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Summary Report

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1. Introduction

This report presents results from the efforts to map the following key questions of WP 2:

- How do RRI-related dynamics vary across sectors, national contexts and other contextual factors?
- How to understand the level of variability and the factors producing such a variability?

The goal of WP2 is to provide an interpretive framework on the diffusion and institutional embedment of RRI and OS in different sectors and to provide input to the experiments under WP3 — the co-creation experiments. The insights from WP2 are needed to assess the impact of RRI and OS-related training tools and awareness raising initiatives.

The activities in WP2 include a literature review (WP2.1) and a series of sectorial workshops in five different countries (WP2.2). The following five sectors have been chosen to explore, both in the literature review as in the sectorial workshops:

- a. Sustainable energy use (and, if possible, specifically zero-emission innovations for the built environment)
- b. Materials science (and, if possible, specifically new coatings)
- c. Information and communication technologies (and, if possible, specifically big data)
- d. Biotechnology (and, if possible, specifically stem cell research and pilots, and personalised medicine)
- e. Photonics (and, if possible, specifically glass fibre technologies and new light-electron chips).

With respect to the variability of RRI-related dynamics, we have explored five analytical levels:

- General trends: What is happening to RRI/OS or related phenomena in the different disciplinary and research sectors?
- What are the barriers to RRI/OS or similar concerns in different disciplinary and research sectors? What are the factors producing the science/society gap?
- What are the drivers of RRI/OS or similar concerns in different disciplinary and research sectors? What are the factors contrasting the gap?
- What are the interests and values involved with RRI/OS or similar concerns in different disciplinary and research sectors? What are the interpretations, social recognitions and expectations to RRI/OS?
- Are there successful experiences of RRI/OS or similar initiatives in different disciplinary and research sectors?

The results of WP2.1 and WP2.2 are documented separately. The results have been presented, discussed and refined at FIT4RRI meetings in Trondheim, Norway (October 2017) and Braga, Portugal (May 2018). In the following sections we will briefly highlight the findings from the literature review (section 2) and the sectorial workshops (section 3) to summarize the comprehensive reports. Here we paraphrase the findings reported in WP2.1 so apologies for repetition of wording. Then we present final observations regarding the sectorial differences (section 4) and we provide lessons for the co-creation experiments (section 5).

2. Findings from the literature review (WP 2.1)

The literature review of WP 2.1 delved into academic publications as well as grey literature to investigate how meanings and ambitions of RRI and OS differ per sector and per country. It discusses the different strategies and uptakes of the notions and the institutions and activities.

The case of sustainable energy use showed how established actors position themselves in the new outlooks. In materials science (specifically new coatings) the efforts of RRI and OS are more related to research and science policy. There is much more societal visibility of and concern about information and communication technologies; in particular, the issue of big data is now visible in most countries of this report. RRI and OS in the case of biotechnology (in particular stem cell research and personalised medicine) follow a longer discussion in many countries about desirability and ethical boundaries. Photonics (glass fibre technologies and new light-electron chips), on the other hand, is mainly presented as a technological promise.

The literature also showed that, as compared to OS, attempts of RRI show more national diversity. OS is less diverse because of international policy initiatives, especially in the context of EU, to promote Open Access and Open Science. The national strategies of RRI do highlight diverse aspects. For Greece, for instance, the focus has been on communication, to make sure that the results of research and the importance of innovations become part of public awareness. The emphasis in Italy is more on commercial potential of research and innovation; here the idea of the Third Mission of universities is stressed. In the Netherlands, RRI is an important ingredient of ongoing societal debates on science and technology, and the Rathenau Institute is a prominent case in point. In Norway RRI has been staged as a do-it-yourself challenge for researchers and engineers. In Portugal, in contrast, the attempts are to increase public involvement in technology and innovation.

To conclude, WP2.1 underpins the lesson that national and sectoral differences regarding meanings and ambitions of RRI and OS do exist and should be taken into account in further attempts.

3. Findings from the sectoral workshops (WP 2.2)

The aim of WP2.2 was to provide input to the making of a diagnosis of RRI and OS in different research and disciplinary sectors and national contexts. A series of workshops in five different countries was designed and performed to study specific factors (e.g., level of interest, acceptance and expectations related to RRI and OS), meanings and role attributed to RRI and OS facilitating or hindering the diffusion and institutional embedment of RRI and OS practices and approaches. Seven conclusions stand out here.

First of all, the national differences were not very clear in the particular outlooks and strategies of the participants concerning RRI and OS. This suggests that one should exercise caution when invoking national contexts as producing pertinent differences regarding the uptake of RRI and OS. However, there are pertinent differences in the kind of institutions that may be involved in RRI and OS and in the national systems of research funding.

Second, there are some sectorial differences. The main factors here are the promises of the research and stakeholder involvement. The fairly established areas like sustainable energy and ICT tended to have stronger and more diverse links to industry than the emerging technology sectors. However, we do not see this to represent important differences pertaining to RRI and OS. Still, it may be easier for the established sectors to communicate the relevance of research and innovation to the public.

Third, there was consensus among the participants in the workshops and the interviews that they have a responsibility towards society in their capacity as researchers; their research should be beneficial. There was broad agreement that their research promised progress, not only with respect to technology but also with regard to environmental issues, medical treatment, etc. All participants were attentive to problems and challenges related to the themes or keys that the RRI policy initiatives address. The participants shared many of the concerns but they did not account for them in the language of the official RRI discourse.

Fourth, many participants were indeed not familiar with the terms RRI and OS, in particular RRI, and they emphasised that these concepts had not emerged from a need or a set of challenges voiced by the scientific communities. OS issues appeared to be somewhat better known, presumably because the participants thought OS to be mainly about open access (OA) to publications, which frequently were on the agenda of the institutions where the participants worked. They associated RRI with the impact of research.

Fifth, with respect to challenges and concerns concerning their research, the responses from the participants were more varied. Quite a few saw no particular undesirable outcome of their research, but some were concerned about unwanted applications or misuse of their results. Many mentioned that industry or other economic interests exercised too much influence on the research agenda. There was also widespread scepticism regarding the benefit of public engagement exercises.

Sixth, participants were able to engage in strategies and measures to address issues of RRI and OS, and go in many directions. There were few recurring issues across countries and sectors. This emphasises the strong effect of individual experiences and values with respect to the outcome of the workshops and the interviews. The variety of suggested measures also implies a lack of systematic policy reflection at the national as well as the sectorial level. Thus, clearly, there is a need for learning how to address the above-mentioned challenges and concerns.

Seventh, participants have an ambiguous relationship to industry. In many cases, the participants had more links to industrial actors than to other possible stakeholders, including the public. Industry was an important outlet for the results of their research and industry also helped fund the research and/or industrial participation was required by the funding institutions. On the other hand, quite a few of the participants thought industry exercised too much power and that industrial actors limited their research options, for example by asking for quick results. Commercial interest could also make it difficult for researcher to appear as neutral to the public or other stakeholders.

4. Sectorial differences in RRI and OS

While both the literature review and the workshops indicate that the common concerns of RRI and OS show more overlap in the five chosen sectors than differences, still there are some clear differences.

The case of *sustainable energy* research is characterized by strong promises and hardly contested societal goals. This helps to justify the research and also gives researchers a sense of purpose. Some scholars have become a bit sceptical about big promises about what this sector could achieve in the short term, but all feel that in the long run the field is promising. The sector has some strong common goals related to societal challenges and this helps to identify with RRI and OS ambitions. One of the consequences of this solid orientation is that established actors like energy companies, also enter the sector and reposition themselves. Their role is sometimes experienced as ambiguous: are they really intending to change the energy sector drastically, or do they participate for defensive reasons.

In contrast, the case of *material science*, in which we specifically focused on new coating, is societally less visible. Here, research agendas are inspired by fundamental questions about the properties of materials. Hence, researchers and institutes in this sector feel more distance to the ambitions of RRI and OS. The forces to enter such initiatives typically start from general research and science policy initiatives.

The case of *ICT research* again is different as the workings of ICT highly visible in society and subject of long lasting promises and concerns. Since the first waves of automation in the 1970s to the latest developments of Artificial Intelligence, ICT has been flagged as a game changer. It promises to render businesses and societies competitive but also raises many questions, for instance about replacement of humans by robots, about privacy and surveillance. This background renders researchers and institutes more prone to consider questions of RRI and OS. Yet, because it is in many ways a mature sector, the role of industry is also large and researchers voice their ambiguity here: industry is the vehicle to bring the scientific goods to society but it is a vehicle with its own interests that not automatically align with the interests of society - and those of researchers.

Also research in *biotechnology* is embedded in a longer tradition of discussions about desirability and ethics. Yet questions of RRI and OS are mostly not seen as troublesome, since biotechnological research, including stem cell research and personalised medicine, is part of health research. And it is difficult to argue against the desirability of health research. Also typical for this sector is the felt distance between the research of the team and the institute and the practical, clinical applications, due to the many phases and timeframes needed in health care research and development.

Finally, research in the sector of *photonics*, specifically glass fibre technologies and new light-electron chips, typically appears as a supportive ingredient of a data-driven knowledge society. Here the discussions about RRI and OS follow that of the technological promise of more efficient and more powerful communication. These aims are seen amongst researchers as less contested, although there are concerns about power asymmetries in the sector, with bigger players deciding how digital infrastructure will be designed, used and paid.

5. Recommendations for the co-creation experiments (WP3)

Based on WP 2.1 and WP 2.2 we are now in a position to bring five recommendations for the co-creation experiments.

1. *Relating to industry*

The first recommendation for the co-creation experiments is to carefully position the relationship with industry. After all, in the workshops as well as the literature, we see an ambiguous positioning of industrial connections with research. On the one hand, a good relationship to industry often counts as an indication of ‘well connected to societal needs’ and thus as a responsible setting. The interest of industry for a particular line of research, then, is taken as a sign that it is useful: it can be translated to practical applications that are valued and used in the long term. In some funding schemes, e.g. in The Netherlands with its Responsible Innovation scheme, researchers need to show support from industry and alignment to industrial agendas. Yet, a strong connection to industry and its interests and agendas can also be seen as sign of ignoring the societal responsibility of research. Here an opposition is introduced: instead of deciding of what the best is for society, researchers are then seen as following the easy path of being guided (and paid) by industry.

2. *Public engagement*

A second recommendation for the co-creation experiments is to decide how to engage the public. In most approaches of RRI and OS the connection to a broader audience than peer researchers is central. There are, however, very different ideas of how this connection should be established. The standard, situation invokes a one-way science communication scheme. Here, the idea is that the ‘public’ will benefit from a better understanding of what happens in science and this will empower them in bringing their priorities on board.

3. *Target and route*

A third recommendation for the co-creation experiments is to take into account that RRI and OS may aim at different targets and follow different routes. In some approaches we have seen that RRI is tantamount to improving ethics of researchers. The reasoning, then, is that with researchers who are aware of ethical implications of their work, the eventual outcomes of research are better for society. Hence, the target are the researchers themselves and the route is address researchers in the first place. The assumption here is that researchers will benefit from ethical reflection and better decision making. Another approach is to make sure that research is sufficiently connected to the views and needs of stakeholders. The target is the research practice, instead of individual researchers, and the route is to start with being inclusive in the first place.

4. *Timeframes*

Another recommendation for the co-creation experiment is to decide about the time frames of RRI and OS. Research typically has various time horizons: there can be direct results from the puzzle solving activities of research, with a short-term gain for society, and there may be contributions to conceptual and theoretical developments that only in the longer term will effect society. In the case of short term gains, a well-aligned network needs to be in place of research, industry and other stakeholders. Improvement on solar power panels, for instance, may directly help the renewable energy sector. In the longer term timeframes, on the other hand, RRI is geared towards the overall

direction of research. Are the relevant aspects and perspectives taken on board? Are the research agendas rich and robust with respect to societal needs? Is the research communities tight to the concerns of a sufficiently broad spectrum of stakeholders? In these cases, RRI is less directed towards the immediate, tangible outcomes and more to the overall direction of research.

5. *Revolutionary*

A last recommendation for the co-creation experiments is to carefully balance the ambiguity of RRI and OS with respect to the changes they suggest. On the one hand, RRI and OS may be presented as a novel or even revolutionary way to organize and perform research and innovation. This may alienate researchers, since they will feel that they are already involved in ambitions of RRI and OS, although they will probably use other terms for these ambitions. As a consequence, trying to bring them on board to RRI and OS while presenting this as revolutionary will be problematic. On the other hand, when the ambitions are presented as business as usual, researchers and other stakeholders will lose interest and will regard it as a merely window dressing that does not merit their attention and investment. Hence, a careful balance between these two edges is required.