2011, p. 310). The case studied here is unique as it consists of research projects within the life sciences and funding conditions set by The University of Oslo: Life Science. However, findings about conceptions of RRI and how RRI is integrated in research proposals can be generalizable to other research settings, and especially research funding processes. In this sense, case studies can be performed to broaden academic understanding about a phenomenon (Hay, 2016, p. 131), which is partly the ambition of this thesis.

This case study is both descriptive, explanatory and exploratory. It aims to describe the circumstances around RRI in the Convergence Environments, and how RRI is understood and integrated in this context. The study is first and foremost exploratory, in that it tries to juxtapose empirical data against established theories, in an attempt to expand theory.

The case study approach is sometimes criticized for lacking generalizability (Campbell & Stanley, 1966). This criticism is often exaggerated, if the case study is performed in a reflective manner (Flyvbjerg, 2006). When appropriately designed and tension between *concrete* and *abstract* concepts is accounted for, findings from case study research can be generalizable (Hay, 2016, p. 142). In qualitative research we tend to talk about generalizability as *transferability*, or the degree to which the findings can be applied to other cases or settings (Hay, 2016, p. 142). This transferability will be discussed more in section 3.4 (validity and reliability).

3.2 Case selection

I chose to make the University of Oslo: Life Science Convergence Environments my focus of study for several reasons. First, the case was suitable due to access of data. Being a student at the University of Oslo, the Convergence Environments were more accessible than other RRI incorporating research programs. I was made aware of this research program through discussions with my supervisor, Magnus Gulbrandsen. Second, the inclusion of RRI as a research criterion was the most important reason why I chose to study this case. Third, the fact that the Convergence Environments are placed in the life science domain makes it very relevant for RRI research, which has often been affiliated with work in biology, nanotechnology and other life science related disciplines (Balmer et al., 2015). I could have chosen to do a comparative case study, with one or more similar cases, e.g. from Digital Life Norway or other research project funded under the Norwegian Research Council or other research programs with an RRI focus. This would however probably have been too large a scope for the thesis, considering the limited time available for gathering data, and analysis.

Within the selected case study, I have chosen to focus on five research proposals. I chose to focus on these five proposals after they had been reviewed and given scores, to gain an understanding of why some proposals were scored higher than others in the RRI-section. I did not have time to make extensive analysis of all of the 22 applications. Therefore, I decided to focus on some applications based on the scoring they received from reviewers. The scoring of the applications seemed to indicate some relationship between “research quality” and “Responsible Research and Innovation”, where low research quality seemed to correlate with lower scoring on RRI. That could be an interesting finding, and a sample selection was made to explore this potential correlation that could provide relevant insight in an eventual analysis. I decided to select applications for in-depth analysis around two variables. Two of these applications received very high scores on RRI and were funded. Two other applications were chosen because they received significantly higher scoring on the research component than on the RRI component of the application. These research applications were not funded. The fifth application was chosen

because it received a high scoring on the RRI component and a low scoring on the research component. This research application was not funded

3.3 Data Collection

The data for the thesis was collected in three ways – through documents, observations and interviews. First, I was given access to research applications for the Convergence Environments. This document contained twenty-two applications and amounted to approximately 370 pages. I also made use of publicly available documents, such as the "criteria for assessment"[14] and "application guideline for the Convergence Environments"[15]. These documents were available at the UiO: Life Science's webpage. I also attended the review meetings where the applications for Convergence Environments were discussed and given scores, on the 24th and 25th of April. Last, I conducted one in-person interview and three Skype interviews with four of the panel experts that had participated in the review meetings.

3.3.1 Direct observation

On the 24th and 25th of April 2017 I attended the review meetings of the 22 applications for UiO: Life Science Convergence Environments. Over the course of two days, all the applications were discussed and given scores on three different criteria: the research, team composition (convergence) and RRI (impact). The meetings were structured as roundtable discussions, where the primary reviewers gave their remarks and preliminary scores on the applications, followed by comments from the other reviewers. My presence these two days was in the role of an observer, and not as a participant in the evaluation. I sat at the back of the room during the meetings with a secretary, and another affiliate of The University of Oslo: Life Science.

[14] University of Oslo: Life Science Webpage. http://www.uio.no/english/research/strategic-research-areas/life-science/news-and-events/funding/convergence-environments.html

[15] University of Oslo: Life Science Webpage. http://www.uio.no/english/research/strategic-research-areas/life-science/news-and-events/funding/convergence-environments.html

Observations can be useful sources of data, as they allow researchers to see with their own eyes in an un-filtered way which is not mediated by others' reports. In this sense, observations are a form of *primary data* (Yin, 2011, p. 143). Direct observations can also be useful when the case is a "real-world setting" and not purely historical phenomena (Yin, 2014). Observations can also serve as a useful supplement to other sources of data. This can add new dimensions in understanding either the context or the phenomenon being studied (Yin, 2014).

When observing, it is important to document the procedures that are followed. This can strengthen the reliability of the research – that is, ensuring that another researcher would get the same results if the researcher conducted the data collection using the same procedures. My focus during the observation was on how the reviewers talked about RRI in general and how they talked about RRI in relation to the different applications. *How did they define "good" and "not so good" RRI proposals? What did they emphasize when they praised or criticized the RRI in the applications?* To get the most out of the observation, I took notes during the meetings and I also made voice recordings of the meetings, enabling me to review my own data after the meetings.

3.3.2 Documents

The study of documents was a central source of information in the present thesis. Documents can be used to identify discrepancies between documents and other sources of information, such as interviews. The 22 applications for Convergence Environments were used to study the conceptions and proposed practices of RRI among the applicants. Application guidelines and posts from UiO:LS' homepage were also used as sources of information. The applications were analyzed using two frameworks. First, and primarily, against the RRI framework proposed by UiO:LS, and secondly along the four-dimension framework of (Stilgoe et al., 2013).

3.3.3 Interviews

The interview is one of the most important sources of evidence in case study research (Yin, 2014). The interview allows for a targeted focus on the topics of the study. It is also very insightful and can provide explanations as well as personal views, such as perceptions, attitudes

and meanings. Interviews can be criticized because poorly articulated questions can provide biases. There can also be a response bias in interviews - sometimes informants might want to provide answers, despite having a poor recollection of the topics in questions, which also challenges the use of interviews. Interviews are also threatened by the interviewee responding with what the interviewer wants to hear.

Four evaluators were asked questions about the meanings they attach to RRI, and why they believed RRI was included as a funding criterion for the Convergence Environments. These questions can be found in appendix A (interview guide). The interviews were documented by using a tape recorder. Before an interview, consent was secured by the informants. I would inform about the purpose of the study and where the information would be published. I informed the interviewees that they would be treated anonymously and asked them if they approved of this. All four informants gave their consent to being treated anonymously.

3.4 Validity and Reliability

This section discusses the validity and reliability of the findings in the thesis. By elaborating the internal logic of the research design, I will argue that the findings are reliable, and whether they can be generalizable. The research design has been kept quite fixed throughout the research process. To test the reliability and validity of the thesis, I will now discuss it by using four tests given by Yin (2014). The four tests are *construct validity, internal validity, external validity,* and *reliability*.

Construct Validity

Testing for construct validity can be especially challenging in case study research (Yin, 2014). To have construct validity means that the operational sets of measures are appropriate and that "subjective judgements" are ruled out. Two steps must be covered to ensure construct validity. (i) Define the object of study in terms of specific concepts (and relate them to the original objectives of the study), and (ii) identify operational measures that match the concepts (preferably citing published studies that make the same links). For this particular study, it will be important to

define Responsible Research and Innovation and the ways in which this concept is understood and used. The literature review brought out different conceptions of RRI that can be related to the concepts in the selected case. Operational measures are found in the RRI framework of UiO:LS and in frameworks presented in the literature review. Although these can be thought of as different operational measures, it is not the purpose of the study to use these frameworks for an accurate measuring. The frameworks will rather function as reference points that enable reflections about how RRI is understood, and practiced in the selected case. Construct validity can be increased using three tactics (Yin, 2014): (i) using multiple sources of evidence (ii) establishing a chain of evidence, and (iii) to have the draft case study report reviewed by key informants. The main strategy in this study has been to study RRI from multiple sources of evidence – documents, observations and interviews. Furthermore, the thesis has looked not only at the RRI-section of the five research proposals. The RRI in the proposals cannot be judged solely on the basis of a two-page section of the proposals. The empirical data therefore includes all of the sections of the research proposals, including the composition of researchers and the content of the work packages.

Internal Validity

How can we be sure that one event or factor *x* led to another event or factor *y*? This is the question we ask when inquiring for internal validity. Internal validity is especially important in explanatory case studies where the investigator tries to identify causal relationships (Yin, 2014). If a third factor *z* is what caused *y*, the study has failed the internal validity if it does not account for this. Studies make inferences all the time. Whenever an event cannot be directly observed, we are dealing with an inference. In such cases, it is important to visit rival explanations and possibilities. I have therefore been attentive to visit rival explanations that might explain the phenomena that I have observed. It should be noted that this thesis does not aim to provide any substantive explanatory explanations. The research design has not been focused on why RRI is understood and practiced in a certain way. Instead, it aims at exploring these understandings and practices.

External Validity

How can we know whether the findings of this study are generalizable beyond the specific case studied? In this case study, I am interested in studying how a concept is understood and practiced in a specific context. The findings from this study could however be generalized to other contexts with similar attributes. Other research environments, or funding agencies, that work with a framework of RRI could possibly see some of the same conceptions and practices of RRI. In this sense, this thesis does not propose any direct link to other similar cases. However, we cannot exclude the possibility that similar mechanisms and understandings can manifest themselves in other research environments.

Reliability

Reliability is a quite familiar test for scientific projects. Reliability means that if a researcher was to proceed in the same way on the same case that has been studied here, she would arrive at the same findings and conclusions (Yin, 2014). In order to ensure reliability, the scientific project needs to document the procedures that have been followed. If the project does not document the procedure, it would be difficult to repeat the research, even for the investigator that initially conducted the research (Yin, 2014). A poor documentation of procedures has been a common critique of previous case study research. It is therefore important that we address it here. Reliability can be strengthened by using a *case study protocol* or developing a *case study database.*

To strengthen reliability, I have attached the interview guide (appendix A) and a list of persons interviewed (appendix C). I have anonymized the interviewees to comply with the non-disclosure agreement with UiO:LS. Reliability is also strengthened by using several sources of evidence, such as documents, individual (semi-structured) interviews and direct observations.

3.5 Anonymity and Ethical Considerations

At the end of March 2017, I signed a non-disclosure agreement with the head of The UiO: Life Science. This agreement states that I will not disclose any sensitive information about the 22 applications, the observations from the panel board meetings or other details that might harm the research or any individuals associated with UiO:LS. The non-disclosure agreement was made by finding an example from Stanford University and using the same outline as a basis. I met with the director of UiO:LS, Finn-Erik Johansen, to sign the agreement. Finn-Erik asked me about my research project and what I would use the information for. I stated that I would mainly use the information that was relevant to the RRI, and that I intended to publish this as a master thesis and perhaps an article after submitting the thesis. We also agreed that I should anonymize the information about the application as best I could.

During the meeting, it became clear that it would be difficult to anonymize the applications because they were limited in numbers, and that detailed descriptions of the scientific aspects of the applications could potentially reveal their identity. I have therefore chosen to name the applications in the thesis by capital letters A, B, C.. etc. I have also sought to mention the scientific aspects of the applications as little as possible.

The observations on the 24th and 25th of April brought some ethical challenges. My attendance at these meetings was just as an observer, but this was challenged when I was invited to participate on a dinner with the panel board the 24th of April, and lunch the next day. I chose not to participate here, because I feared that any conversation with the panel board members might influence the way the group discussed RRI and evaluated the proposals. Another challenge consisted in not participating during the evaluations.

All of the individual interviews are anonymized. I refer to the evaluators as “evaluator 1”, “evaluator 2”, etc. This information is anonymized to protect the informants, and because the names and positions of the informants are not relevant information for the thesis.

4 Empirical Findings and Analysis

The empirical findings focus on conceptions of RRI, and challenges for UiO:LS in integrating RRI in research proposals. First, I look at how frameworks and conditions for RRI were established at UiO: Life Science. I then move on to findings from interviews with application reviewers. Sub-chapter 4.3 presents a description and analysis of five research proposals for Convergence Environments. These research proposals are analyzed comparably between the UiO:LS framework, and the four-dimension framework, and draw on insights from the review meetings. The last section of this chapter points to some challenges around the conception of RRI in UiO:LS, and how these differ from the motivations and purposes of the four-dimension framework.

4.1 Conceptions of RRI in the funding criteria for UiO:LS

The application guideline for the Convergence Environments represents RRI through four different criteria. These criteria served both as a guide for the applicants on what to emphasize in the applications, and as a guideline for the panel board evaluating the applications. According to the guideline, Responsible Research and Innovation should address the following questions:

1) To what extent do planned RRI activities address probable societal concerns, legal issues and support stakeholder engagement?
2) To what extent may results from the project generate a foundation for new innovations?
3) To what extent do plans for dissemination address key users of the research results?
4) If the scientific field is characterized by a gender imbalance, are the plans to support development of research talents of the under-represented gender appropriate?

The first criterion can be broken down to three different aspects: addressing probable societal concerns, legal issues and stakeholder engagement through planned RRI activities. To address societal concerns is an important feature of RRI, and is linked to what Stilgoe et al. (2013) have called anticipation, and what von Schomberg (2013) calls “promoting the right impacts”. Legal issues need to address regulation and legal compliance. If these legal issues are properly addressed, they can provide useful guidelines concerning e.g. privacy and research on biological materials, but also patent infringement and commercialization. Stakeholder engagement is also

included as a criterion, which is a known component of RRI in the framework of Stilgoe et al. (2013). Stakeholder engagement is essential to ensure an *inclusive* research process. In the second criterion, Convergence Environments asked to address how the results of the project can generate a foundation for new innovations. This criterion is noteworthy, as it can urge reflexivity concerning the use of the research results – both the potential for new and socially desirable innovations, but also new and controversial innovations. The third criterion, which is dissemination towards key users, bears similarities to what can be defined as *science communication* – the research project should communicate its result to policy makers, private sector and other relevant stakeholders. The fourth criterion addresses gender balance in the research environment. Applicants are asked to provide plans to support the development of research talents of the under-represented gender, if the scientific field is characterized by such an imbalance.

The application guidelines contain some important directions for Responsible Research and Innovation. The guideline can, however, be both too vague and narrow, which is often a challenge for research programs that incorporate RRI. In light of the four-dimension framework of Stilgoe et al. (2013), it may be unclear how the it promotes more anticipatory, reflexive, inclusive and responsive research and innovation. First, "probable societal concerns" can be interpreted in several ways. Are the researchers asked to anticipate issues related to the use of the research and technology, or are they asked to elaborate on the positive outcomes of this knowledge and technology, or both? The second criterion is also open to interpretation. What types of foundations for new innovations are the researchers asked to reflect on? One interpretation of this is to address how the research can generate new insight and eventually new technologies that can benefit society. The researchers are not explicitly asked to reflect on the effects of the new innovations that their research provides a foundation for. This is potentially challenging, as RRI requires one to think holistically about the effects of research and innovation. If the research provides a foundation for controversial research and innovation, do the researchers have any responsibility for how their results are being used in that context? Given that the applicants want their application to look as good as possible, the applicants are incentivized to consider the more socially desirable effects of their research, rather than the less desirable ones.

The third criterion asks the researchers to show how the results of the project will be disseminated. Researchers are used to, and somewhat obliged to, communicate the results to other researchers by publishing the results. Who else has an interest in these results, and what is the purpose of sharing the results with these key users? The application criterion does not provide any guidance as to which actors can be key users. The last criterion addresses gender balance in the research project, which is one of the key targets in the EC framework on RRI. In UiO:LS, gender balance is coupled with recruitment and *public outreach* (Hartley et al., 2017), that is, encouraging future scientists and recruiting scientists of the underrepresented gender.

The four-dimension framework asks questions about the purpose and motivation for science and innovation initiatives. The application guideline does not really urge the scientists to reflect on these aspects of their research. None of the four criteria asks questions about the underlying purposes, motivations and values of the research. The applicants have not been asked to reflect on what is known, uncertain, assumptions, or ethical dilemmas. Such questions could have fostered more reflexive processes for the applicants. Furthermore, RRI requires that the processes of anticipation and opening-up be met in a responsive way. The application guideline does not emphasize that the RRI efforts be met with such responsiveness. One reason why this was not emphasized could be that UiO:LS was unaware of the importance of being responsive. Another reason can be that UiO:LS did not know how to evaluate the responsiveness in the applications. It is often difficult to evaluate the responsiveness of a research environments solely on the basis of a proposal, and prior to the execution of the research. Such an evaluation would have to elicit the intentions of the applications, that is, whether it is likely that the researchers will take into consideration the inputs from the inclusive processes.

Figure 2. Application criteria for UiO: Life Science, Convergence Environments

Application criteria for Convergence Environments	**RRI-dimension**
• To what extent do planned RRI activities address probable societal concerns, legal issues and support stakeholder's engagement?	• Anticipation • Reflexivity • Inclusion
• To what extent may results from the project generate a foundation for new innovations?	• Anticipation? • Reflexivity
• To what extent do plans for dissemination address key users of the research results?	• Openness? • Reflexivity • Inclusion
• If the scientific field is characterized by a gender imbalance, are the plans to support development of research talents of the under-represented gender appropriate?	• Reflexivity • Inclusion • Responsiveness

(The application criteria are retrieved from the UiO: Life Science's webpage (Torheim, 2016) and attached as appendix B)

The table above (figure 2) shows that the RRI dimensions proposed by UiO:LS can be understood as an operationalization of the four-dimension framework. The sum of the four criteria encompasses all four dimensions: anticipation, reflexivity, inclusion and responsiveness.

Two different guidelines on RRI

Every research proposal for the Convergence Environments had to include a section on Responsible Research and Innovation. In the research proposals, this is, however, referred to as "Impact (Innovation and societal impact; RRI)". All potential applicants for Convergence Environments had to submit a sketch by the 28th of October 2016, to be eligible for final submission of applications. In this sketch phase, UiO:LS frequently referred to "Responsible Research and Innovation". In the final guideline for funding, this was, however, changed to "Impact (Innovation and societal impact; RRI)". This is important, because it may have given new directions to the applicants, possibly resulting in different articulations of Responsible Research and Innovation. Furthermore, in the final evaluation guideline, these two questions were set up as a guide on RRI:

1. How can the results from the project be of interest for the society and how will it be communicated?
2. How can the results from the project generate a foundation for new innovations?

Some of the analyzed research proposals focus more on these two criteria, than on the initial four criteria. This is important to keep in mind, as the two latest criteria represent less critical and self-reflexive questions about the impact of the research. The research proposals analyzed in this section of the thesis bear traces of both of these guidelines. Some applications focus more on the latter two and some incorporate the four initial criteria. Some applications also drew on the European Commission framework, the EPSRC framework, or the Norwegian Research Council Framework.

The findings from the "impact section" of the proposals will be the focus of this part of the empirical section. Five different applications are analyzed. The first two applications, C and D, are among the applications that received the highest total scoring on RRI, and were also funded by the UiO:LS (see figure 3). I have chosen to focus on these applications because they consist of research that could potentially be controversial, and because they received a score of 9.0 out of 10 on RRI. Two applications, P and Q, are included because they received significantly higher

scoring on the research than on the RRI. One application, S, is included because it received a low scoring on the research, but a relatively high scoring on the RRI.

Figure 3: Detailed scores for the five applications

Application	Research	Convergence	Impact / RRI	
C	9,0	9,5	9,0	Funded
D	8,8	9,1	9,0	
P	8,3	7,7	6,0	Not Funded
Q	8,5	7,5	6,3	
S	6,5	7,2	8,0	

4.2 Reviewer perspectives on RRI

RRI as an external demand and competitive advantage

The reviewers were asked why they thought UiO:LS included RRI as a criterion in the funding process. Several evaluators believed that RRI was included in the evaluation process because of an increasing demand for RRI in state funded research, both in the NRC and the EC. One evaluator also believes that RRI has been introduced in UiO:LS because it has been important in NRC initiatives such as BIOTEK2021 and NANO2021, and the Digital Life Initiative. RRI has become central in UiO:LS not only because it is expected in other areas, but because a growing familiarity with practicing RRI can provide a competitive advantage in acquiring funds from other funding agencies such as the NRC and European Research Council. This is not to say that RRI is not important in and of itself, but that it is increasingly recognized as important by scientists because of its role in research funding. This is in alignment with Braun's (1998) views on the cognitive development of science, where RRI serves some function in deciding who gets funding and under what conditions. Furthermore, RRI is perceived as important because UiO:LS wants to foster more innovation and collaboration with the private sector.

Pathways to impact

RRI was seen as important because science needs to contribute to societal development. This means that the research environments collaborate with industry, and that the research is communicated to the public beyond publishing in scientific journals. One evaluator also stated that society spends a lot of money on science. Science should therefore contribute to societal development, and especially innovative solutions (evaluator 2). Sustainability was also seen as an important motivation for the inclusion of RRI in research proposals (evaluator 2). RRI should also serve the function of reminding the scientists of the role they have in society, and that they should configure their activities with this in mind.

Conceptions of what constitutes Responsible Research and Innovation

The evaluators had quite different perceptions of what good RRI meant in the context of UiO:LS. In general, the evaluators said that applications with good RRI were the ones in which it was clear that the researchers had made reflections on the societal impacts, and that they showed that they took this seriously. One evaluator emphasized the importance of having a good research plan and to include partners beyond the established research group. It was also important that the applicants showed that they could combine different scientific disciplines in an adequate manner. One evaluator said that "you could tell from an application whether it was a team that would cooperate to reach the target of the application" (evaluator 1). According to this evaluator, cooperation was important because UiO:LS wanted the Convergence Environments to be more synergetic than traditional research groups. Another evaluator said that applications with good RRI had expertise on RRI, and activities supporting this. It is however unclear exactly what this expertise amounts to, be it research background or other qualities or experiences of the researcher. The evaluators found it important that applications contained a broader notion of RRI that went beyond e.g. publication conferences and government propositions. One evaluator said applications with good RRI had innovation and impact on the agenda, and included relevant expertise into the research group. One evaluator even thought that the research quality was important for the RRI component. If the research was seen as groundbreaking, then that research could lead to some potential beneficial outcomes. However, this perception of RRI was not shared by all evaluators.

Defining what is not Responsible Research and Innovation

Some applications were given low scores on the RRI because they had a very "bragging" lingo, without really providing any clear answers to what the RRI elements of the application were. One evaluator noted that some applications seemed like they were re-using old versions of other applications, without really adjusting to the demands that the UiO:LS provided. Applications that didn't have a good RRI section typically had narrow ways of communicating the research, or they were only including traditional science communication methods. These applications were also characterized by the RRI as being an add-on, and not an integrated part of the application. Applications that were less realistic, either because there was a weak science component or that they were less ambitious, were also deemed as poor RRI. This shows that the evaluation of RRI was difficult to distinguish from the evaluation of the research itself. One evaluator stated that there were not many ethical considerations to be taken into account in the applications, and that the ones that had these addressed them in a good way. Applications that did not have excellent research and that only described traditional ethical issues were generally given lower scores on the RRI.

RRI is difficult to discern from research quality

Some evaluators believe that research quality is an essential part of Responsible Research and Innovation. One evaluator said that it is unlikely that the research will result in any productive outcomes for society if the research plan is not good (evaluator 1). Another evaluator nuances this a bit further and says that it is not just the research quality that matters, but what the research group aims to achieve. Advanced research can result both in radical and incremental innovations. What matters is the goals that the research group has. If a research group aimed at developing a treatment for a serious and very common disease, that could urge a higher RRI grading. One evaluator says that research quality is not relevant for the RRI. For example, the evaluator recalled proposals that were given very high scores on the research quality, but lower scores on the RRI, because the proposal did not include good enough processes for stakeholder engagement.

4.3 Conceptions of RRI in research proposals

This section analyzes five research proposals for the Convergence Environments. All applications contain a table that present the RRI aspects mentioned in the application and match them with corresponding RRI keywords. These tables are intended to provide a more structured overview the different research proposals. The applications are also analyzed in light of the UiO:LS criteria for RRI and the four-dimension framework by Stilgoe et al. (2013). Finally, all applications are supplemented by observations from the evaluation board meetings.

Application C

Application C was evaluated as one of the best applications in respect to Responsible Research and Innovation (see figure 3). The proposal discussed the following aspects:

Figure 4: RRI keywords in application C

Application aspect	RRI keyword
Issues around data storing and security	Legal issues – anticipation – reflexivity
Communication and recruitment of researchers	Inclusion
Gender balance	Inclusion
Creating an open source environment	Inclusion – transparency/openness
Commercialization through a technology transfer office (TTO)	Inclusion (?) Responsiveness (?)
Attendance at a conference, and an annual outreach technology workshop	Stakeholder engagement (?)
Establishing a “researcher school”	Inclusion / stakeholder engagement
Including patients in a “transplantation program”	Stakeholder engagement (?) – anticipation (?) – Inclusion
Potential of reducing animal suffering and experimentation	Reflexivity – anticipation
Collaboration with an ethics expert.	Anticipation – reflexivity (?) – interdisciplinarity

The societal concerns identified in the application were the potential of reducing animal suffering and to accelerate drug discovery and testing. The proposal addressed legal issues around the use of human/in silico hybrid interfaces, qualitative uncertainty, dynamic consent and patient involvement. The proposed measures to deal with these issues were to include an "ethics expert", and stating that the research group would oblige with the Helsinki declaration and only perform research upon strict ethical approval. This approach is more accurately described as research ethics, rather than RRI. Stakeholder engagement activities in the project were reduced to collaboration with a firm interested in patenting the technology that the research group aimed to develop. The research group also wanted to create an open-source environment that allowed for recreation of the hardware and data sharing anywhere in the world. This open-source solution was said to create a foundation for new innovations. There were extensive plans for dissemination, addressing key users and the public. The sharing of results included the establishment of a "researcher school", and a frequent Norwegian Workshop. The group also wanted to reach the broader public by arranging an annual outreach technology workshop.

Three annual publications in Norwegian language journals would serve the purpose of communicating the knowledge to the public. The research group also wanted to create a Twitter account with weekly tweets, and collaborate with the Norwegian National Broadcaster (NRK) on an open access format where the technology can "catch attention and imagination".[16] The research group also planned on using their national and international network to ensure gender balance, and attract female researchers. In addition to this, the group had ambitions to become a research environment where bachelor and master students could be trained in multidisciplinary research. The multidisciplinary research training would integrate physics, chemistry and biology. Training in social sciences and humanities, which is an ambition of UiO:LS and an important feature of RRI, was not mentioned. One explanation for this could be that the research group does not find training in social sciences and humanities important, or that the research group does not have the capacities to undertake such training.

[16] Application C, submitted to UiO: Life Science

Links to UiO:LS criteria

Despite the evaluation board perceiving it favorably, the application did not properly address all the requirements that the application guide required. The societal concerns mentioned in the proposal were only potentially positive outcomes of the research. It did not include discussions of the potential negative impacts that could result from the research. For a much of the public, reducing animal suffering, and accelerating drug discovery and testing, can indeed be viewed as socially desirable. However, the application did not address the potential negative implications of the technology. The proposal could have discussed who might be negatively affected or harmed by the technology, and what measures the research environment would take to reduce or prevent these outcomes. Another critique of the application is that stakeholder engagement was limited to collaboration with a private company, and to engaging a certain patient group in the transplantation program. The proposal does not specify how this patient group would be included, and for what purposes. Will the patients be able to have a say on their experiences, values and views of the technology? Furthermore, the proposal did not address a broader audience in their stakeholder engagement activities. Some conferences are proposed, but it is not clear whether these conferences will open debates around relevant ethical, legal and social issues.

The four-dimension framework

Viewed through the lens of the four-dimension framework, some considerations were underdeveloped in the research proposal. The anticipatory elements of the proposals were weak, as it did not address potential risks, controversies and values. Neither did the proposal suggest activities that could increase reflexivity in the research process in order to identify the risks, controversies and values. This could have been remedied by facilitating more inclusive activities and a genuine stakeholder engagement, where relevant stakeholders are included throughout the research process, and where the research is properly aligned with the feedback from stakeholders. This would also have strengthened the reflexivity of the research environment, resulting in a better understanding and articulation of motivations and purposes of the research. It is also clear that responsiveness would be rare to observe in this research environment, given that there are very few arenas where stakeholders are given a voice. The proposed activities in the application emphasized science communication and public outreach instead of stakeholder engagement.

There is little room for a constructive and reflexive debate when stakeholders are given a voice only after the research is performed, and the technology is developed.

Comments from the evaluation meeting

The RRI aspects of the application received little time and attention at the evaluation board meeting. It was considered positive that the research group planned to reach out on broad social media platforms. One evaluator said that the RRI was good, if the research group succeeded with the research. This was responded to by the board leader who said, "we are scoring the application now, not the end result". The RRI aspects of the application received little attention because more time was devoted to the scientific aspects of the application, and on which PhD positions UiO:LS potentially wanted to fund. The board debated whether all the work packages of the proposal were necessary, because some of them seemed to overlap or not contribute to the research in an essential way. This shows that there are many other priorities in funding processes that can demand attention, at the cost of RRI-discussions.

Application D

Application D received one of the highest scores on RRI, with a score of nine out of ten. Although this proposal has a shorter section on impact/RRI, it stands out as more reflexive than the previously discussed application C.

Figure 5: RRI keywords in application D

Application aspect	RRI keyword
Work packages in sociology and bioethics	Interdisciplinarity – Anticipation - Reflexivity
Particularly important results communicated to a broad audience	Science Communication – inclusion (?)
Public debates including scientific and ethical aspects of the research and the challenges they pose	Anticipation – inclusion – responsiveness (?)
PhD students publishing at least one article in the popular media	Science communication

Relationships with policy makers (…), so that the political, legal and regulatory implications of our research feed into the broader social approach to treatment and research.	Inclusion – reflexivity – responsiveness
The group is innovative and holds several patents	Unknown

This research project has a dual purpose which is to gain a better understanding of a problem – both scientifically and ethically. Because of this, the research group has an integrated and interdisciplinary approach where natural scientists and social scientists/humanists work together throughout the research process.[17] The project includes work packages with sociological and bio-ethical objectives, and an integration of these work packages with the more "science-based" work packages. The impact section of the proposal mentions that one of the strengths of the project is that "it bridges ethical thought and basic science directly with clinical application"[18].

Although the proposal includes workshops and "stakeholder engagement" it is not clear what the motivations for this is. The proposal does not mention how these activities will feed back to the research process. What issues will be addressed in the workshops, and how will they affect the research? The position in bio-ethics will include discussions with the scientists about key concepts of responsibility, health, harm and biology. Although this position can serve to increase the reflexivity of the research environment, these processes do not include the public. These discussions could have been opened up to the broader public, in addition to discussing them within the research group.

Links to UiO:LS criteria

The societal challenges addressed in the proposal focus on improving in vitro fertilization treatment, live birth rate, and the health of children born after such treatment. The application does not address any legal challenges, nor does it include any stakeholder engagement activities.

[17] Application D, submitted to UiO:LS.
[18] Application D, «Impact (innovation and societal impact; RRI).

This is primarily addressed through an undefined relationship with domestic and global policy makers. The potential for new innovations can be found in novel biomarkers "which may allow developing non-invasive assays for early embryo development, which may supersede present embryo assessment methods mostly relying on morphology and developmental dynamics". The proposal includes communication of research results to some key users such as policy makers. The strengthened relationship with domestic and global policy makers was intended to ensure that the political, legal and regulatory implications of the research feed into the broader social approach to fertility treatment and research. The proposal did not discuss gender balance or provide any plans to support the development of research talents of the underrepresented gender.

The four-dimension framework

The application has several underdeveloped elements, seen through the lens of the four-dimension framework. The proposal is vague regarding how interventions will be carried out. This makes it difficult to anticipate what the ethical, social, and legal implications of the research are. These applications, impacts and interactions of the technology are not addressed by the research environment. The application only mentions positive outcomes that might result from the research, and does not provide discussions of what is known, unknown, uncertain or possible. There is also a low level of reflexivity in the proposal. The research is ethically challenging, but the proposal does not discuss these challenges and how the research group would deal with them. Research on embryos and in vitro fertilization (IVF) are certainly value-laden areas where specific attention should be paid to the different beliefs and value systems that surrounds it. The proposal also has very limited inclusivity. Particularly important results are planned to be communicated to a broad, non-scientific audience. It is problematic that only particularly important results will be communicated. Who decides what results are particularly important to communicate? Is it the researchers themselves? This might serve to close down (Stirling, 2008) debates about the research, because the researchers are allowed to set the premise for the public debate. Results will be communicated through TV and national newspapers. Results will also be communicated through frequent lectures in collaboration with the Norwegian Biotechnology Board. These lectures will include scientific and ethical aspects of the research, and the challenges they pose. Due to the aspects mentioned above, it is hard to see how the anticipatory,

reflective and deliberative processes will have any bearing on, and shape the purposes, processes and impacts of the research. Because of this, the research environment does not seem to be very responsive.

Comments from the evaluation meeting

Application D received a high scoring on RRI, despite several critical notes during the evaluation meeting. The engagement with users was seen as positive, but it was described too briefly to understand what the research group would actually do. One evaluator said that there were some "promising social science stuff" in the application. Another evaluator said that "this is ethically difficult, but there is so much happening here now. So, you need to address it". The fact that the project included a philosopher was also seen as a strength for the RRI aspect of the application. This shows that the inclusion of social scientists and humanists serves to legitimize the research as responsible, in the eyes of the reviewers. Some questions were asked about the research on embryos: "they describe what can be done and what they want to do, but not how it is going to be done", said one evaluator. Some evaluators also had questions about what the research on fertility medicine approaches would include. The discussion of the RRI elements was concluded with the following remark: "There are some ethical issues that were not addressed, but each evaluator can make these considerations for themselves".

Application P

Application P involves research on a neurodegenerative disease, and aims to develop new methodologies for advances in neurosciences. The RRI elements mentioned in the application are:

Figure 6: RRI keywords in application C

Application aspect	RRI keywords
Important socio-economic challenge	Anticipation
Early detection of the mentioned disease	Anticipation
Releasing an open source software	Inclusion – transparency/openness
Publication of results in high-profile journals and at international conferences	Science communication

Links to UiO:LS criteria

The application addressed few requirements from the application guide. The societal challenges addressed, focused mainly on the neurodegenerative disease, and the societal importance of solving this issue. The application only addressed the potentially positive outcomes that might result from the research, and did not include reflections on risks and uncertainties. No stakeholder engagement activities were proposed, and no legal issues relating to the research were mentioned. The foundation for new innovations was addressed by proposing an open source software program. The results of the research were not targeted to any specific key users that might benefit from the research, and the application did not mention any gender imbalance and measures to be taken to support gender balance.

The four-dimension framework

Application P showed little signs of anticipation. There were very few articulations on the potential intended and unintended applications, impacts, and interactions of the research. The application does not ask "what if?" questions, considering what is known, unknown, likely, plausible or possible. There is also a low degree of reflexivity upon the underlying purposes, motivations and values of the research. There are no stakeholder engagement activities proposed. Only a proposed documentary film, which could be described as science communication rather than stakeholder engagement. The inclusive dimension of the application is therefore under-developed. Furthermore, it is difficult to see how the proposed activities enable a responsive research process where the anticipatory, reflective and deliberate knowledge can shape the purposes, processes and impacts of the project.

Comments from the evaluation meeting

One strength of the RRI in the application was that the research represented important "know-how", and that it could be useful in clinics. Some said that it was likely that software would be developed, although this was contested by other reviewers. One reviewer said that the RRI was insufficient, as it only mentioned software development as an RRI aspect. Another reviewer said

that there was very little mentioning of ethical aspects in the research, and no planned conferences.

Application Q

Figure 7: RRI keywords in application Q

Application aspect	RRI keyword
Producing a documentary film	Science communication – inclusion (?)
Publication in non-scientific journals	Science communication – Inclusion (?)
Encouraging post docs to attend conferences	Standard academic practice

Application Q aims to understand some biological functions relating to metal uptake in the intestine. The research group consists of researchers from the fields of traditional physical chemistry, structural biology and pharmaceutical biology. An anthropologist is also included in the project with responsibility of producing a documentary film about the research. The only elements of RRI mentioned in the application was the production of a documentary film. The documentary film would be a 30 minutes long film, and possibly a shorter film of 7 minutes. The research group also proposed to share the results of the research in high-impact journals. The proposal does not discuss any potential risks and negative impacts of the research and does not propose any activities of stakeholder engagement. There is also a very low level of reflexivity on the norms and values that are embedded in the research. The proposal mentions some societal challenges that can be met if the research succeeds, for example in food industry and pharmaceuticals.

Links to UiO:LS criteria

The application only addresses some of the UiO:LS evaluation criteria. It addresses some societal concerns relating to nutrition and the war on pathogens, but it does not address any legal issues relating to the conduct of the research, or its implementation. There is little to no stakeholder engagement in the project. Instead, the application focuses on a one-way communication of

results. This is mainly planned to be done through the production of a documentary film, but also through scientific articles. One of the main ambitions of the documentary film is to "humanize" the research and the researchers. The documentary will give "a glimpse of the world of the scientific community, therefore deconstructing stereotypes and contributing to a "humanization" of science".[19] The purpose of the science communication seems to be to legitimize the research, rather than opening it up for critique. The potential for innovations can be found in the food processing industry and in crop nutritional enrichment. The results of the research are not directed towards any key users of the knowledge besides from the research community. Results are presented through a documentary, scientific articles, broader journal articles and attendance at conferences such as the PhD-day at the University of Oslo.

The four-dimension framework

Application Q included few anticipatory elements. Anticipation was reduced to addressing some challenges related to the gut flora and the potential for innovations in this area. The proposed research was very closed, as it did not not include any stakeholder activities. The only stakeholder activity was the production of a documentary film. However, this is not really stakeholder *engagement*, as it doesn't include stakeholders in the early stages of the research process. Instead, the research group aimed to communicate the results of the research after the research was done. This could be more accurately characterized as science communication. The reflexivity of the researchers is also very limited, as the application does not discuss the purposes and motivations of the research. The researchers assume that there is a consensus on the need for this research, and that the research does not pose any controversies. With a lack of proper inclusive processes, it is hard to see how the research environment will respond to societal feedback. Taking these factors into account, it seems appropriate that the application received a low grading on the RRI section of the proposal.

[19] Application Q, submitted to the UiO: Life Science.

Comments from the evaluation

The RRI in the research proposal received mixed feedback in the evaluation meetings. One of the primary reviewers though that the production of a documentary film was an interesting way of reaching out with the research. It is often difficult to "reach out" with research results, and the documentary film was thought of as an interesting approach in this regard. The other primary reviewer also liked the idea of a documentary film, but was skeptical of the overall RRI activities. The reviewer said that the RRI was very "narrow", as they were only making a documentary film. The first reviewer wanted to give the application an 8.0 on the RRI. After hearing the comments from the second primary reviewer, the application was given a preliminary scoring of 6.3 on RRI (see figure 3).

Application S

Figure 8: RRI keywords in application S

Application aspect	**RRI keyword**
Philosophy as an integrated part of the research	Interdisciplinarity – reflexivity (?)
Educate young talented scientists in a multidisciplinary environment	Interdisciplinarity – inclusion
a redefinition of the "ideal" conditions necessary to provide a therapeutic solution	Reflexivity
Include patients in the discussion in order to understand their concerns and expectations.	Inclusion – reflexivity
High focus on communication - encourage students and team members to present data to a broad audience through seminars	Science communication
Communicate through classical media (radio, TV and newspaper	Science communication

Provide an opportunity for scientists and patients to compare their interests, motivations and goals in the research	Reflexivity
Feedback from the first debate at the start of the project will inform the ongoing scientific and philosophical direction of the project.	Reflexivity – responsiveness

Application S received a high grade on the RRI in the project, despite lower grades on the research and convergence criteria. Application S seeks to understand cell migration mechanisms in order to develop new innovative cancer vaccines. The research environment sought to promote Responsible Research and Innovation by including a philosopher/bioethicist in the research. One of the reasons for including this researcher was to provide a "redefinition of the "ideal" conditions necessary to provide a therapeutic solution" .[20] The proposal included a project plan for RRI which aimed at raising important ethical and conceptual questions. These questions included: "who will the research benefit? Will we only improve the clinical design by decreasing the number of non-responders before the trials? Or will this also spare false hope to non-eligible patients?"[21]. The research group also emphasized communication of the research by including a researcher of the humanitarian sciences in the team. This would also be done by encouraging students and team members to present data to a broad audience through seminars. Communication through classical media such as radio, TV and newspapers were also proposed. One of the strengths of the research environment is, according to themselves, that they "will include patients in the discussion in order to understand their concerns and expectations". Furthermore, the group wanted to provide an opportunity for scientists and patients to compare their *interests, motivations* and *goals* in the research, and to identify *discrepancies* and *conflicts* between the two". The research group also emphasized the education of young researchers in traditional STEM fields in a Responsible Research and Innovation approach.

[20] Application S, submitted to the University of Oslo: Life Sciences.
[21] Application S, submitted to the University of Oslo: Life Sciences.

Links to UiO:LS criteria

The application addresses important societal challenges by improving the personalization of cancer vaccines. It does not address any legal challenges, and does not provide any extensive stakeholder activities. Stakeholder activities consist in patient involvement, which is described as important in the project plan for RRI. The potential for new innovations include more personalized cancer therapies that will work on the majority of the vaccinated population, and a reduction of costs for the health care system through more targeted treatments. The communication of research results will happen mainly through scientific articles. Industry or regulatory bodies are not mentioned in the application. The research proposal did not mention gender balance and gender perspectives in the recruitment of researchers. However, two out of the four principal investigators were female.

The four-dimension framework

Some elements of the proposal were under-developed, viewed through the lens of the four-dimension framework. The anticipatory elements of the application highlighted that cancer is an important societal challenge, and also reflected on how some patients could potentially not benefit from the results of the research. The group did reflect and articulate some potential intended and unintended applications, impacts and interactions that might result from the research. This was done through questions about what is known, likely, plausible or possible regarding the research and technology. The reflexivity in the project was most evident in the research position on bioethics. This position was supposed to develop a system for analyzing and interpreting the scientific and ethical goals of the research. An important element of this was “a redefinition of the “ideal” conditions necessary to provide a therapeutic solution”. Beyond this, the application did not reflect extensively on the assumptions, motivations and commitments of the research. The only problems that were addressed were the patient/researcher relationship and that some patient might not benefit from the research. The proposal also had weak inclusive elements. It contained few stakeholder engagement activities, but had some reflections on how patients would be engaged in the research. It is, however, unclear how this engagement would be organized, and such an inclusion can in itself be problematic and challenge the privacy of the patients. Some conferences were proposed, but these were conferences for scientists, and are not

likely to reach the broader public. The responsive aspects of the application were also underdeveloped. Due to a low degree of openness and stakeholder engagement, it is hard to see how the research environment would incorporate this type of feedback into the research process.

Comments from the evaluation meeting

In the evaluation board meeting, the RRI aspects of the application were described as "relatively standard" and "nothing that stands out". One reviewer said that the project was of high societal importance, which was seen as positive for the application. One reviewer wanted to give the application a high score, because the proposal had a model on reflexivity and stakeholder engagement, and also included a philosopher in the project. Some reviewers though that it was positive that the research group included collaborators from top universities. This was however contested by another reviewer saying, "I don't think that they will be that innovative, but they have links to very innovative people". The application was given a preliminary scoring of 8.0 on RRI, 6.7 on research, and 7.2 on convergence. There was disagreement about the logic of the research design, but the project was thought to be in alignment with Responsible Research and Innovation.

4.3.1 Summary

The main conceptions of RRI included increased and improved science communication, both *to and with* the public. Fostering new innovations and building innovative capacities were also seen as important aspects of RRI. Last, there were different conceptions of what type of interdisciplinarity RRI urges. Some applications were interdisciplinary within the natural sciences and others included social sciences and humanities.

The main findings from the five applications are:

i. RRI is understood as being partly about the outcomes of the research. If research can result in great innovations, then the research is responsible.
ii. *Science communication* is a very common approach, rather than stakeholder *engagement*.
iii. Not all the applications are convergent between social sciences and natural sciences.

iv. In some applications, RRI is an integrated part of the research agenda. In other applications RRI is an "add on" with focus on the potential positive outcomes and on proposed channels of communication.
v. Many applications stated that there were ethical and social issues, and either did not address them or said that they had included someone to deal with these issues.

Communicating to the public

Most applications had a very strong focus on communicating the results of the research to the public, the scientific community, to industries and governmental stakeholders. This communication was proposed through traditional communication channels such as publishing in scientific journals, but also through conferences, Twitter accounts, web pages and even a documentary. For some of the applications, questions could be raised whether the purpose of this communication was to disseminate the results, or if it also included ambitions about a dialogue that feeds back into the research process.

Communicating with the public

There is also some evidence of research environments that sought to open up a dialogue with the public about the ethical, legal and social implications of their research. As exemplified in proposal D, where sociologists and bioethicists would study the social and ethical aspects of the science and technology.

Strengthening the innovative potential of the research group

Another common approach to RRI was to address how the research could benefit society. Many of the applicants therefore addressed how they would cooperate with other research environments and with industrial partners to increase the probability of producing new knowledge or technologies.

Different types of interdisciplinarity

There are different practices concerning the type of interdisciplinarity in the research environments. While some research environments have social sciences and humanities as an integrated part of the research agenda, other research environments are characterized by

interdisciplinarity within the natural sciences. Application C, for example, consists of researchers from physics, chemistry, informatics and basic medical science.

4.4 Challenges for Responsible Research and Innovation at UiO:LS

Little space for elaboration of RRI in the applications

How can a research proposal explain the elements of RRI with limited space to do so in the proposal? Given that RRI would only amount to one sixth of the total grade of the applications, RRI was given very low priority in the applications. Most applicants dedicated about one or two pages describing how they would ensure responsible research and innovation. This poses a challenge for RRI, as it becomes less important than the scientific aspect and the team composition. This situation requires that RRI is integrated throughout the research proposals and not limited to one specific section of the proposals.

Administrative challenges - unclear guidelines around RRI

Responsible Research and Innovation was introduced in an unclear way by UiO:LS, which made it unclear what aspects should be targeted in the RRI section of the proposals. The initial criteria for RRI mentioned in section 4.1 were more detailed and included a focus on stakeholder engagement, legal issues and gender balance. The final instructions for submission of applications did, however, only mention two aspects – first, how the research could be of interest to society and how the results would be communicated, and second, whether the research could generate a foundation for new innovations. It is reasonable to think that this may have resulted in more narrow applications where the researchers focused on impact and communication of results, rather than on inclusive and reflexive processes. At the end of September 2016, workshops were held by UiO:LS where potential applicants were invited to "speed dates" with other researchers. After the speed dates, Philip Macnaghten[22] held a 30 minutes lecture on RRI to the applicants. It

[22] Professor Philip Macnaghten is employed at Wageningen University & Research, and was one of the contributors to the development of the EPSRC framework on RRI in 2012. https://www.wur.nl/en/Persons/Philip-prof.dr.-PM-Philip-Macnaghten.htm

is likely that this lecture presented a more nuanced version of RRI, given that he was one of the architects of the RRI framework which includes anticipation, inclusion, reflexivity and responsiveness.

Innovation and impact-centeredness

The strong focus on impact and innovation at UiO:LS and its reviewers, is challenging the notion of RRI in the research environments. This impact and innovation imperative can contrast with Responsible Research and Innovation processes, since RRI necessarily involves some degree of "stopping up", and asking sticky questions about purposes and motivations. For UiO:LS, RRI is more about *doing more of the right stuff*, than reducing and communicating risks, and including new perspectives in the research processes.

Confusion about the purposes of stakeholder engagement

It is also found that there are different understandings of the purposes of stakeholder engagement. Some researchers see stakeholder engagement as an important way of democratizing the research and gaining knowledge about the ethical, legal and social aspects of the research. Others see stakeholder engagement as an imperative to collaborate with industry, to promote the innovative capacities of the research environment.

Including social scientists and humanists in a meaningful and practical way

As the research environments are required to work interdisciplinary, there is a challenge in defining a meaningful way of integrating social scientists and humanists in the research. What purpose should these scientists serve? An important question is whether the researchers are doing RRI in addition to the research or whether they are doing it as an integrated part of the research projects. RRI is unlikely to have any transformative capacity if it is reduced to "moral labor" done by social scientists and humanists. This study finds that social scientists and humanists serve both of these roles in the Convergence Environments.

5 Discussion and Conclusion

This thesis has aimed to identify conceptions of RRI and their integration into research proposals in Convergence Environments at the UiO: Life Science program. It also aimed at identifying some challenges for the conception and integration of RRI in research proposals. The empirical material was based on observations, analysis of research applications and interviews with application reviewers. The existing literature on Responsible Research and Innovation (e.g. European Commission, 2012; Stilgoe et al., 2013), provided a basis to do empirical work on conceptions and practices of RRI in the Convergence Environments.

The main findings in this study are as follows: Responsible Research and Innovation at UiO:LS is understood as (i) an increased focus on innovation and impact, (ii) an increased focus on science communication and new ways of communicating research results to the public, (iii) including social scientists/humanists in natural science research. These conceptions of RRI correspond with other conceptions of RRI, such as that of Stilgoe et al. (2013) and the European Commission (2012). However, the study also finds that the conceptions of RRI is reduced to a few activities and principles, and lacks insight into the motivations and purposes of Responsible Research and Innovation. This results in a very narrow and limited understanding of what RRI means and how it can be operationalized.

5.1 Conceptions of Responsible Research and Innovation at UiO:LS

RRI as innovation and impact oriented research

A recurring theme in all of the applications for the Convergence Environments was a heavy focus on innovation and the potential impacts of the research. The research proposals devote much attention to describing how a phenomenon, for example as a disease or an underdeveloped treatment for a disease, is a societal challenge, and how the research meet this challenge. As a result of this, there is also an understanding that RRI requires the research groups to be affiliated with actors that can promote innovative activity, such as private companies.

Responsible Research and Innovation requires excellent research

Applications that were perceived as excellent research received higher RRI scoring in general, and applications with low scoring on research received a lower RRI scoring. This could be explained in at least two ways. The first interpretation is that some applications were better articulated in general, and therefore provided better explanations of both the research plan and objectives and the RRI-dimensions. The other interpretation is that RRI is perceived as relating to research quality. Observations from the discussions at the review board point to the fact that research quality was a requirement for higher RRI scores. This is supported by the observation that the potential impacts of the research were emphasized. And since excellent research was seen as a requirement for innovative potential, it is perhaps natural that the reviewers (knowingly or not) saw research quality as related to RRI.

Is excellent research *responsible research*, or is responsible research *excellent*? The answer to this question is probably "a bit of both". As most of the applications with high research scores received high scores on RRI, it seems like it is an underlying conception among the reviewers that excellent research is an important part of RRI. However, research applications can hold very high scientific standards, but still lack reflexivity, anticipation, inclusion and responsiveness. They can lead to seemingly ground-breaking research and socially desirable outcomes, and at the same time be negligent of unforeseen social, ethical and environmental side-effects. It is therefore important to question our definition of scientific excellence, and discuss whether RRI has anything to do with research excellence.

RRI as increased and improved science communication

A common strategy for incorporating RRI in the research proposals was to elaborate on how the research group would communicate its results to the public and different key stakeholders. Several proposals included plans for making videos, or webpages, and even a documentary film. Some applications also planned to arrange conferences to inform the public about the research and ethical aspects of the research. Very few applications emphasized whether and how they sought to get feedback from the public through these conferences. This shows that the Convergence Environments were operating with a deficit model of science communication, in

which the public's concerns with science are the result of a lack of scientific knowledge. In this sense, there is an understanding that the research is not controversial, and that the public needs to be informed in order to "close down" (Stirling, 2008) discussions. The introduction of RRI as a funding criterion could have served to open up these discussions. Instead, it served as a way to frame the research as uncontroversial.

RRI as interdisciplinary research

One of the prerequisites for applying funding from the UiO:LS was to have an interdisciplinary research environment combining research from different academic disciplines. As seen in the previous sections, this was understood in mainly two different ways. The first conception of interdisciplinarity means that researchers from different fields are collaborating in the research. The second conception of interdisciplinarity requires an embedment of social scientists and humanists in the research. These findings suggest that interdisciplinarity is an ambiguous term that is open to interpretation. It therefore becomes important for institutions such as UiO:LS to be explicit about the need to involve social scientists and humanists in the research proposals, to broaden the conception of interdisciplinary research.

5.2 Challenges for Responsible Research and Innovation at UiO:LS

Understanding the purpose of doing RRI

This study finds that there are very different understandings and integrations of RRI in the Convergence Environments. The core understanding of RRI involves attention to societal challenges, focus on innovative capacities within the research environments, and an increased focus on science communication. RRI is also to some extent associated with research quality, where excellent research is seen as a prerequisite for Responsible Research and Innovation.

An important challenge for RRI concerns the risk of instrumentalization (Stilgoe et al., 2013). If used as a "go to"-tool, RRI can be reduced to single measures, such as stakeholder engagement and gender balance, resulting in less reflexive research processes about purposes and motivations

of the research. Furthermore, as Chilvers (2012) has argued, institutional and governance pressures typically close down such (RRI) processes in such a manner that they are used in an instrumental way (Stilgoe et al., 2013).

Many of the applications included extensive descriptions of the anticipation aspect of the proposals, although in a limited sense of "anticipation". All applications addressed societal challenges, such as Alzheimer's disease or environmental pollution, and argued for the relevance of the research to these problems. What these applications lacked was another essential feature of anticipation, that is, to address potential impacts, risks, and uncertainties.

The reflexivity aspect of the proposals was hardly discussed in the evaluations of proposals, nor thoroughly manifested in the proposals through questions around motivations and purposes of the research. The very introduction of RRI could have pointed to an institutional reflexivity by UiO:LS. By introducing RRI to the *Convergence Environments,* UiO:LS shows that it acknowledges that its scientific endeavors must be coupled with processes of anticipation, inclusion and responsiveness. However, the way that RRI was embedded in the research environments shows that it did not serve the purpose of "holding up a mirror to one's own activities". Instead, RRI served as a way to legitimize the importance of the proposed research by reference to societal challenges and potential (positive) implications of the research.

Giving RRI a meaningful role in the funding processes

One important challenge for successful RRI practice was that UiO:LS provided different guidelines on what was required in the "Impact (societal challenges/RRI)" section of the applications before the submission deadline. This is somewhat an administrative issue, but it is worth mentioning because of its effects on the applications. The first application guideline emphasized six different criteria, as mentioned in section 3. The final application guideline only consisted of two different criteria: (i) *How can the results from the project be of interest for the society and how will it be communicated?* And (ii) *How can the results from the project generate a foundation for new innovations?* Because of these unclear demands, it is perhaps not that surprising that the applicants had very different descriptions of how RRI related to their projects.

This suggests that research funders should pay close attention to how they frame RRI as a funding criterion and how this will be received by applicants.

It should also be noted that when the research institution, UiO:LS, defined RRI in its own way, without reference to the underlying ideas of Responsible Research and Innovation, important reflections and discussions were left out. Because UiO:LS gave a check list of six criteria, the evaluators and the applicants lost sight of the motivations for RRI, and the issues RRI is supposed to address. This resulted in an arbitrary reference to the different dimensions of RRI, thus undermining the promotion of more responsible research and innovation.

Strong focus on impact and innovation

The University of Oslo: Life Science has a strong focus on innovation and impact, both in its strategy and in the guidelines for the Convergence Environments. Because of this, applicants naturally devote much attention to explicating the potential for innovation and societal impacts of their research, but at the cost of other important discussions. This resulted in the neglect of other aspects, such as discussions of risks and controversies, and stakeholder engagement activities. The strong focus on impact and innovation does correspond with the ambitions of RRI, as the governance of innovation, but it should not lose track of the reflexive and inclusive dimensions.

Incentive to be perceived as less controversial

When applying for funding, scientists naturally have an incentive for their research to be perceived as unproblematic with regards to ethical and social issues. Applicants that elaborate on ethical, legal or social issues of their research might end up jeopardizing their research proposal by revealing the RRI challenges of the proposed research. However, RRI requires scientists to be open about values and norms, motivations and purposes of the research. This would imply that researchers address aspects of the research that are (potentially) controversial, and address issues about unknown impacts of the research. However, the way the application procedure was set up did not incentivize researchers to address these issues in a genuine way. Instead, most applications did not even address these aspects. This should be seen as a call for what I would call “protected reflexivity”. This refers to a research funding set-up where research proposals are

rewarded, rather than jeopardized, for being reflexive and dealing with the "sticky questions" of RRI.

RRI as a meaningful research funding criterion

Another central finding is that there was a low level of insight into RRI in the evaluation board. During my observation at the panel board meeting, there was almost no reference to the four dimensions of RRI or any other framework. Instead, the evaluators only made use of the six criteria posed by UiO: Life Science. One panel member was familiarized with the RRI frameworks in the EU commission and in the NRC, and this panel member was the one who often made the critical remarks about the RRI in the proposals. The panel board also used the RRI criteria in an arbitrary way: some applications were given lower RRI scores because of low stakeholder engagement, low gender balance, or because the envisioned innovation was not seen as that important. However, other applications that did not include these reflections were sometimes given a high RRI score, because the quality of the research was seen as "excellent" and because the RRI was "good enough".

Another finding is that the RRI section of the proposals was very compressed. All applications had to be maximum 15 pages, and RRI was therefore only discussed on between 2-3 pages. The applicants therefore wrote very brief descriptions of RRI, following the RRI keys provided by the UiO:LS, with some exceptions. Some applications explicitly referred to the four-dimension framework of RRI and included these dimensions in the very design of the research. Due to the limited space for writing about RRI, it became important that the RRI was an integrated part of the research proposals that is not limited to one specific section of the proposals. Some would perhaps argue that this is the way RRI should be embedded in research proposals, but such integration is arguably difficult, as most applicants were not familiar with RRI in advance.

5.3 Implications

This study finds that there are important limitations to the effective integration of RRI in the research proposals. A narrow understanding of the dimensions of RRI and an arbitrary use of RRI dimensions are some of the main challenges for an effective realization of RRI in funding processes. Applicants should not necessarily be given more concrete instructions on how to

integrate RRI in research proposals, but the criteria by which they are judged should be clear. Furthermore, these criteria need to be open enough to foster comprehensive and organic processes that increases the reflexivity of the research groups, and at the same time concrete enough to be used as evaluative criteria for research funding. Research funders should make it clear that inputs from anticipatory, inclusive and reflexive processes need to feed back to the research plans and practices. This should be the responsibility of the whole research group and not only dedicated to social scientists and humanists.

These findings should be of interest for higher education institutions and for research policy actors, such as the Norwegian Research Council. This study can provide some preliminary guidance for other research environments on the challenges for RRI integration in research funding processes.

5.4 Limitations and Suggestions for Further Research

This study offers some interesting findings from a micro-perspective on RRI in funding processes. Due to the time frame of the study, the findings cannot discuss research activities and RRI activities, such as hybrid forums and stakeholder workshops in the Convergence Environments. This has however been the focus of other studies such as the RRI Tools project (Groves, 2017) and European Commission workshops (Randles et al., 2015). What this thesis brings to the table is a perspective on the activities that happen before research is engaged. Research proposals, and their funding conditions, can have a significant impact on the directions and priorities of research (Braun, 1998) and are therefore vital in understanding the way RRI is integrated in research projects. We should therefore pay attention to what happens from the call for application, to the articulation and evaluation of these. That could shed some light on how RRI is understood and how it is transforming research proposals, and what its limitations are.

It would have been interesting to study the role of RRI through the proposal stage and into practice. Further research should study the understandings of RRI and its relation to the increased focus on impact and innovation in research. Such a study would then follow some of the research

environments as they conduct their research, to see what kinds of activities and processes they include, and what the motivations are for these configurations. Such a study could potentially identify some of the challenges and institutional conditions that face research environments when translating RRI from theory to practice.

It would also be interesting to study the potential conflicts and valuations between research excellence and RRI. Is excellent research also Responsible Research and Innovation? And is Responsible Research and Innovation necessarily a more innovative way of doing research and innovation? I believe these debates and priorities will become more important in the future, if Responsible Research and Innovation continues to gain traction.

5.5 Conclusion

In the case studied, RRI is conceived as research that devotes attention to increased innovative efforts and impact, and research that is communicated to the public more than before. This conception of RRI shares similarities with previous RRI frameworks, but lack some of their features. The Convergence Environments lack proper motivations for including relevant stakeholders in a meaningful and deliberate way that serves a collective care for the future. The introduction of RRI as a research funding criterion does, however, seem to have fostered increased reflexivity and stimulated some new ways to think about the role of the Convergence Environments in society. These findings point to a situation where researchers and their funders are re-envisioning and co-producing the techno-scientific futures science can contribute to.

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Appendix A: Interview Guide

Questions were adapted to each interviewee.

PART 1 – INTRODUCTION (INTERVIEWER):

"Hello (name). Thank you so much for taking time for this interview. I really appreciate that. Before we start, I thought that I could tell you a little about the purpose and outline for this interview.

Purpose of the interview: The purpose of this interview is to provide data for my master thesis about RRI and how RRI is understood and integrated in research proposals for the Convergence Environments at UiO: Life Sciences. The master thesis is the finishing work in my master program "Technology, Innovation and Culture (TIK) at the University of Oslo. I am taking a specialization course called "Innovation and global challenges" and this thesis is somewhat connected to this course. Personally, I find it interesting to see how research policy moves from a policy level to single actors and researchers. That is what I want to find out here too – what role does RRI get in this research environment and how is it understood? My three initial research questions are:

(1) How is responsible research and innovation understood in the convergence environments, and how is it integrated in the research proposals?
    a. *How does this understanding relate to the underlying ideas and discussions that led to the RRI-framework?*
(2) What are the challenges and opportunities in promoting responsible research and innovation in the convergence environments?

Your perspectives as a reviewer of the applications are important for my research project and will help me to gain a deeper understanding of the role of RRI in the Convergence Environments. I will not include your name in the thesis. Instead, I will attempt to anonymize everything to the best of my ability.

Audio recording: To best capture the things you say during the interview, I want to make an audio recording of this conversation. In addition, this can make the conversation flow more easily, and I won't have to take as many notes during the interview. If you have any issues with this, I can turn the recorder of at any time.

This interview will last about 30 minutes. Does that work with you? It is up to you what questions you want to devote more or let time to. Do you have any question before we begin?"

PART TWO – BACKGROUND INFORMATION

1. What is your current research position?
2. Can you shortly explain what your area of scientific expertise is?
3. What was your role in the evaluation board for UiO:Life Science?

PART THREE – CORE QUESTIONS

RRI in UiO: Life Science

4. What was the role of the evaluation board in UiO:Life Science?
5. Why do you think UiO:LS included RRI as a criterion in the evaluation process?
6. To what extent did RRI affect how you evaluated the applications?
    a) Was RRI an important part of the application?
7. Was there something that characterized the applications that had a good RRI component?
8. Was there something that characterized the applications that had a weak RRI component?
9. How do you think UiO:LS' definition of RRI worked, with its six keys?

RRI in general

10. What is the point of including RRI in the evaluation of research proposals?
11. Are there any parts of the RRI that you consider more important than others?
    a. If yes, why these criteria?
12. What role do you think "stakeholder engagement" has in making science more responsible?
    a. Do you think it can make science more responsible?

b. Are there any negative sides of stakeholder engagement?

13. Do you think research quality is important for the RRI in an application?
14. Do you think RRI is important for the research quality in an application?

Challenges for RRI in UiO: Life Science

15. Were there any barriers that made it difficult to promote RRI in the research environment?
16. Was RRI a big part of the discussions in the evaluation board?
17. How would you characterize the panel board's knowledge on RRI?
    a. Are there any ways you think that this knowledge could have been strengthened?

PART FOUR – CLOSING

18. What do you think the convergence environments would have looked like, if RRI was not included as a criterion?
19. Based on your experience, do you think it will be useful to include RRI in other research projects in the future?
    a. If yes, what types of research projects?
20. Is there anything you would like to add, before we end the interview? Things that I didn't ask about, or anything you want to share?

Thank you for taking your time for this interview. Your answers will be useful to understand how RRI was conceived in the Convergence Environments. If there is need for it, can I contact you again with follow-up questions or clarifications? I will not share your contact information, and I will delete it in October when I submit my thesis.

Appendix B: Assessment criteria for Convergence Environments

1. Research

a) To what extent is the proposed research ambitious with the potential to achieve groundbreaking results?
b) To what extent does the proposed research address important research challenges?
c) To what extent are the objectives beyond the state-of-the-art (e.g. novel concepts and approaches, development of novel methodology or development across disciplines)?
d) To what extent does the proposed research fit with UiO's strategy for convergence in life sciences?
e) To what extent are the outlined scientific approaches feasible?
f) To what extent are the proposed research methodologies appropriate to achieve the goals of the convergence environment?
g) To what extent are the proposed timescales and resources necessary and properly justified?

2. Project leader and team and convergence environment organization

a) To what extent is the track record of the project leader and principal investigators characterized by the ability to propose and conduct groundbreaking research that goes beyond the state-of-the art?
b) To what extent has the project leader demonstrated good leadership of research groups, including training of early career researchers?
c) To what extent do the principal investigators have expertise of essential importance to conduct the proposed research?
d) To what extent is successful accomplishment of the main research objectives dependent on the described research collaboration in the proposed convergence environment?
e) To what extent is the described research team and expertise optimal for the proposed research? f) To what extent are the structure, organization and size of the convergence environment optimal for the proposed research?
f) To what extent is the proposed convergence environment appropriately supported by host and participating UiO departments/institutes?

3. Responsible research and innovation (RRI)

a) To what extent do planned RRI activities address probable societal concerns, legal issue and support stakeholder's engagement?
b) To what extent may results from the project generate a foundation for new innovations?
c) To what extent do plans for dissemination address key users of the research results?
d) If the scientific field is characterized by a gender imbalance, are the plans to support development of research talents of the under-represented gender appropriate?

Appendix C: List of semi-structured interviews

(Names are anonymized)

Role in the UiO:LS	Name	Interview form	Date of interview
Evaluator	Evaluator 1	1x Skype interview	21st of June, 2017
Evaluator	Evaluator 2	1x Skype interview	22nd of June, 2017
Evaluator	Evaluator 3	1x In-person interview	27th of June, 2017
Evaluator	Evaluator 4	1x Phone interview	27t of June, 2017